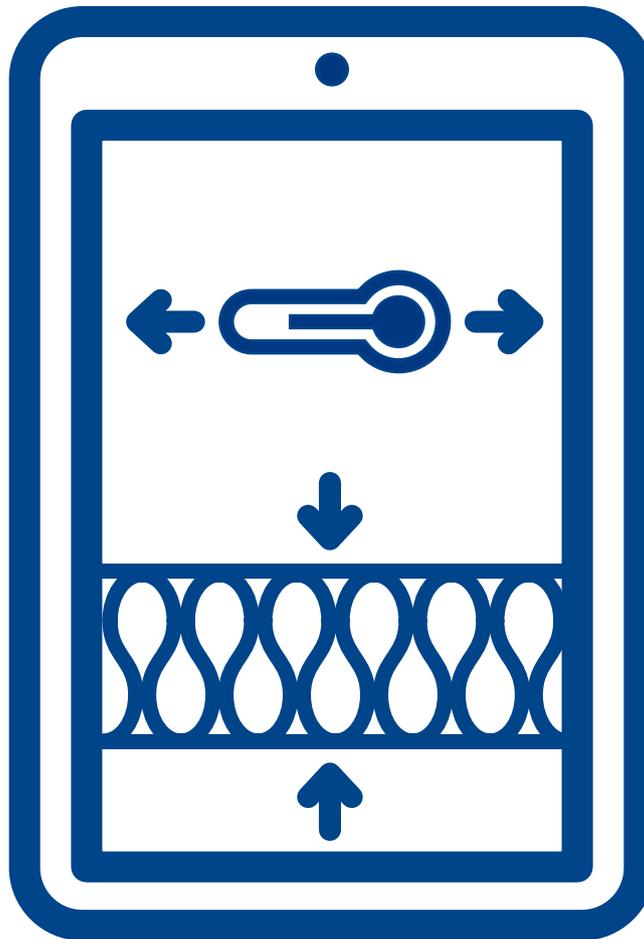




TechCalc 3.0 User Guide

Thermal Calculation software
for Technical Insulation





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G. DISCLAIMER



A. INSTALLATION GUIDELINES

How to access to Isover TechCalc 3.0

It's necessary to accept the terms of use and Privacy Policy to continue.
2 versions of **Isover TechCalc 3.0**:

- › Free access – limited version of Isover TechCalc 3.0: **Click “Next”**

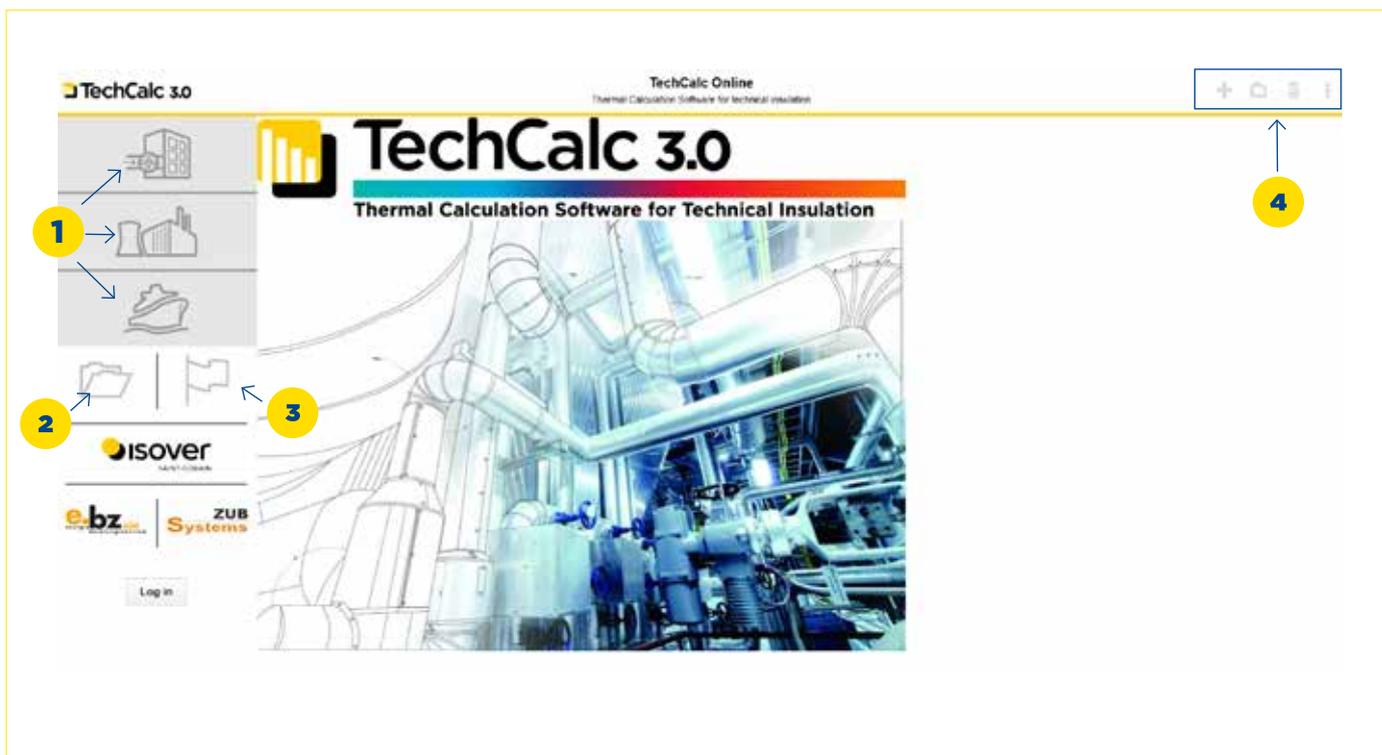
The screenshot shows the 'TechCalc Online' interface. At the top, it says 'TechCalc Online' and 'Thermal Calculation Software for technical insulation'. Below this is the 'Terms of Use TechCalc Online calculator' section. It includes a 'Purpose' section explaining the software's function and a 'Liability' section stating that the user is responsible for the accuracy of the data provided. There is also a 'Privacy Policy' section. At the bottom, there is a checkbox labeled 'I have read the Terms of Use and Privacy Policy and agree to accept them', a 'Next' button, and a 'Log in' button.

The screenshot shows the 'TechCalc 3.0' login page. It features the 'TechCalc 3.0' logo at the top. Below the logo, there are two input fields: 'User Name' with the example 'example@example.com' and 'Password' with a masked password '.....'. At the bottom, there are two buttons: 'Log in' and 'Forgot password'.

- › Access with user name (e-mail address and password)
– Full version of **Isover TechCalc 3.0**: **Click “Log in”**

B. HOME SCREEN

Every time you start Techcalc you will arrive to this «Home'screen»



- 1 Application Selection:
HVAC - Industry - Marine**
- 2 Open an existing TechCalc
file (.json)**
- 3 Select your language**
- 4 Other functions
(see chapter 'e' for further
details)**

B.1 APPLICATION SELECTION

You need to choose the kind of application of your project.

You have **3 choices**:



HVAC: Applications relative to the heating and cooling systems. Focus in ducts, pipes and walls thermal calculations.

INDUSTRY: Applications relative to any kind of insulation in industrial sites (pipes, boilers, tanks, vessels, ovens, etc.). Covers all calculation methods included in ISO 12241-2022. You can also select ISO 12241-2008, VDI 2055 or ASTM C 680 calculation methods.

MARINE: Applications relative to any kind of insulation in ship (pipes, walls, tanks, vessels, etc.).

After selecting your application, you will start with the calculation steps (see chapter 'c')

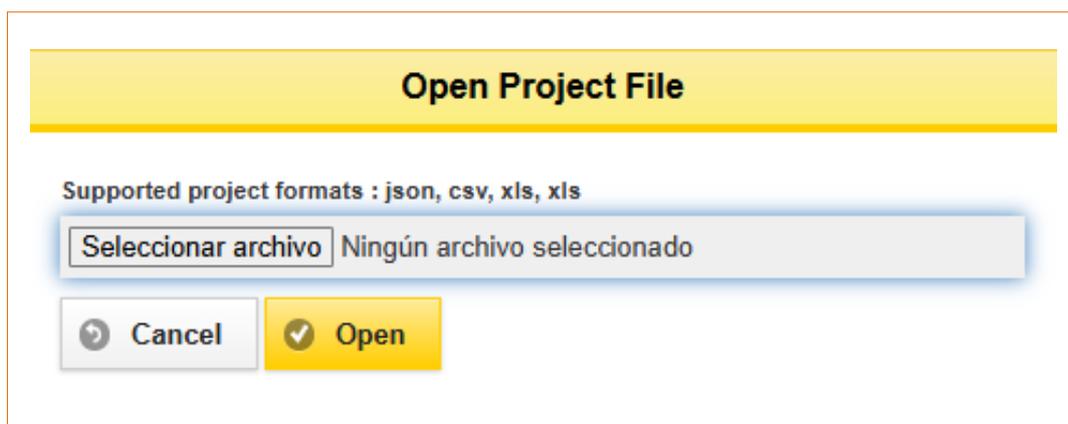
B.2 OPEN AN EXISTING FILE

TechCalc 3.0 allow the user to save calculation files. These files have the special **TechCalc 3.0** extension '.json'. You can always recover this calculation files.

By clicking in this option:



You will get the next navigation screen where you will select the **TechCalc 3.0** file (.json) you want to restart:



Once you select your file, click on 'Open' and you will have recovered all your calculation data and will be placed in calculation step 1 to modify or review any data of your previous calculation.

B.3 LANGUAGE SELECTION & DATABASE SELECTION



When you select a language you select two things: the language for the software and the local portfolio that ISOVER offers in your selected flag.

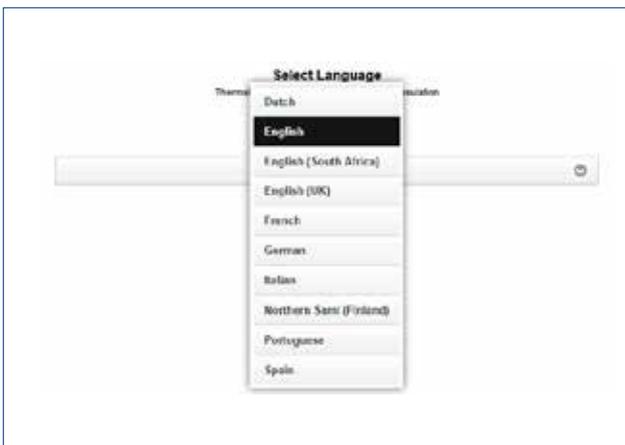
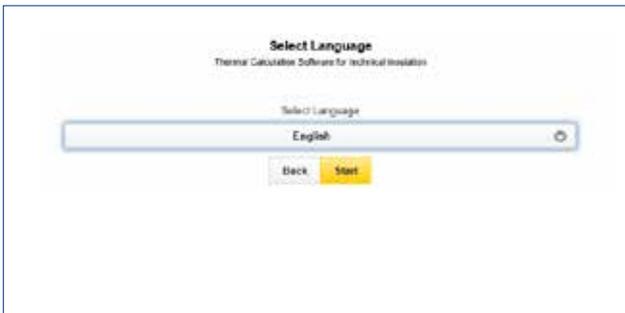
TechCalc 3.0 is multilingual software. In next table you can see what your choices are depending in your selection:

TechCalc Language:

- › Dutch
- › English
- › English (South Afrika)
- › English (UK)
- › French
- › German
- › Italian
- › Northern Sami (Finland)
- › Portuguese and Spain.

TechCalc Database:

- › Benelux (Netherlands & Belgium)
- › Finland
- › France,
- › Germany
- › Gulf Cooperation Council (GCC)
- › International
- › Italy
- › Poland
- › South Afrika
- › Spain and UK/Ireland



Once you have selected your language you will be back to 'Home Screen' for opening an existing file or selecting an application before starting up your calculations.

You can change your software language or your database whenever you want later on (see chapter 'e5 - change language or database').

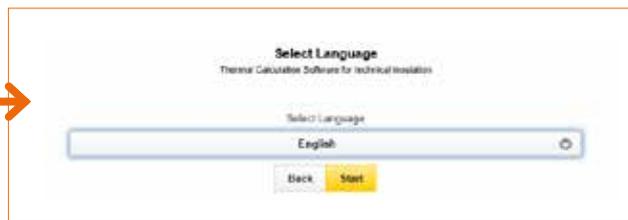


DATABASE SELECTION EXAMPLES:

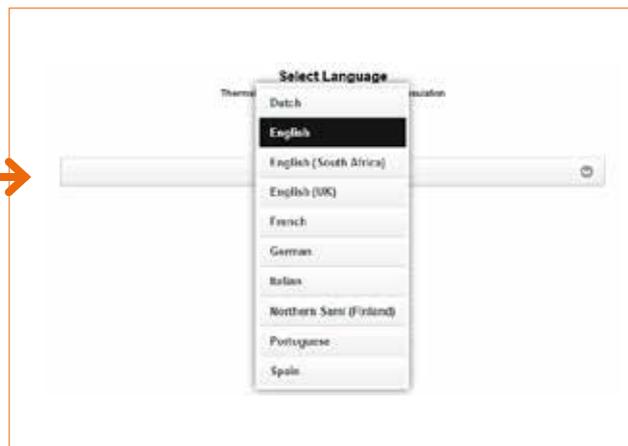
In the down part of the screen appears a small window including Language, Database and Unit



Click Language to change language



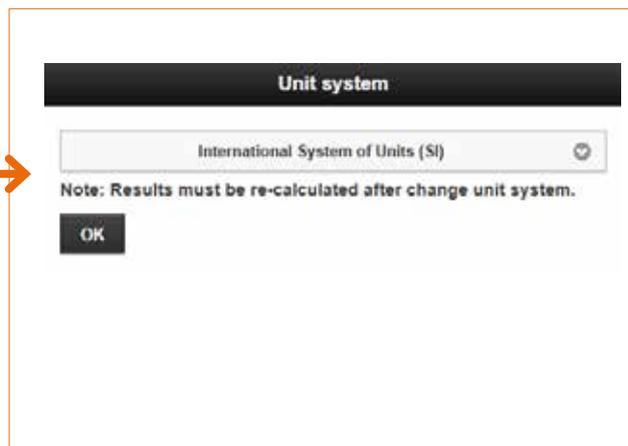
Click database to change Country Database



Click Unit system to change the units for calculations:

2 options:

- › International system of Units (SI)
- › Imperial system of Units (IP)



C.DATA INPUT STEPS

Data introduction to obtain the final calculated results is split in 5 main steps and 2 optional ones:



- > **Components**
- > **Calculation Methods**
- > **Medium**
- > **Climate**
- > **Insulation System**
- > **Thermal Bridges (Optional)**
- > **Economy (Optional)**

The amount of input data required varies depending on different factors, like component position, chosen calculation method, medium type, etc. A detailed description of each step is given in the next chapters.

There are different areas in your screen that are common, no matter what your calculation step is:

The screenshot shows the TechCalc 3.0 software interface. At the top, a progress bar indicates the current step is 'Components'. The main area is divided into several sections:

- 1**: A sidebar on the left with icons representing different component types.
- 2**: A central input area for 'Pipe Component No. 1' with fields for 'Length (m)', 'Diameter (mm)', 'Material' (set to 'Stainless steel (NPS)'), 'Area of insulated surface (m²)', and 'Structural thickness (mm)'. There are also fields for 'Insulated area of surface (m²)' and 'Select an orientation' (set to 'Horizontal indoor').
- 3**: A section for 'Calculation standard' with buttons for 'ISO 12241 (2008)', 'VDI 2668 (2008)', 'ASTM C 686 (2019)', and 'ISO 12241 (2022)'. The 'ISO 12241 (2022)' button is highlighted.
- 4**: A summary panel on the right titled 'Pipe Component No. 1' showing 'Energy efficient case requirement (EN 17500)', 'Length: 1.00 m', 'Diameter: 114.30 mm', 'Orientation: horizontal indoor', and a 3D model of the pipe. Below this is a 'Done' button with a green checkmark.

- 1 Component list:** you can create as many components as you want. There is no limit. The selected component appears with a dark shadow on it. To change the selection, just click on the component you want.
- 2 Component window:** a summary with all dimensions and conditions linked to the selected component. You can make a zoom by just clicking in 
- 3 Warning window:** any kind of warning will appear in this area. (i.e.- Maximum Service Temperature limit exceed, no possible calculation, etc.)
- 4 Actions:** Go through, Copy and Delete

Go through: once that all your data is correct, in each step, confirm and go to the next step by clicking in the icon:



Copy: If you have to calculate different scenarios with the same component, this possibility offers you the opportunity of saving a lot of time. The only thing you need to replicate a certain component is click in this icon:



A new component will be created, inheriting all properties of the copied one and will appear in the component list.

Delete: To erase a component, just click on this icon and you will delete the selected component:



C.1 COMPONENTS

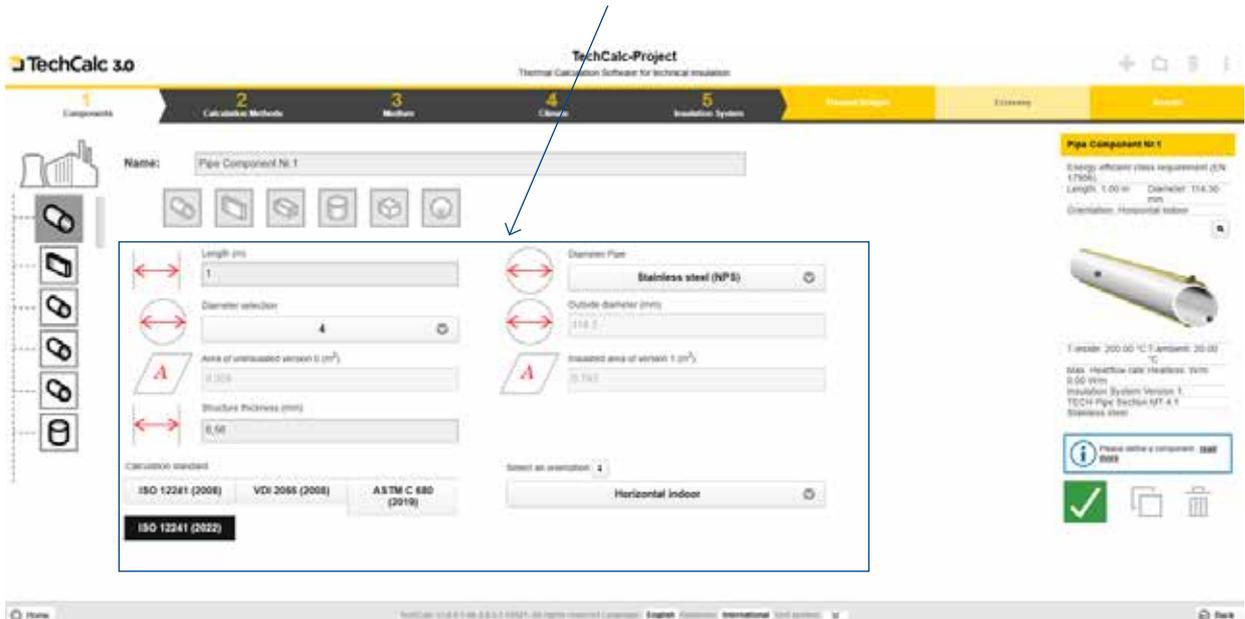
You can create up to 6 different components:



For creating a new component, just click on the component you wish and it will appear in the component list, on the left of you screen. Remember there is no limit for the amount of components you want to create.

At this step we will provide the main characteristics of the selected component (dimensions and position), the calculation method we want to use (ISO 12241-2022, ISO 12241-2008, VDI 2055-2008, ASTM C 680-2019) and the orientation.

Shadowed area in next picture is the area to fill in the information linked with every component:



Inputs requirement changes depending on the component selection.

PIPES



Length (m):
length of your pipe or duct in meters

Selection: you can deploy the list and you can choose among these values:

- free input**
- Copper (mm)
 - Copper (DN)
 - Copper (NPS)
 - Steel (mm)
 - Steel (DN)
 - Steel (NPS)
 - Stainless steel (mm)
 - Stainless steel (DN)
 - Stainless steel (NPS)
 - Synthetic (mm)
 - Ductile Iron Class 52
 - ASTM C585 NPS

Area uninsulated (m²):
area around your pipe before increasing the diameter with insulation in square meters your pipe in millimetres.

Outside diameter (mm): outside diameter of your pipe in millimetres.

Area insulated (m²): area around your insulation once it is in place in square meters

DN and NPS are databases containing the right external diameter for each kind.

Select an orientation: select the orientation of your pipe

- Horizontal indoor**
- Vertical indoor
- Horizontal outdoor
- Vertical outdoor
- Underground pipe
- free input hse/hle

Information note appears for clarification:

Orientation Indoor (horizontal,vertical):
ISO, VDI, ASTM : (Definition ISO "inside buildings") only free convection calculation, no wind velocity

Orientation Outdoor (horizontal,vertical):
ISO: (Definition ISO "outside buildings") only forced convection with wind velocity
VDI, ASTM: Mix of free and forced convection

Orientation Approximation (horizontal, vertical):
ISO, VDI: Calculation method for indoor and outdoor
ASTM: no approximation calculation method

Orientation Underground pipe:
ISO, VDI : only component pipe, same calculation methods in standards ISO, VDI
ASTM: no specific calculation method for underground pipe in this standard but use of ISO, VDI equations

Orientation Ground horizontal area:
(p 3-120 Table 7 Handbook Heat Transfer (1973 Rohsenow and Hartnett)
only components wall, cube, cylinder with checked option
Subcomponent
With components cube, cylinder additional selection of single button
Bottom

'free input hse/hie' is the option to use in case outer/inner surface coefficients are known

WALLS



Length (m):
length of your wall in meters

Area uninsulated of version 0 (m²): area around on your wall before increasing the perimeter with insulation in square meters (bare wall)

Area insulated of version 1 (m²): area around your insulation once it is in place in square meters for version 1.

Height (m):
height of your wall in meters

Select an orientation:
select the orientation of your wall



- Horizontal indoor**
- Vertical indoor
- Horizontal outdoor
- Vertical outdoor
- free input hse/hle

Horizontal indoor It is necessary to choose the direction of gradient of temperature

Heatloss

▲ q

▼ q

Vertical Indoor

Horizontal outdoor It is necessary to choose the direction of gradient of temperature, the direction of free convection air flow compared with forced convection air flow direction and air flow direction (from height side or from length side)

Heatloss

▲ q

▼ q

Free convection air flow (thermal buoyancy) and forced convection air flow directions

same direction

opposite direction

Airflow direction

from height side

from length side

Subcomponent

Vertical outdoor It is necessary to choose the direction of free convection air flow compared with forced convection air flow direction and air flow direction (from height side or from length side)

Free convection air flow (thermal buoyancy) and forced convection air flow directions

same direction

opposite direction

Airflow direction

from height side

from length side

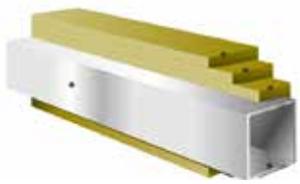
Subcomponent

Free input hse/hie. 'free input hse/hie' is the option to use in case outer/inner surface coefficients are known
Subcomponent Click Subcomponent if it is necessary to divide the wall in several parts with different insulation solutions. The software then performs independent calculations for each subcomponent and automatically aggregates the results to provide the total thermal losses or performance values for the complete component.

he-Value W/(m²K)

Subcomponent

DUCTS



Length (m):
length of your duct in meters

Width (m):
width of your duct in meters

Area uninsulated of version 0 (m²):
area around your duct before increasing the perimeter with insulation, in square meters (bare duct)

Area uninsulated of version 0 (m²): area around your duct before increasing the perimeter with insulation, in square meters (bare duct).

Height (m):
height of your wall in meters

Select an orientation:
select the orientation of your duct



- Horizontal indoor**
- Vertical indoor
- Horizontal outdoor
- Vertical outdoor

Only For Horizontal Outdoor & Vertical Outdoor. It is necessary to choose the direction of free convection air flow compared with forced convection air flow direction and air flow direction (from height side or from width side).

free input hse/hle

Free convection air flow (thermal buoyancy) and forced convection air flow directions

- same direction**
- opposite direction

Airflow direction

- from height side**
- from width side

Free input hse/hle. 'free input hse/hle' is the option to use in case outer/inner surface coefficients are known
Subcomponent Click Subcomponent if it is necessary to divide the wall in several parts with different insulation solutions. The software then performs independent calculations for each subcomponent and automatically aggregates the results to provide the total thermal losses or performance values for the complete component.

he-Value W/(m²K)

 Subcomponent

CYLINDRICAL TANKS



Outside diameter (m):
outside diameter of your tank/vessel in meters

Area uninsulated of version 0 (m²):
area around your tank/vessel before increasing the diameter with insulation in square meters (bare cylindrical tank)

Uninsulated area of version 1 (m²):
uninsulated area around your tank/vessel when you decide insulation only in top, side or bottom

Insulated area of version 1 (m²): area around your insulation once it is in place in square meters for version 1

Height (m):
height of your tank/vessel in meters

Select an orientation:
select the orientation of your tank



- Horizontal indoor**
- Vertical indoor**
- Horizontal outdoor**
- Vertical outdoor**
- free input hse/hle**

Only For Horizontal Outdoor & Vertical Outdoor. It is necessary to choose the direction of free convection air flow compared with forced convection air flow direction and air flow direction (from height side or from width side).

Free convection air flow (thermal buoyancy) and forced convection air flow directions

- same direction**
- opposite direction

Airflow direction

- from height side**
- from width side

Free input hse/hle. 'free input hse/hle' is the option to use in case outer/inner surface coefficients are known

Subcomponent Click Subcomponent if it is necessary to divide the wall in several parts with different insulation solutions. The software then performs independent calculations for each subcomponent and automatically aggregates the results

he-Value W(m²K)

Subcomponent

Insulation on You can set what part of your tank is insulated. By defect, the whole tank appears as insulated (three buttons marked (black color)).

Insulation on:

- Top**
- Side**
- Bottom**

CUBICAL TANKS



Length (m):
length of your tank/vessel in meters

Width (m):
width of your tank/vessel in meters

Insulated area of version 1 (m²): area around your insulation once it is in place in square meters for version 1

Area uninsulated of version 0 (m²): area around your tank/vessel before increasing the dimensions with insulation in square meters (bare cubical tank) insulation in square meters (bare cylindrical tank)

Uninsulated area of version 1 (m²): uninsulated area around your tank/vessel when you decide insulation only in top, side or bottom

Height (m): height of your tank/vessel in meters

Select an orientation: select the orientation of your tank

Horizontal indoor

Vertical indoor

Horizontal outdoor

Vertical outdoor

free input hse/hle

Only For Horizontal Outdoor & Vertical Outdoor. It is necessary to choose the direction of free convection air flow compared with forced convection air flow direction and air flow direction (from height side or from width side).

Free convection air flow (thermal buoyancy) and forced convection air flow directions

same direction opposite direction

Airflow direction

from height side from width side

Free input hse/hie. 'free input hse/hie' is the option to use in case outer/inner surface coefficients are known

Subcomponent Click Subcomponent if it is necessary to divide the wall in several parts with different insulation solutions. The software then performs independent calculations for each subcomponent and automatically aggregates the results to provide the total thermal losses or performance values for the complete component.

he-Value W(m²K)

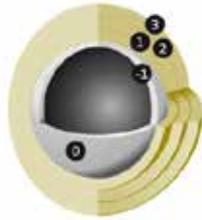
Subcomponent

Insulation on You can set what part of your tank is insulated. By defect, the whole tank appears as insulated (three buttons marked (black color)).

Insulation on:

Top Side Bottom

SPHERICAL TANKS



Outside diameter (m):

outside diameter of your spherical tank/vessel in

Area insulated of version 1 (m²):

area around your insulation once it is in place in square meters

Area uninsulated of version 0 (m²): area around your spherical tank/vessel before increasing the diameter with insulation in square meters (bare spherical tank)

Select an orientation:

select the orientation of your tank



Indoor
Outdoor
free input hse/hle

Only for outdoor: It is necessary to choose the direction of free convection air flow compared with forced convection air flow direction.

Free input hse/hie. 'free input hse/hie' is the option to use in case outer/inner surface coefficients are known

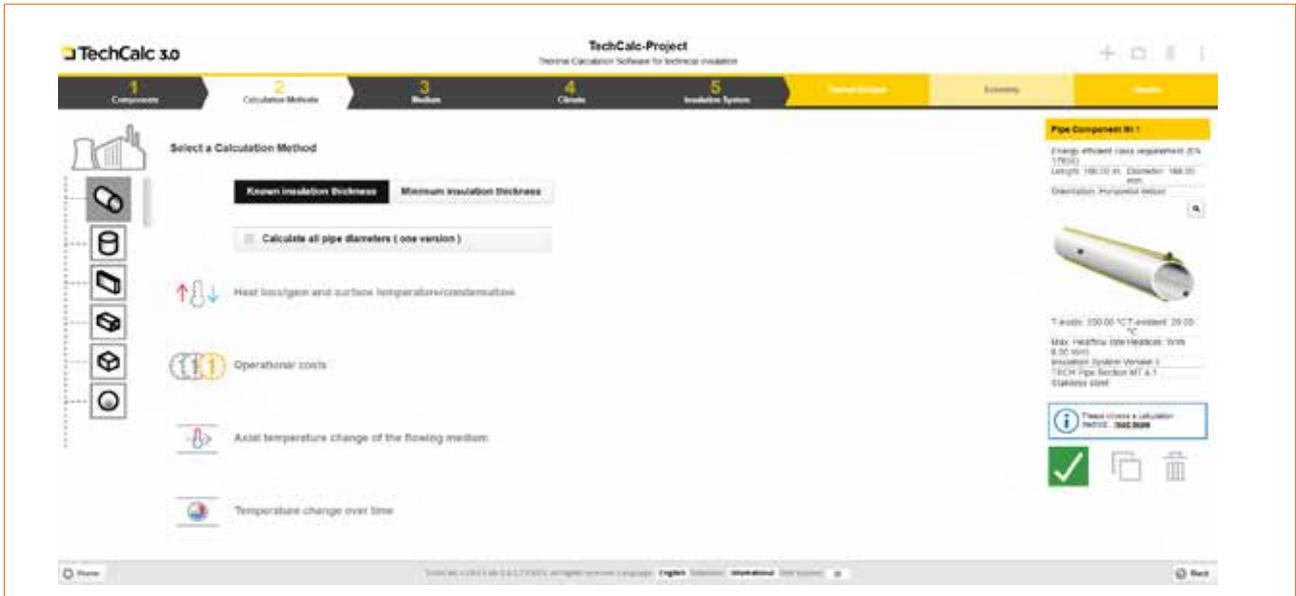
Free convection air flow (thermal buoyancy) and forced convection air flow directions

same direction opposite direction

he-Value W/(m²K)

C.2 CALCULATION METHODS

In this second step you will select the calculation method you want to use for your component:



Depending on the application you are in and the type of component you are working with, you will find different calculation methods. First it is necessary to select if you know the insulation thickness or want to know the minimum insulation thickness under certain requirements. All calculation methods available are:

Known insulation thickness

Option: Click **“Calculate all pipe diameters (one version)”** for calculations of all ranges of diameters of pipes depending on the type of chosen pipe (Copper, Steel, SS, Synthetic, Ductile iron or ASTM C585 NPS). The calculation will be done only for Version 1.



- › Heat loss/gain and surface temperature
- › Operational cost
- › Axial temperature change of the flowing medium
- › Temperature change over the time
- › Moisture accumulation on a cooling component
- › Calculation U-R value
- › Time it takes for the water inside component to freeze (0°C/32°F)
- › Economic cost
- › Energy efficient class (EN 17956)

Minimum insulation thickness

Option: Click **“Calculate all pipe diameters (one version)”** for calculations of all ranges of diameters of pipes depending on the type of chosen pipe (Copper, Steel, SS, Synthetic, Ductile iron or ASTM C585 NPS). The calculation will be done only for Version 1.



Requirements for calculation of Minimum insulation thickness:

- › Maximum Heatflow rate – W/m
- › Maximum Heatflow rate (area insulated) – W/m².
- › Surface temperature
- › Both Max. Heatflow rate & Surface temperature
- › Prevention condensation
- › Prevention condensation inside
- › Energy efficient class requirement (EN 17956)

All calculations are done following formulas given in the international standard ISO 12241:2008 / VDI 2055 / ASTM C 680, and ISO 12241:2022 depending on the choice made.

Declared lambda values (λ_d) will be modified following procedures given in ISO 23993 / VDI 2055:

$$\lambda = \lambda_d F + \Delta\lambda$$

$$F = F_{\Delta\theta} F_m F_a F_C F_c F_d F_j$$

For further details, see 'c6 - Thermal bridges'.

C.2-1 KNOWN INSULATION THICKNESS

Whether you click “Know insulation thickness” you will be able to choose the next calculation methods.

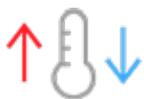


Option: Click “Calculate all pipe diameters (one version)” for calculations of all ranges of diameters of pipes depending on the type of chosen pipe (Copper, Steel, SS, Synthetic, Ductile iron or ASTM C585 NPS). The calculation will be done only for Version 1.

You have up to 9 different calculation methods for knowing insulation thickness.

- Heat loss/gain and surface temperature
- Operational cost
- Axial temperature change of the flowing medium
- Temperature change over the time
- Moisture accumulation on a cooling component
- Calculation U-R value
- Time it takes for the water inside component to freeze (0°C/32°F)
- Economic cost
- Energy efficient class (EN 17956)

C.2-1.1 HEAT LOSS/GAIN AND SURFACE TEMPERATURE



Within this calculation method you will obtain the heat loss/gain through your system and the surface temperature.

All calculations are done following formulas given in the international standard ISO 12241, chapter 4, VDI 2055 & ASTM C680 depending on the standard that you choose.

This is the output you will have following this method:

Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C

Heat loss can be expressed in W/m (for pipes or circular ducts) or in W/m² for the rest of components.

C.2-1.11 OPERATIONAL COST



Through this method you will be able to calculate the total energy cost of your system and payback time for the different solutions on your choice.

Within this calculation method two different standards are used: ISO 12241 chapter 4 for thermal calculations and VDI 2055 Part 1, chapter 6 for economic calculations.

When selecting this calculation method you will find that some additional data is required in steps 3, 4, 5 and 7.

In **step 3** you will need to fill in the amount of hours that your facility is working per year:

You'll have an available list of most frequent scenarios just clicking in 'free input':

You can select one from the list or just go for a free input. The value set will influence in the total cost of energy and therefore the payback time.

In **step 5** you will need to provide a budget for your insulation installation, including all costs (insulation material, installation cost (manpower plus accessories, cranes, scaffolding, etc), transport, etc. You can introduce the total cost in EUR, in EUR/m or EUR/m²

This is the value that will be used, as your total capital investment, for calculating the payback time later on.

Finally, when you select this calculation method, is mandatory to fill in the data required in step 7: Economy:

Currency: you can select any currency in the world. Select the one you want just by clicking on it.

Heating system: you can select any currency in the world. Select the one you want just by clicking on it.

Energy Efficiency here means the factor of necessary final energy (oil,gas, electricity...) to the heating or cooling energy generated with it (factor = $Q_{\text{final energy}}/Q_{\text{produced energy}}$); for hot systems with heating systems this value is ≥ 1 ; for cooling systems with heat pumps/ compressors this value is ≤ 1

Energy Efficiency of the heating system (1=100%): You can fill in with your own yield data or just select one heating system and it will provide you with the right system efficiency figures. Be careful because usually the yield is expressed as the reverse function, so $1/\text{yield}$.

Energy cost (/kWh): You must fill in the price you are paying for your en-ergy in 'Currency'/ kWh. For EU countries it will be in EUR/kWh, as it is selected as default value.

Actual energy cost (/kWh): This is the result of your energy cost and the yield of your system. TechCalc will calculate it automatically.

Energy source CO₂-Emissions: based on The Global Emission Model of Integrated Systems (GEMIS)

The Global Emission Model of Integrated Systems (GEMIS) is a freely available computer model with integrated database for life cycle and life cycle assessment and material flow analysis as well as the carbon footprint for energy, material and transport systems.

GEMIS was developed by the Öko-Institut Darmstadt Germany and was created in its first version in 1989 with funding from the Hessian Ministry of Environment and Economics. Since then, it has been continuously updated and extended with funding from, among others, the German Federal Ministry for the Environment, the German Federal Ministry of Research, as well as the German Federal Environmental Agency, the GIZ, the EEA, and EU projects.

In April 2012, GEMIS was transferred to the International Institute for Sustainability Analysis and Strategies (IINAS) <http://iinas.org/about.html>, which will take over further development and data maintenance.

GEMIS is used in over 30 countries for environmental and cost analysis. The values for electricity mix are very dependent on the regional production of electricity (coal,gas,oil,water nuclear power plant).

- No selection = without CO₂-Emissions**
- Electricity mix DE (GEMIS 2015)
- Electricity mix EU (GEMIS 2015)
- Electricity mix CA (GEMIS 2015)
- Electricity mix US (GEMIS 2015)
- Electricity mix AU (GEMIS 2015)
- Electricity mix CN (GEMIS 2015)
- Electricity mix IN (GEMIS 2015)
- Electricity mix JP (GEMIS 2015)
- Electricity mix AR (GEMIS 2015)
- Electricity mix BR (GEMIS 2015)
- Oil (GEMIS 2015)
- Gas (GEMIS 2015)
- Brown coal (GEMIS 2015)
- Anthracite coal (GEMIS 2015)
- Wood (GEMIS 2015)
- Pellet (GEMIS 2015)
- free input

It is possible to select among several options: "No selection", "under GEMIS" or "free input".

CO₂ emission/certificates price (EUR/ton): You can fill in with your own average price of CO₂ emissions

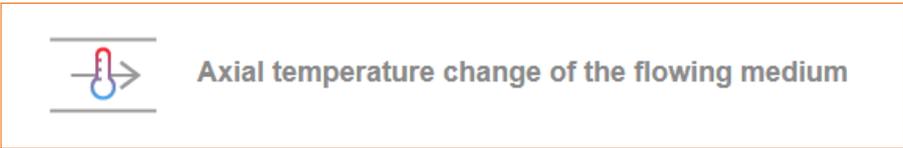
CO₂ emission/certificates price (EUR/ton)

As an output you will have the following:

Energy consumption (n° hours/year)	kWh/a
Operational costs (Energy price EUR/kWh)	EUR/a
CO₂ emission (kg CO₂/kWh)	kg/a
CO₂ emission/certificates costs	EUR/a
Insulation costs	EUR
Payback time	a
Heatflow (Heatloss)	W/m or W/m²
Heatflow (Insulated version area)	W/m²
Total heatflow (Heatloss)	W
T-surface	°C

C.2-1.III AXIAL TEMPERATURE CHANGE OF THE FLOWING MEDIUM

With this method you will calculate the temperature drop in your medium between the beginning and the end of your pipe or duct.



Axial temperature change of the flowing medium

All calculations are done following formulas given in the international standard ISO 12241, chapter 5.1.

In the step 3 you will have to fill in additional data:

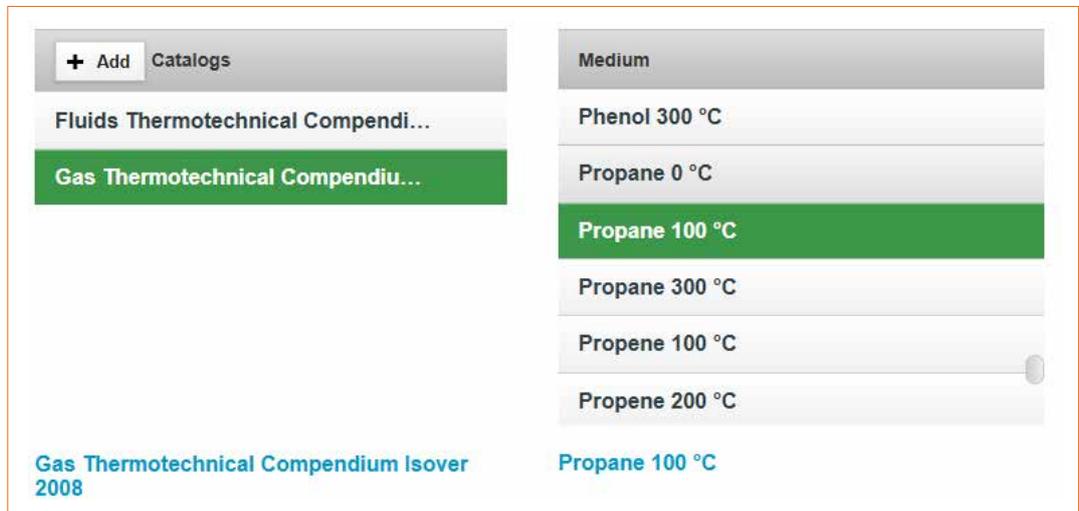
- › Temperature medium in °C
- › Heat capacity in kJ/KgK
- › Mass flow rate in kg/h, If you clicked it.

If you click on “**Volume flow rate**”, it is necessary to fill additional data with density “ ρ ” in kg/m³ and “velocity” in m/s



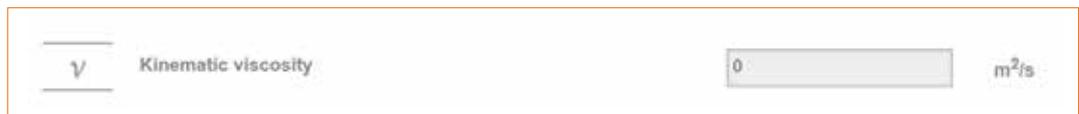
Database

Other option is to choose the characteristics of the flowing medium in the database, or include the characteristics of the flowing medium in the medium Database. See How to manage TechCalc databases later on.



Another option that you can choose is click on Medium Type, and a drop-down list will appear with the following options, depending on the type of fluid you consider.

- › Fluid with $h_i = \infty$
- › Gaseous / fluid with $h_i < \infty$. It is necessary to fill in the value of Kinematic viscosity m^2/s , in addition to all the values indicated above



- › Water / steam. For this option the software can calculate h_i with the data that you have to fill in (characteristics of Water / steam as Temperature of the Water / steam and Pressure). Rest of values of magnitudes will appear automatically.
- › Air: It's only necessary to include the value of Temperature of the air. Rest of values of magnitudes will appear automatically.



As an output you will have the following:

Axial temperature change of the flowing medium	°C
T-final medium	°C
Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C

C.2-1.IV TEMPERATURE CHANGE OVER THE TIME

With this method you will calculate the temperature drop in your medium after a certain amount of time (minutes).



Temperature change over time

In the step 3 you will have to fill in additional data:

- › Temperature medium in °C
- › Standstill period in minutes.
- › Heat capacity in kJ/KgK
- › Density in kg/m³
- › Volume percentage in %

	Temperature medium	<input type="text" value="0"/>	°C
	Standstill period	<input type="text" value="0"/>	min
C_p	Heat capacity	<input type="text" value="0"/>	kJ/kgK
ρ	Density	<input type="text" value="0"/>	kg/m ³
$V\%$	Volume percentage	<input type="text" value="100"/>	%



Database

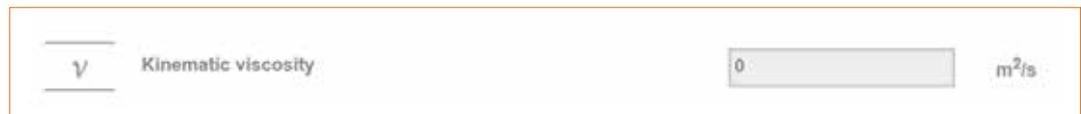
Other option is to choose the characteristics of the flowing medium in the database, or include the characteristics of the flowing medium in the medium Database. See How to manage TechCalc databases later on.

<div style="border: 1px solid gray; padding: 5px;"> <div style="background-color: #cccccc; padding: 2px; display: flex; align-items: center;"> + Add Catalogs </div> <div style="padding: 5px;"> <div style="background-color: #cccccc; padding: 2px; margin-bottom: 2px;">Fluids Thermotechnical Compendi...</div> <div style="background-color: #008000; color: white; padding: 2px; margin-bottom: 2px;">Gas Thermotechnical Compendiu...</div> </div> </div>	<div style="border: 1px solid gray; padding: 5px;"> <div style="background-color: #cccccc; padding: 2px; display: flex; align-items: center;"> + Medium </div> <div style="padding: 5px;"> <div style="background-color: #cccccc; padding: 2px; margin-bottom: 2px;">Phenol 300 °C</div> <div style="background-color: #cccccc; padding: 2px; margin-bottom: 2px;">Propane 0 °C</div> <div style="background-color: #008000; color: white; padding: 2px; margin-bottom: 2px;">Propane 100 °C</div> <div style="background-color: #cccccc; padding: 2px; margin-bottom: 2px;">Propane 300 °C</div> <div style="background-color: #cccccc; padding: 2px; margin-bottom: 2px;">Propene 100 °C</div> <div style="background-color: #cccccc; padding: 2px; margin-bottom: 2px;">Propene 200 °C</div> </div> </div>
Gas Thermotechnical Compendium Isover 2008	Propane 100 °C

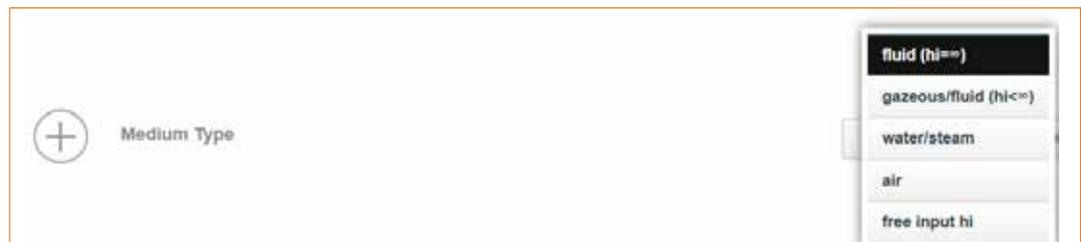
Please,note that it is always necessary to fill in: “Standstill period”, “Volume percentage” and “velocity”

Another option that you can choose is click on Medium Type, and and a drop-down list will appear with the following options, depending on the type of fluid you consider.

- › Fluid with $h_i = \infty$
- › Gazeous / fluid with $h_i < \infty$. It is necessary to fill in the value of Kinematic viscosity m^2/s , in addition to all the values indicated above



- › Water / steam. For this option the software can calculate h_i with the data that you have to fill in (characteristics of Water / steam as Temperature of the Water / steam and Pressure). Rest of values of magnitudes will appear automatically.
- › Air: It's only necessary to include the value of Temperature of the air. Rest of values of magnitudes will appear automatically.



Please, note that it is always necessary to fill in: “Standstill period”, “Volume percentage” and “velocity”

As an output you will have the following:

Temperature change in X minutes	°C
T-final medium	°C
Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C

C.2-1.V MOISTURE ACCUMULATION ON A COOLING COMPONENT

With this method you will calculate the amount of moisture ingress in the system due to water vapour diffusion effect in your insulation system (sd and μ values).

Moisture accumulation on a cooling component

All calculations are done following formulas given in the German standards VDI 2055, chapter 5.3 and AGI Q 112. In the step 3 you will have to fill in additional data:

- › Temperature medium in °C
- › Operational hours (hours/year)
- › Relative humidity inside in %

Temperature medium °C

Operational hours hours/y

Relative humidity inside %

Operational hours hours/y

You'll have an available list of most frequent scenarios just clicking in 'free input':

free input

- Heating period 185 days *24h, new building (with no reduction in power at night)
- Heating period 220 days *24h, renovation (with no reduction in power at night)
- Heating period 275 days *24h, old building (with no reduction in power at night)

You can also include the medium data through the database, or by Medium Type (seen in previous sections) In the step 4 you will have to fill in additional data also:



As an output you will have the following:

Moisture accumulation rate according to VDI (X h)	kg/m
Moisture accumulation rate defined by AGI Q112 (X h)	kg/m ³
Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C

C.2-1.VI CALCULATION U-R VALUE

With this method you will calculate U and R values of your system.

- › R: Thermal Resistance of insulating material. Formula used: $R = d/\lambda$ (m²K/W)
- › U: Thermal Transmittance of the insulation system. Formula used: $U = 1/((1/h_i)+R+(1/h_e))$ (W/m²K)



Calculation U- R- value

All calculations are done following formulas given in the International standard ISO 12241, chapter 4.

As an output you will have the following

U-Value	W/(m.K)
R-Value	mK/W
Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C

C.2-1.VII TIME IT TAKES FOR THE WATER INSIDE COMPONENT TO FREEZE (0°C/32°F)

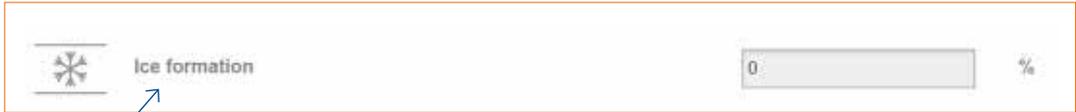
With this method TechCalc will calculate the time it takes the water inside a component to get freeze, at 0°C. This calculation method is only available for pipes.



Time it takes for the water inside component to freeze (0°C/32°F)

All calculations are done following formulas given in the international standard ISO 12241, chapter 6.

In the step 3 you will notice that you cannot set a temperature inside your pipe because it is pre-set to 0°C. You will have to provide additional data:



Ice formation (%): This value represents the total amount of water volume that will become ice inside your pipe.

Freezing Time	min
Heatflow (Heatloss)	W/m or W/m²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C
Heat capacity of water $m_w C_{pw}$	J/K
Heat capacity of the pipe $m_p C_{pp}$	J/K

C.2-1.VIII ECONOMIC COST

With this method Tech-Calc will calculate the economy chart based on insulation thickness vs total cost (energy plus insulation system). The aim of this chart is searching the economic thickness and/or the energy efficiency thickness.



All calculations are done following formulas given in the German standard VDI 2055, chapter 6.

In step 3 you will need to fill in the amount of hours that your facility is working per year:

Operational hours hours/y

You'll have an available list of most frequent scenarios just clicking in 'free input':



- free input**
- Heating period 186 days *24h, new building (with no reduction in power at night)
- Heating period 220 days *24h, renovation (with no reduction in power at night)
- Heating period 276 days *24h, old building (with no reduction in power at night)

You can select one from the list or just go for a free input. The value set will influence in the total cost of energy.

When you select this calculation method, is mandatory to fill in the data required in step 7: Economy:

Basic Economic Setting

Currency:

Heating/Cooling system: Energy Efficiency of the heating/cooling system (1=100%):

Energy price (EUR/kWh):

Expected service life for years (a): Annual price variation (%):

Interest rate (%): Maintenance (%):

General cost (%):

Cladding material cost (EUR): Cladding installation cost (EUR):

Insulation outside:

Nr.	Name	Min.Thickness (mm)	Max.Thickness (mm)	Basic cost (EUR/m ²)	Thickness cost (EUR/m)
1	TECH Pipe Section MT 4.1	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

Currency: you can select any currency in the world. Select the one you want just by clicking on it.

Heating system: by choosing one heating system, you are selecting a yield for your energy system. Clicking on it you will find the most common heating systems with their efficiencies: Energy Efficiency of the heating system (1=100%): You can fill in with your own yield data or just select one heating system and it will provide you with the right system efficiency figures. Be careful because usually the yield is expressed as the reverse function, so 1/yield.

Energy cost (/kWh): You must fill in the price you are paying for your energy in 'Currency'/kWh. For EU countries it will be in EUR/kWh, as it is selected as default value.

Actual energy cost (/kWh): This is the result of your energy cost and the yield of your system. TechCalc will calculate it automatically.

Annual price variation (%): The difference between the actual and future prices of your insulation system.

Expected service life (y): It is the time that the machine or facility is expected to be working, in years

Interest rate (%): the interest percent that a bank or other financial company charges you when you borrow to invest in your insulation system.

Maintenance (%): The amount of money invested in maintenance of your insulation system along its service life compared with the total amount of the investment.

General cost (%): The amount of money expended related to your insulation system (maintenance excluded) along its service life compared with the total amount of the investment. Cladding material cost (Currency): Cladding total cost in your insulation system for your machine or installation.

Cladding installation cost (Currency): Total cost of installing the cladding of your insulation system in your machine or installation.

Insulation outside:

No.	Name	Min.Thickness (mm)	Max.Thickness (mm)	Basic cost (EUR/m²)	Thickness cost (EUR/m)
1	TECH Pipe Section MT 4.1	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

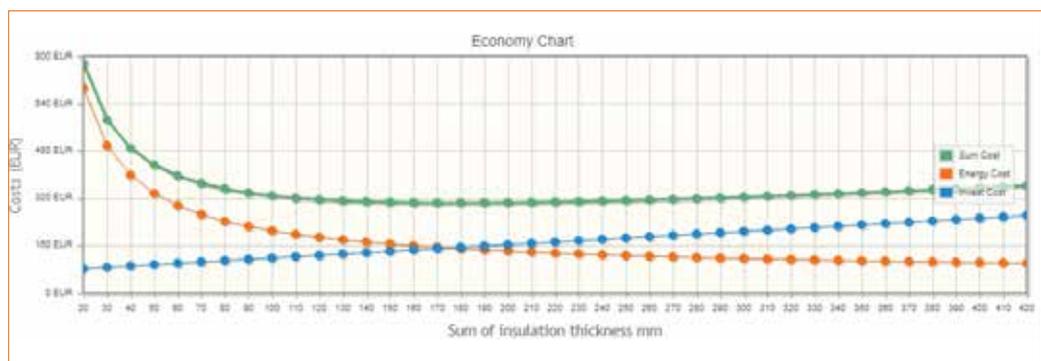
Min. and Max. Thickness (mm): Through these two values we define the thickness range.

Basic cost (Currency/m²): Insulation installed cost by m².

Thickness cost (Currency/m): Price for one meter thickness insulation of the selected material.

As an output you will have the following:

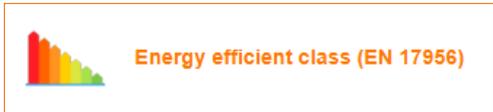
Heatflow (Heatloss)	W/m or W/m²
Heatflow (Insulated version area)	W/m²
Total heatflow (Heatloss)	W
T-surface	°C



C.2-1.IX ENERGY EFFICIENT CLASS (EN 17956)

With this method Tech-Calc will calculate the Energy efficient Class (EEC) according to EN 17956.

If you click the next pictogram, it will change the color (from grey to colorful), and within this calculation method you will obtain the heat loss/gain through your system, the surface temperature, and then all calculations will add the Energy efficient class (EEC) according to EN 17956 and Maximum heatflow depending on the letter of the Energy efficient class.



As an output you will have the following:

Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C
Energy efficient class (EEC)	Optimum, From A to G
Max heatflow	W/m or W/m ²

C.2-2 MINIMUM INSULATION THICKNESS

Whether you click “Minimum insulation thickness” you will be able to choose the next calculation methods



Option: Click “Calculate all pipe diameters (one version)” for calculations of all ranges of diameters of pipes depending on the type of chosen pipe (Copper, Steel, SS, Synthetic, Ductile iron or ASTM C585 NPS). The calculation will be done only for Version 1.

Within this calculation method you will obtain the minimum insulation thickness for the scenario you have created, including your insulation selection.

You have up to 6 different choices for calculating the minimum insulation thickness:

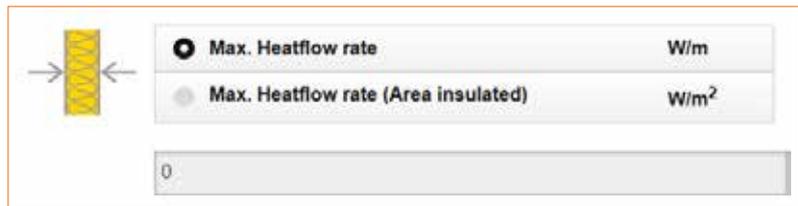
- › For a maximum heat flow rate
- › For a maximum surface temperature
- › For both, maximum heat flow rate and maximum surface temperature
- › For prevention condensation outside
- › For prevention condensation inside
- › For Energy efficient Class requirement (EN 17956)

All calculations are done following formulas given in the international standard ISO 12241, chapter 4.

C.2-2.1 MAXIMUM HEAT FLOW RATE

With this method TechCalc will calculate the economy chart based on insulation thickness vs total cost (energy plus insulation system). The aim of this chart is searching the economic thickness and/or the energy efficiency thickness.

Within this option, TechCalc will calculate the minimum thickness required to get a determined maximum heat flow. When selecting this option, you will find a field to fill in, Max. Heat flow rate, in W/m for pipes and circular ducts or in W/m² for the rest of components:



In this field you must set the limit in terms of heat loss you want to have as maximum in your system.

As an output you will have the following:

Minimum insulation thickness (Total)	mm
Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C

C.2-2.11 MAXIMUM SURFACE TEMPERATURE

Within this option, TechCalc will calculate the minimum thickness required to get a determined maximum surface temperature.

When selecting this option, you will find a field to fill in, Surface temperature (°C):

The screenshot shows a software interface element for setting surface temperature. It features a thermometer icon on the left, the text 'Surface temperature' in the center, and a degree Celsius symbol (°C) on the right. Below the text is a horizontal input field containing the number '0'.

In this field you must set the limit in terms of heat loss you want to have as maximum in your system.

As an output you will have the following:

Minimum insulation thickness (Total)	mm
Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C

C.2-2.III BOTH

When selecting this option, you will find two fields to fill in, Max. Heat flow rate (W/m or W/m²) and Surface temperature (°C):

In this field you must set the limits in terms of heat loss and surface temperature you want to have as maximum in your system and on your cladding or external surface. TechCalc will calculate the thickness required for the worst scenario, either Max heat flow or Surface temperature.

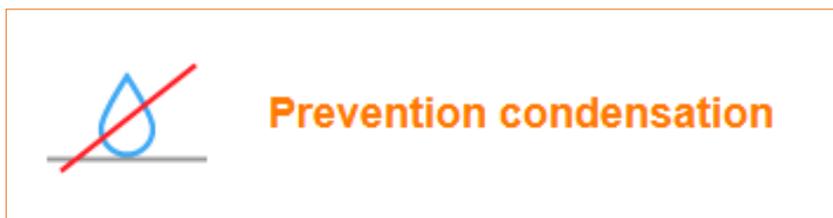
As an output you will have the following:

Minimum insulation thickness (Total)	mm
Heatflow (Heatloss)	W/m or W/m²
Heatflow (Insulated version area)	W/m²
Total heatflow (Heatloss)	W
T-surface	°C

C.2-2.IV PREVENTION CONDENSATION OUTSIDE

Within this option, Tech-
Calc will calculate the mi-
nimum thickness required
to avoid condensation
outside the system.

When selecting this option, you will find there are no additional fields to fill in:



However, you will find an additional data is required in the step 4: Climate, the external ambient relative humidity:

As an output you will have the following:

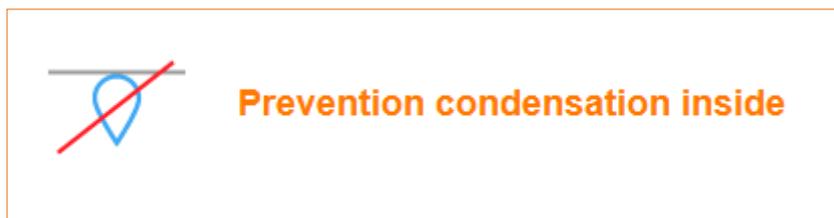
Minimum insulation thickness (Total)	mm
Dewpoint temperature outside	°C
Max. rel. Humidity	%
Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C

Note that dew point and Maximum relative humidity are calculated.

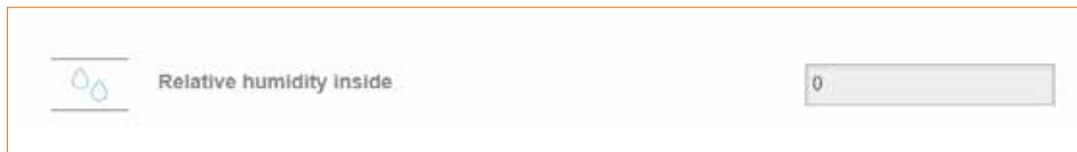
C.2-2.V PREVENTION CONDENSATION INSIDE

Within this option, TechCalc will calculate the minimum thickness required to avoid condensation inside the system.

When selecting this option, you will find there are no additional fields to fill in:



Using this method, you will find a constraint regarding the medium, it can only be air or gas medium. You will find additional data is required in the step 3: Medium for creating a definition of the medium state:



As an output you will have the following:

Minimum insulation thickness (Total)	mm
Dewpoint temperature inside	°C
Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C

C.2-2.VI ENERGY EFFICIENT CLASS REQUIREMENT (EN 17956)

Within this option, Tech-Calc will calculate the minimum thickness required for each Energy efficient Class (Optimum Class, and from A to G)

When selecting this option, you will find there are no additional fields to fill in:

Heatflow (Heatloss)	W/m or W/m ²
Heatflow (Insulated version area)	W/m ²
Total heatflow (Heatloss)	W
T-surface	°C
Energy efficient class (EEC)	Optimum, From A to G
Max heatflow	W/m or W/m ²

C.3 MEDIUM

In this step you will fill in all the data related to the medium inside your component. By default TechCalc will show a 'standard' fluid (Fluid with $h_i = \infty$, then the effect of internal surface coefficient is neglected).



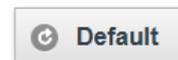
Database

For choosing a different medium, just click in the symbol. Database and the you will access to different mediums (Medium Database):

You can select from the 'Catalogs' ⁽¹⁾ first the kind of medium (liquid or gas) and then select from the 'Mediums' list ⁽²⁾ the medium you want. On the right you have medium information ⁽³⁾.

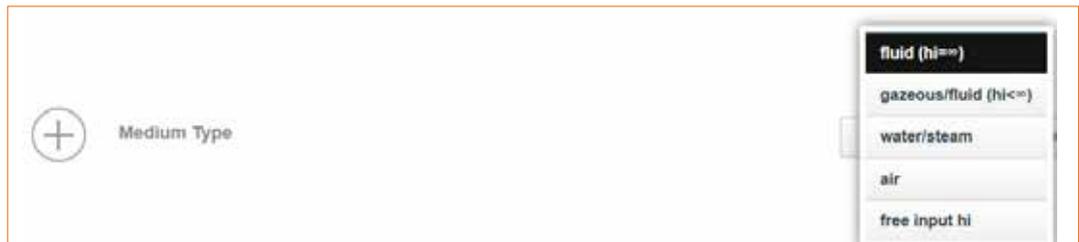
Once the medium has been selected, click on

You can click in the symbol "Default" to return to the initial state.



Another option that you can choose is click on Medium Type, and a drop-down list will appear with the following options, depending on the type of fluid you consider.

- › Fluid with $h_i = \infty$
- › Gaseous / fluid with $h_i < \infty$. It is necessary to fill in the value of Kinematic viscosity m^2/s , in addition to all the values indicated above
- › Water / steam. For this option the software can calculate h_i with the data that you have to fill in (characteristics of Water / steam as Temperature of the Water / steam and Pressure). Rest of values of magnitudes will appear automatically.
- › Air: It's only necessary to include the value of Temperature of the air. Rest of values of magnitudes will appear automatically.



This step changes the input fields depending on the calculation method and of course the kind of medium selected. The fields you can find in this step 3 are the followings:

Parameter	Unit
Relative humidity inside	%
Heat capacity (C_p)	kJ/kgK
Conductivity (λ)	W/(m.K)
Density (ρ)	kg/m ³
Velocity (v)	m/s
Kinematic viscosity (ν)	m ² /s
Pressure (P)	Bar
Standstill period	min
Volume percentage ($V\%$)	%

You will find the explanation relative to each parameter along the chapter 'c.2'. An explanation is given only for those parameters not purely physics, as it could be density, heat capacity, etc.

C.4 CLIMATE

In this step you will fill in all the data related to the ambient conditions outside your component. If your component is 'indoor', you will have to fill in just the outside temperature:


Ambient temperature

°C

In case of having an 'outdoor' component you will need to fill in the wind speed also:


Wind

m/s

Other parameters could be needed in this step depending on the calculation method selected:


Relative humidity outside

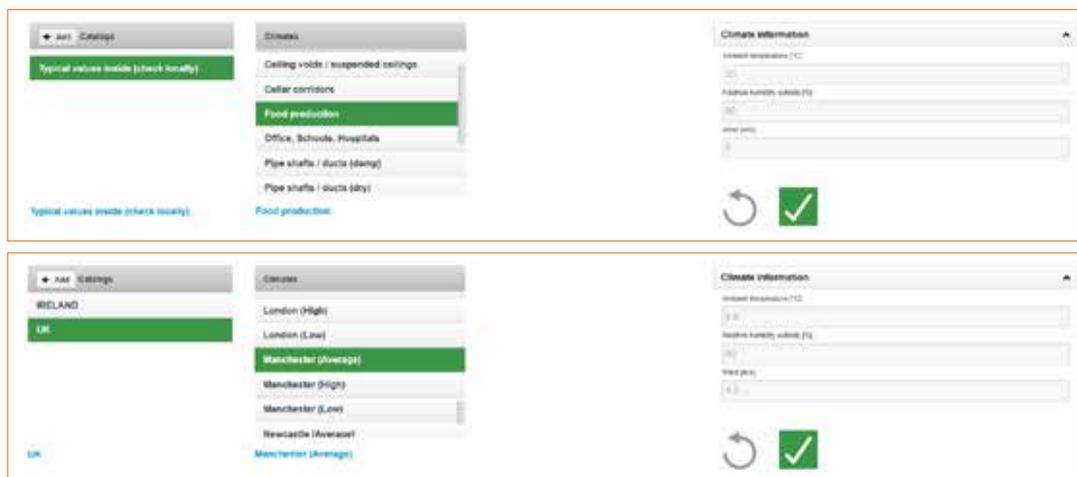
%

You have access to a database of climate conditions, either 'indoor' conditions or local areas or cities, depending on the 'database language' (see chapter 'e3 - Database access and manage').

To access the database to select a climate condition you just need to click on this icon:



After clicking on this icon you will find:



After selecting a climate condition, just click on 

C.5 INSULATION SYSTEM

In this step you will define your insulation system. There are up to 4 different parts in your insulation system:

- › Cladding
- › Insulation outside
- › Wall
- › Insulation inside

Cladding

This is the area of your screen dedicated to the cladding:



- 1** Cladding proposed for your system
- 2** Wall of your component without insulation and without cladding

For the cladding proposed in your system, **1**, you can either introduce an emissivity value (ϵ) directly on the field or select it from the database (). If you click on the database option, you will find the list of different claddings, with their technical values, as they are in ISO 12241:



After selecting selecting a cladding, just click on

For setting an emissivity value for the bare wall of your component, you only have the possibility of introducing it in the field **2**. This value will be used by TechCalc to calculate the heat loss of your system before putting any kind of insulation or cladding. By default, TechCalc gives you a value of 0,8, steel emissivity.

INSULATION OUTSIDE

By this you will define the insulation you will place in the external face of your component's wall. This option is always available, for any calculation method or component.

This is the area of your screen dedicated to Insulation outside:

This '+' symbol is used to add one layer on insulation

Insulation material choice

Thickness for each layer

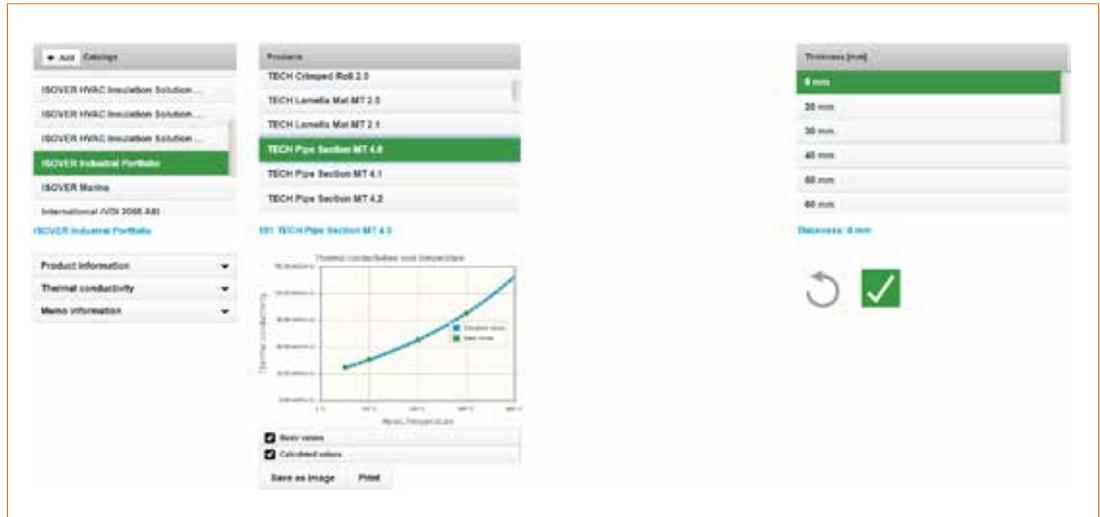
Copy	Remove	Nr.	Name	Thickness [mm]	λav
		1	TECH Pipe Section MT 4.1	60	<input checked="" type="checkbox"/> λav
		2	TECH Wired Mat MT 4.1	80	<input type="checkbox"/> λav

Edition tools:

- Copy layer
- Delete layer

Selection for insulation materials tested under ISO 8497 standard (cylindrical)

After clicking on the '+' symbol you will arrive to the material selection place in the database:



You select first your 'Catalogue' and then you can select the exact product you want to use. Later on you can select the thickness in this screen or you can place it directly in the thickness field later on. By selecting a thickness from the thickness list you will be sure about the thickness selected is a commercial one you can find in the market. Remember always clicking on after making your choice.

Once you have accomplished this material selection it will appear in your 'Insulation outside' area:



Now, as said before, you can set your insulation thickness or modify the previous one directly on the thickness field.

You could add a new insulation layer by just repeating the same steps: clicking on '+' symbol, selecting the material from the database and setting the thickness. You can add up to 10 layers, with no limitation in the total thickness. You can also copy a previously existing layer, with all its attributes, by just clicking on . For deleting an existing layer you just have to click on



WALL

Defining a wall is optional. Usually component walls are not affecting too much to the final results since wall materials conductivities use to be very high and thickness small. It is only required with 'Insulation inside' option.

The steps to follow for defining a wall are exactly the same than for the 'Insulation outside'.

INSULATION INSIDE

Insulation inside is optional. Usually the insulation inside is just used for some air conditioning ducts. If you select to put some insulation inside you will need to define the wall of your component.

The steps to follow for defining insulation inside are exactly the same than for the 'Insulation outside'.

AAV

This box must only be marked in case of using products whose declared lambda curve has built up following ISO 8497 standard, for cylindrical shapes (Pipe Sections).

As stated in ISO 23993, chapter 7.2:

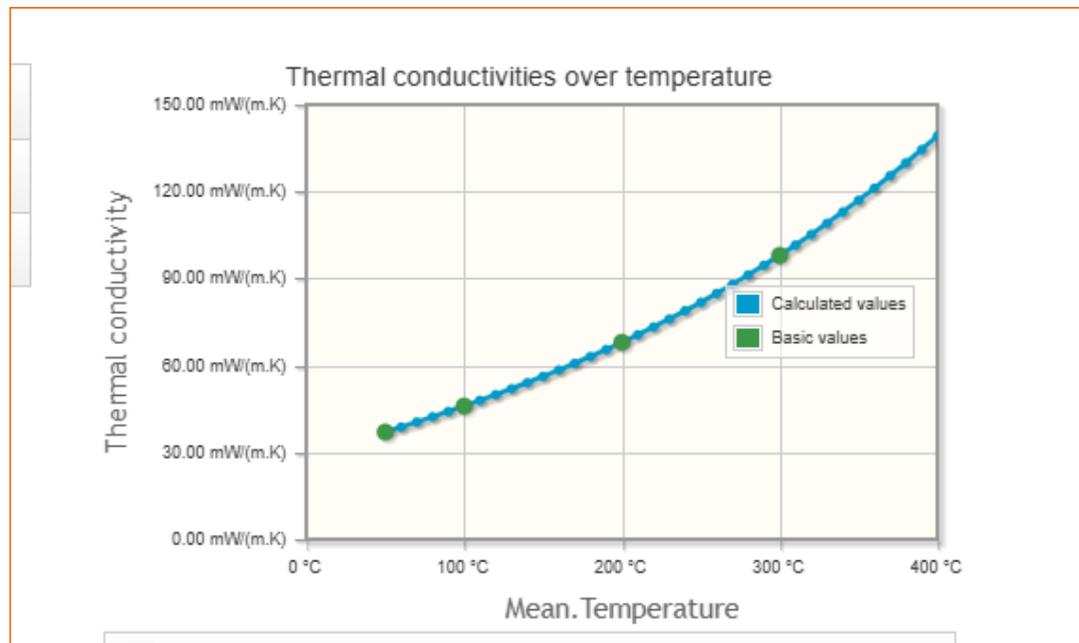
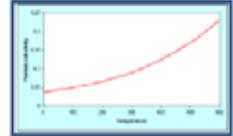
"If the design thermal conductivity is needed at another mean temperature than that of the declared thermal conductivity and with another temperature difference, the procedures outlined above shall be followed successively. As an alternative, the influence of the non-linearity of the thermal conductivity curve may be taken into account by integrating the measured curve as given by Equation:

$$\bar{\lambda} = \frac{1}{\theta_2 - \theta_1} \int_{\theta_1}^{\theta_2} \lambda(\theta) d\theta$$

You could add a new insulation layer by just repeating the same steps: clicking on '+' symbol, selecting the material from the database and setting the thickness. You can add up to 10 layers, with no limitation in the total thickness. You can also copy a previously existing layer, with all its attributes, by just clicking on does by default, but it is not the case for Pipe Sections (ISO 8497), where lambda value ($\lambda(\theta_m)$) does not need any kind of correction over declared values.

Flat products $\lambda(\theta) = a_0 + a_1 \cdot \theta + a_2 \cdot \theta^2 + a_3 \cdot \theta^3$ ISO 2055 (eq.4)

Pipes $\lambda(\theta_m) = a_0 + a_1 \cdot \theta_m + a_2 \cdot \theta_m^2 + a_3 \cdot \theta_m^3$



Example for ISO 8497 and ISO 12667 products:

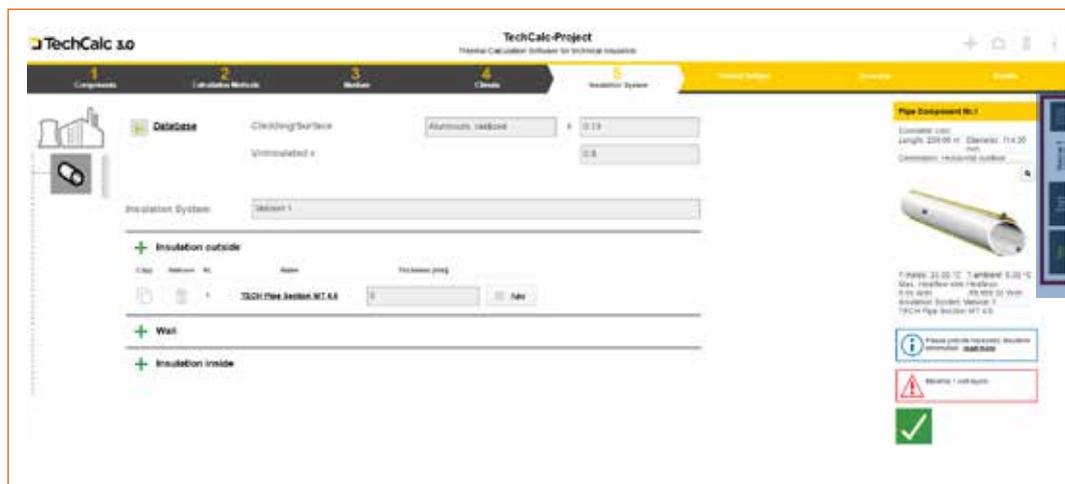
ISO 8497:	1	TECH Pipe Section MT 4.1	<input type="text" value="50"/>	<input checked="" type="checkbox"/> λ_{av}
ISO 12667:	1	TECH Wired Mat MT 5.1	<input type="text" value="50"/>	<input type="checkbox"/> λ_{av}

RESULTS COMPARISON BETWEEN DIFFERENT INSULATION SYSTEMS

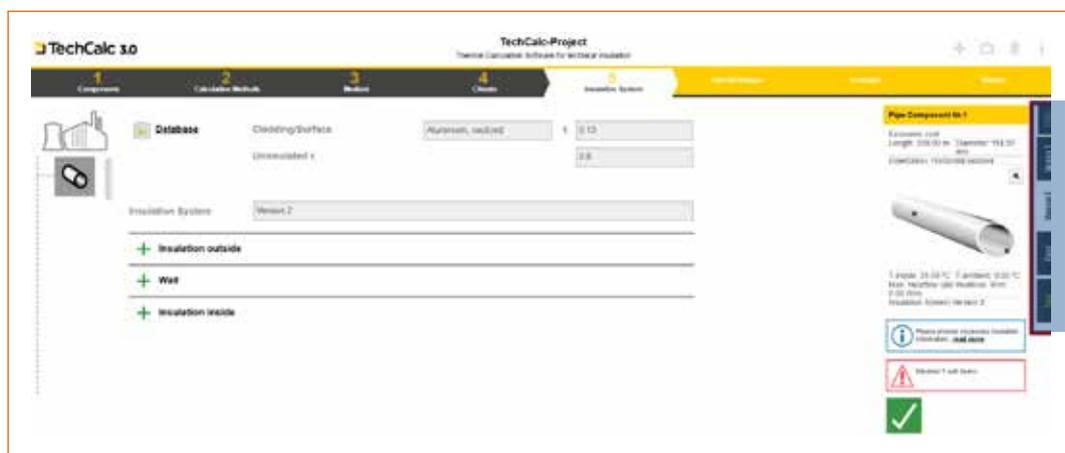
Once you have defined your insulation system, you can compare it with other insulation system under the same scenario (component, medium, climate) for comparing results.

You can define up to 5 different insulation systems per component. The aim of defining more than one insulation system is to give you the possibility of comparing, at a glance, results for each of them afterwards.

The way for creating a new insulation system inside a selected component is clicking on 'New' on the right 'versions' strip on the right side of your screen:

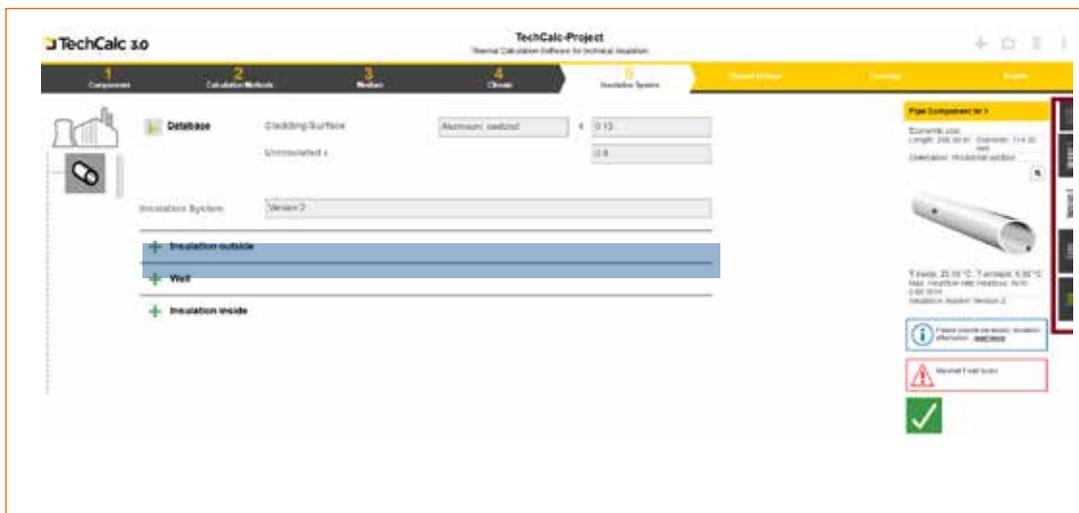


After clicking on 'New', a new insulation version will appear with all the data concerning to the insulation (outside, wall and inside) empty for defining the new insulation system ('version') to be compared with the previous one

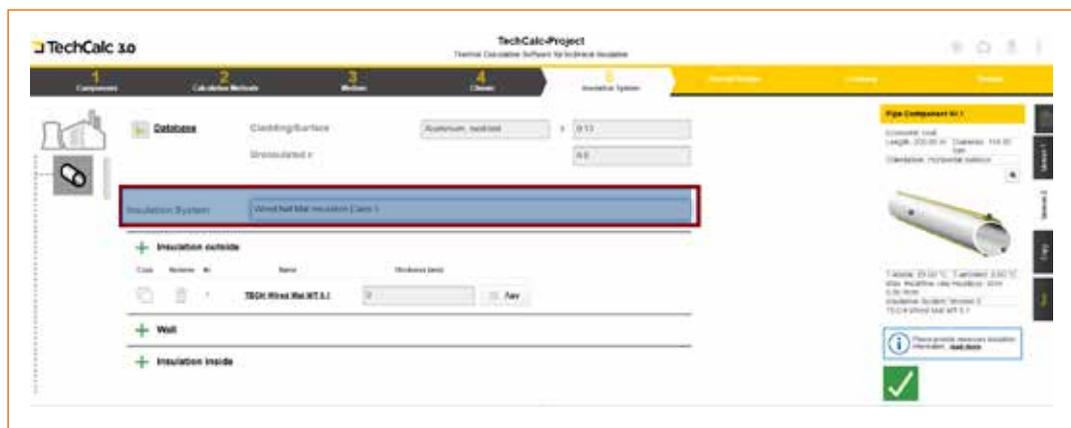


For deleting an existing insulation system 'version', just click on  allocated on top of the 'version' number.

You have the possibility of naming each of your system for having a clearer output and for making easier the navigation through different results:



See on the next picture how the name has been modified by just writing the name you desire inside the 'Insulation System' field:



C.6 THERMAL BRIDGES (OPTIONAL)

This step is totally linked to what is stated in ISO 23993 (Thermal insulation products for building equipment and industrial installations – Determination of design thermal conductivity) and in VDI 2055-part1: 4.2.1.1 c) operational thermal conductivity (design value). The aim of this ISO standard is determine the lambda value in real design conditions, what are quite different to the conditions existing in the lab when the tests carried out for declaring lambda values were done. VDI has the same aim in the mentioned chapter.

For obtaining this lambda design value, that will be the one used in the calculations, TechCalc has the options of setting all the factors included in ISO 23993 and VDI 2055 that are affecting to the lambda design value:

Symbol	Quantity	Unit
F	overall conversion factor for thermal conductivity	—
F_a	ageing conversion factor	—
F_C	compression conversion factor	—
F_c	convection conversion factor	—
F_d	thickness conversion factor	—
f_d	thickness conversion coefficient	—
F_j	joint factor	—
F_m	moisture conversion factor	—
$\Delta\lambda$	additional thermal conductivity due to thermal bridges, such as spacers, which are regular parts of the insulation	W/(m·K)
$\Delta\lambda_{sq}$	thermal conductivity per spacer per square metre	W/(m·K)

$$\lambda = \lambda_d F + \Delta\lambda$$

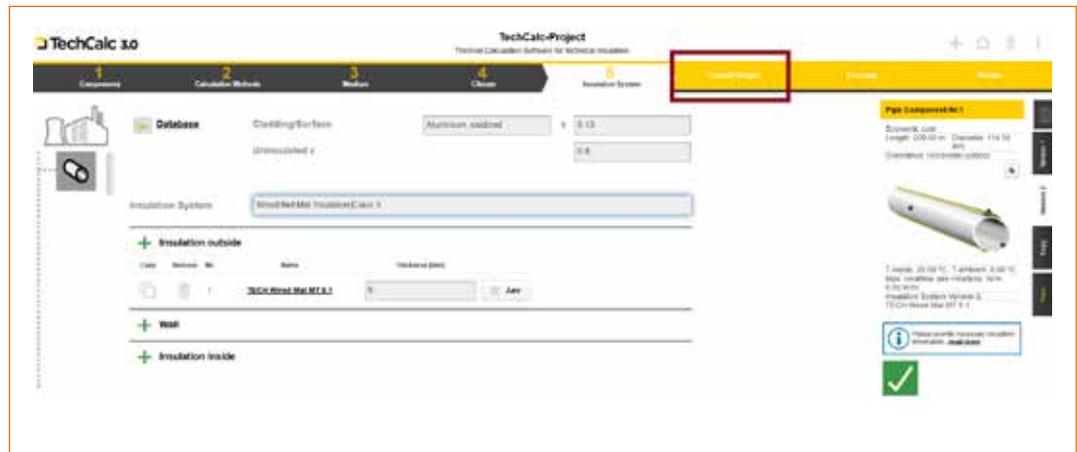
$$F = F_{\Delta\theta} F_m F_a F_C F_c F_d F_j$$

$F_{\Delta\theta}$ doesn't need to be introduced in this step because TechCalc is always integrating (except if λ_m is selected) and there is no need to calculate a temperature difference conversion factor.

Even though this calculation step is optional, it is highly recommended to use it for real purpose calculations. Otherwise results could be really different due to the lack of correction when using directly the lambda values declared by the insulation manufacturer.

Before starting with this step 6, the step 5 needs to be finished because all calculations linked with the modification on declared lambda values will be based in the insulation system definition.

For having access to this step you need to click on the marked area (Thermal Bridges):



Once you click on it, you'll arrive to this screen:



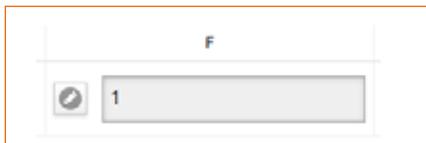
$\Delta\lambda$ factor (real thermal bridges)

F factor

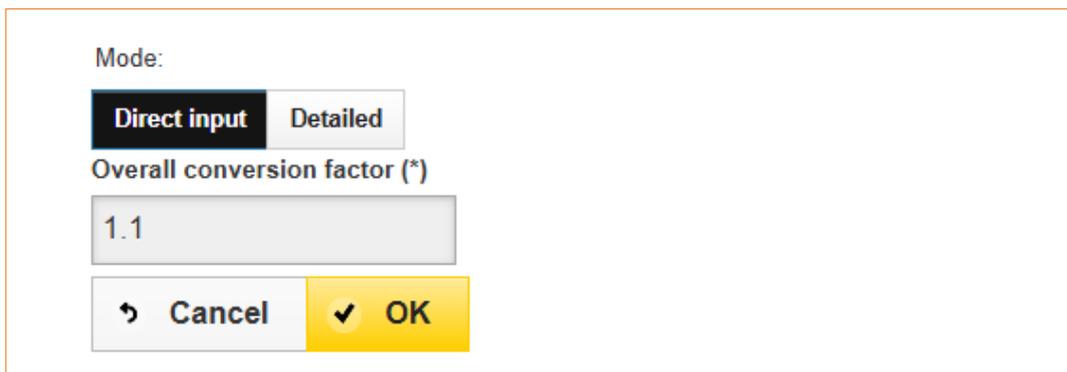
Hangers

F FACTOR

To define the F factor variables, you need to click on:



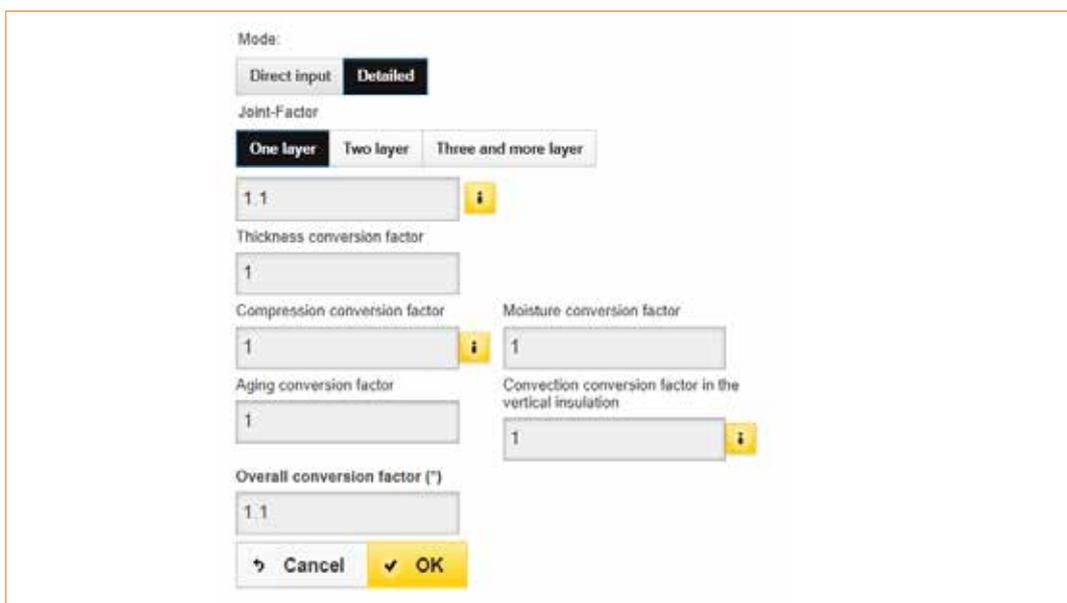
After clicking on this 'pencil' symbol, you'll arrive to this screen:



Here you have to choose between:

- › **Direct input:** you can set directly the F factor value
- › **Detailed:** you can set the values for each factor

If you choose 'Detailed' you will get this screen:



For setting the 'joint factor' you can choose one of the three options corresponding to your real system:

- › **One layer: Fj = 1,1**
- › **Two layers: Fj = 1,05**
- › **Three and more layers: Fj = 1**

For the rest of the factors you can set the value manually depending on your calculations (out of TechCalc's scope. See ISO 23993 / VDI 2055 for further details).

Δλ FACTOR

To select the thermal bridges of your system click on:

After clicking on this 'pencil' symbol, you'll arrive to this screen:



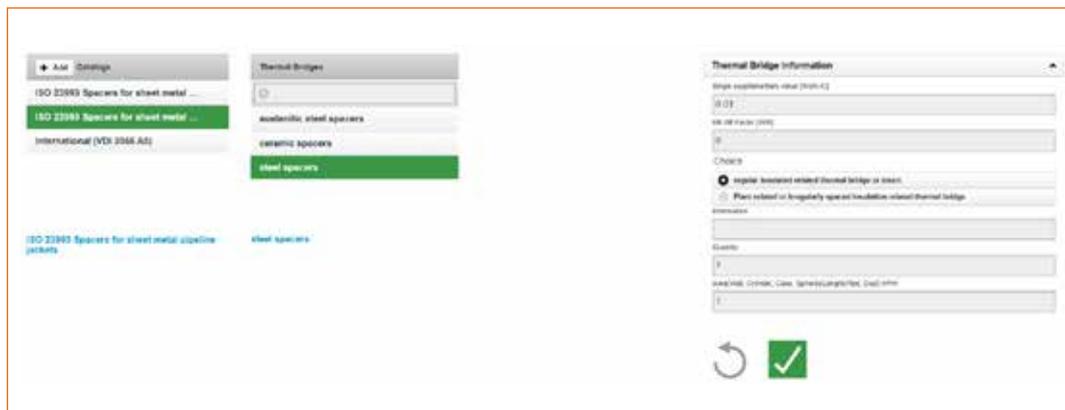
Here you have to choose between:

- › **Direct input: you can set directly the Δλ value for different thermal bridges**
- › **Database: you can select the value from TechCalc database of thermal bridges**

If you choose 'Direct input' Just give a name to the thermal bridge you want to create, specify the amount of them per linear meter (pipes or circular ducts) or per square meter (walls, rectangular ducts and tanks with any shape). After clicking in the  symbol you will add the thermal bridge for calculation and it will appear in your list:



If you would select the 'Database' option, you will access to this screen:



Inside the 'Catalogue' area you will find three different catalogues:

- › **ISO 23993 for wall jackets**
- › **ISO 23993 for pipeline jackets**
- › **VDI2055 for any kind of component**

TechCalc's database of thermal bridges provide you with the values stated in these two well-known Standards.

Select first the catalogue you want to use and later on the kind of spacer you have in your system. Once you have selected the one you will use, just click on and the thermal bridge will be added to your list.

Mode: **Direct input** Database

Name	Quantity	$\Delta\lambda$ [W/(m.K)]	Add
<input type="text"/>	1	<input type="text"/>	+

Thermal conductivity additional values

Name	Area [m ²]	Quantity	$\Delta\lambda$ [W/(m.K)]	Delete
My thermal bridge example	1	1	0.009	
Spacers of steel in the form of a flat bar 40mm x 4mm	1	1	0.006	

Sum of the thermal conductivity supplementary values (*) [W/(m.K)]

Your thermal bridges list

Total value as a result of your thermal bridge definition

Hangers:

There is another kind of thermal bridge you can add out of the standard $\Delta\lambda$ definition: hanging system. This is only available for pipes or circular ducts.

For selecting a hanging system, just click on the on the right of the word 'Hanging':

Hanging / Valves / Flanges

Insulation outside

Nr.	Name	F	$\Delta\lambda$ [W/(m.K)]
1	TECH Pipe Section MT 4.1	<input type="text" value="1"/>	<input type="text" value="0"/>

Again, you will arrive to a selection screen where you will be able to choose the method you want to use:

- › Equivalent length (for adding elements as valves, flanges, etc.)
- › Pipe hanger global

Thermal Bridge Mode

Pipe equivalent length
 Pipe hanger global

ISO 12241 Table A.1 (pdf)

Name	Equivalent length (m)	Pipe length (m)	Quantity	Factor z ^x (1=100%)
		200	1	

You will have guidance by clicking in the 'ISO 12241 Table A.1 (pdf)', where you will find a list of equivalent lengths for different scenarios:

Table A.1 — Equivalent length for installation-related "thermal bridges"

Flanges for pressure stages PN 25 to PN 100 ^b			Equivalent length for given temperatures ^a		
			ΔT m		
			100 °C	250 °C	450 °C
Uninsulated for pipes	in buildings at 20 °C	DN 50 ^c	3 to 5	5 to 11	9 to 15
		DN 100	4 to 7	7 to 16	13 to 16
		DN 150	4 to 9	7 to 17	17 to 30
		DN 200	5 to 11	10 to 26	20 to 37
		DN 300	6 to 16	12 to 37	25 to 57
		DN 400	9 to 16	15 to 36	33 to 56
	in the open air at 0 °C	DN 50	7 to 11	9 to 16	12 to 19
		DN 100	9 to 14	13 to 23	18 to 28
		DN 150	11 to 18	14 to 29	22 to 37
		DN 200	13 to 24	18 to 38	27 to 46
		DN 300	16 to 32	21 to 54	32 to 69
		DN 400	22 to 31	28 to 53	44 to 68
Insulated	in buildings at 20 °C and in the open air at 0 °C	DN 50 ^c	0,7 to 1,0	0,7 to 1,0	1,0 to 1,1
		DN 100	0,7 to 1,0	0,8 to 1,2	1,1 to 1,4
		DN 150	0,8 to 1,1	0,8 to 1,3	1,3 to 1,6
		DN 200	0,8 to 1,3	0,9 to 1,4	1,3 to 1,7
		DN 300	0,8 to 1,4	1,0 to 1,6	1,4 to 1,9
		DN 400	1,0 to 1,4	1,1 to 1,6	1,6 to 1,9
		DN 500	1,1 to 1,3	1,1 to 1,6	1,6 to 1,8

In addition to this you can select, as well, the kind of 'hanging system' you have (indoor or outdoor) by just selecting 'Pipe hanger global'. In this case, after clicking on this option you will have this screen:

Thermal Bridge Mode

Pipe equivalent length
 Pipe hanger global

Hanger global selection

Indoor pipe hanger
 Outdoor pipe hanger
 Direct input

Factor z^x

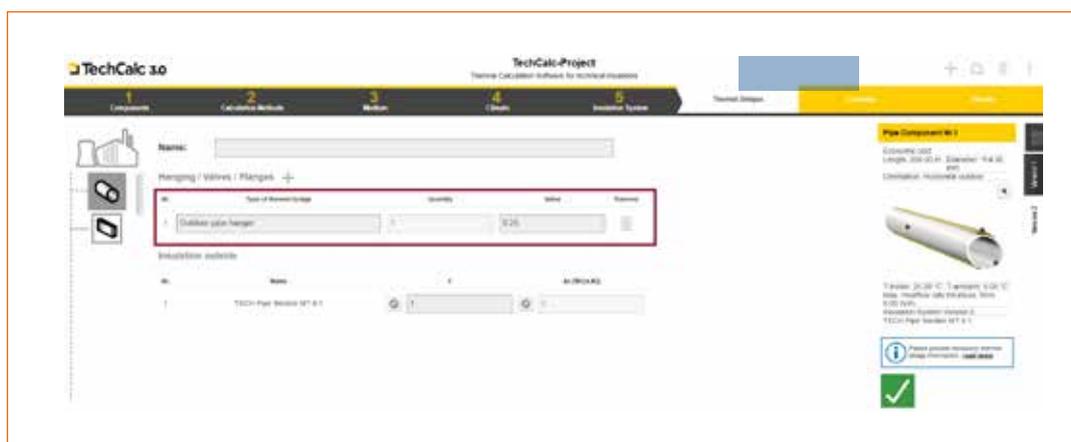
0.15

(1=100%)

You can set a free value for the Z_x factor ('Direct input') or select between one of the two options given in the ISO 12241 / VDI 2055 A14:

Pipe suspensions	Supplementary value y'
In buildings	0,15
In the open air	0,25

You can add as many items as you need. They will be saved in your calculation and you will have access to any of them through the 'hanging' list:



C.7 ECONOMY (OPTIONAL)

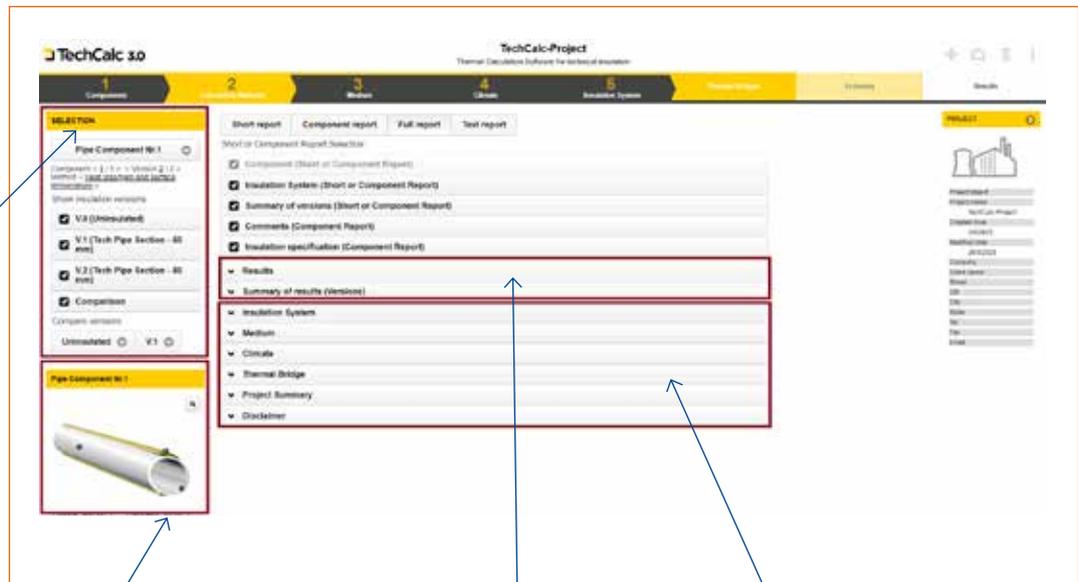
This step is totally linked to what you can find in the C2.1-V. ECONOMIC COST chapter. Within the mentioned chapter you will find all the information related to Economy..

D. OUTPUTS

You will have to different outputs for your calculation results, on screen or in a printable form. You will have access to them by clicking on 'Results'.



D1. ON SCREEN



Output selector: you can choose different outputs and comparisons between solutions

Graphical output: picture with solution selected and all the data link to it

Output main results: a summary of the different thermal related calculations. It will change depending on the calculation method chosen (see c2.- Calculation methods)

Output secondary data: all the data used for the calculation setting is available in this section

There are two ways to present results:

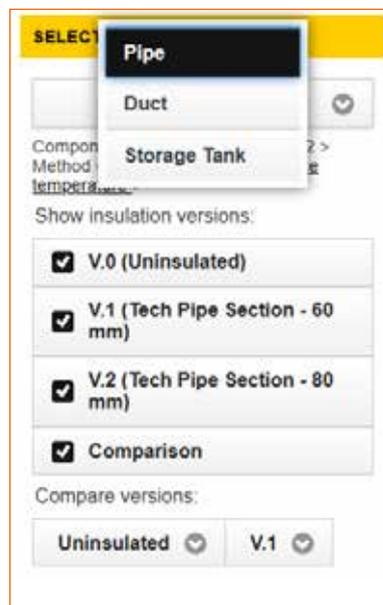
Results: Shows the complete results for the selected version

Summary of results: Shows the results for all versions, starting with the non-isolated version and ending with a comparison between the selected versions.

OUTPUT SELECTOR



Component selector: you can choose between the different created components by clicking on this area. Outputs shown on screen will correspond to the selected component.



Output selector: you can choose different outputs and comparisons between solutions selecting or deselecting insulation versions

2

Show insulation versions:

- V.0 (Uninsulated)
- V.1 (Tech Pipe Section - 60 mm)
- V.2 (Tech Pipe Section - 80 mm)
- Comparison

Compare versions:

Uninsulated V.1

Summary of results (Versions)

	Uninsulated	Version 1	Version 2	Comparison
Heatflow (Heatloss)	5,434.01 W/m	243.38 W/m	200.99 W/m	5,190.64 W/m
Heatflow (Area insulated)	15,132.94 W/m²	330.64 W/m²	233.24 W/m²	14,802.31 W/m²
Total heatflow	1,086,802.68 W	48,675.09 W	40,198.52 W	1,038,127.59 W
T-surface	391.75 °C	45.54 °C	40.19 °C	

Show insulation versions:

- V.0 (Uninsulated)
- V.1 (Tech Pipe Section - 60 mm)
- V.2 (Tech Pipe Section - 80 mm)
- Comparison

Compare versions:

Uninsulated V.1

Summary of results (Versions)

	Version 1	Version 2
Heatflow (Heatloss)	243.38 W/m	200.99 W/m
Heatflow (Area insulated)	330.64 W/m²	233.24 W/m²
Total heatflow	48,675.09 W	40,198.52 W
T-surface	45.54 °C	40.19 °C

Compare insulation versions: the 'Saving' column is reserved for comparing results between two different solutions.

By clicking on any of the two selectors, you can modify the comparison calculation.

3

Compare versions:

Uninsulated V.1

Eg: Comparison between Uninsulated and Version 1

Summary of results (Versions)

	Uninsulated	Version 1	Comparison
Heatflow (Heatloss)	5,434.01 W/m	243.38 W/m	5,190.64 W/m
Heatflow (Area insulated)	15,132.94 W/m²	330.64 W/m²	14,802.31 W/m²
Total heatflow	1,086,802.68 W	48,675.09 W	1,038,127.59 W
T-surface	391.75 °C	45.54 °C	

Compare versions:

V.1 V.2

Eg: Comparison between Version 1 and Version 2

Summary of results (Versions)

	Version 1	Version 2	Comparison
Heatflow (Heatloss)	243.38 W/m	200.99 W/m	42.38 W/m
Heatflow (Area insulated)	330.64 W/m²	233.24 W/m²	97.40 W/m²
Total heatflow	48,675.09 W	40,198.52 W	8,476.57 W
T-surface	45.54 °C	40.19 °C	

OUTPUT MAIN RESULTS

You can choose different outputs and comparisons between solutions selecting and deselecting the insulation versions.

Pipe Component Nr.1

Component < 1 / 1 > -> **Version 1 / 2** ->
 Method < Heat losses and surface temperatures >

Show insulation versions:

- V.0 (Uninsulated)
- V.1 (Tech Pipe Section - 60 mm)
- V.2 (Tech Pipe Section - 80 mm)
- Comparison

Compare versions

Uninsulated V.1

Results

Tech Pipe Section - 60 mm

Heatflow (Heatloss) 343.36 W/m

Heatflow (Insulated) versus area 300.64 W/m²

Total heatflow (Heatloss) 40,675.09 W

T-surface 43.34 °C

Characteristic length (heat loss) 0.37 m

Characteristic length (heat loss) 0.37 m

Insulation outside:

1: TECH Pipe Section MT 4.0

Thickness: 60 mm

Wall:

1: Stainless steel

Thickness: 2.56 mm

Show insulation versions:

- V.0 (Uninsulated)
- V.1 (Tech Pipe Section - 60 mm)
- V.2 (Tech Pipe Section - 80 mm)
- Comparison

Compare versions

Uninsulated V.1

Summary of results (Versions)

	Uninsulated	Version 1	Version 2	Comparison
Heatflow (Heatloss)	5,434.01 W/m	243.38 W/m	200.39 W/m	5,190.64 W/m
Heatflow (Area Insulated)	15,132.94 W/m²	330.64 W/m²	233.24 W/m²	14,802.31 W/m²
Total heatflow	1,056,802.66 W	40,675.09 W	40,136.52 W	1,038,127.59 W
T-surface	391.75 °C	45.54 °C	40.19 °C	

OUTPUT SECONDARY DATA

You can click on any of the secondary data labels to get the information related to the tag:

INSULATION SYSTEM

Insulation System

Insulation outside

1: TECH Pipe Section MT 4.0

Thermal conductivities over temperature

Thermal conductivity vs Mean Temperature graph for TECH Pipe Section MT 4.0. The graph shows a non-linear increase in thermal conductivity from approximately 30 mW/m.K at 0°C to 130 mW/m.K at 400°C. A table on the right lists values for 50, 100, 200, and 300°C.

T	λ
50 °C	0.337 W/m.K
100 °C	0.348 W/m.K
200 °C	0.368 W/m.K
300 °C	0.398 W/m.K
0 °C	0 W/m.K
0 °C	0 W/m.K

Temp Coefficient

1	0.0260000000
2	0.000158856667
3	8.00000000e-5
4	5.33333333e-10
5	0.00000000
6	0.00000000

F Δλ μ sd Thickness

1 8 W/m.K 1.03 60 mm

Wall

1: Stainless steel

Thermal conductivities over temperature

Thermal conductivity vs Mean Temperature graph for Stainless steel. The graph shows a constant thermal conductivity of approximately 17.6 W/m.K across the entire temperature range from 0°C to 1500°C.

T	λ
10 °C	17.6 W/m.K

Temp Coefficient

1	17.60000000
---	-------------

F Δλ μ sd Thickness

1 8 W/m.K 0.1500 8.56 mm

MEDIUM

Medium
 Medium Type: fluid (h=1)
 Temperature inside: 400.00 °C
 h-Value: - W(m²K)

CLIMATE

Climate
 Standard: ISO 12241 (2012)
 Ambient temperature: 25.00 °C
 Wind: 2 m/s
 h-Value:
 Version 1: 16.10 W(m²K)

THERMAL BRIDGE

Thermal Bridge
 Hangers / Valves / Flanges

Nr.	Type of thermal bridge	Quantity	Value
1	Indoor pipe hanger	20	0.65
2	Valve	6	3.83

ECONOMY

Economy
 Currency: EUR
 Energy price: 0.1 EUR/kWh
 Energy (Efficiency of the heating system): 1.47

PROJECT SUMMARY

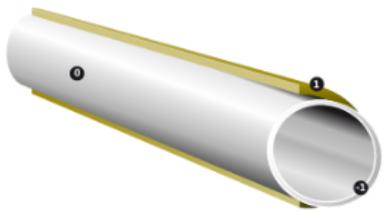
Project Summary

Component	Subcomponent	Version	Active	Total heatflow (Insulated area)	Total heatflow (Uninsulated area)	Total heatflow
Pipe	No	Version 1	No	52,569.10 W	0.00 W	52,569.10 W
		Version 2	Yes	49,554.41 W	0.00 W	49,554.41 W
Duct	No	Version 1	No	1,664.81 W	0.00 W	1,664.81 W
		Version 2	Yes	1,019.42 W	0.00 W	1,019.42 W
Storage Tank	No	Version 1	Yes	32,248.59 W	0.00 W	32,248.59 W
		Version 2	No	42,624.98 W	0.00 W	42,624.98 W
Sum (only active versions)				82,822.41 W	0.00 W	82,822.41 W
Sum (Subcomponents only active versions)				0.00 W		

GRAPHICAL OUTPUT

If you click on the icon  , you will have a more detail graphical output:

Pipe

T-inside: 400.00 °C T-ambient: 25.00 °C
 T-surface
 (Undisturbed area):
 42.34 °C

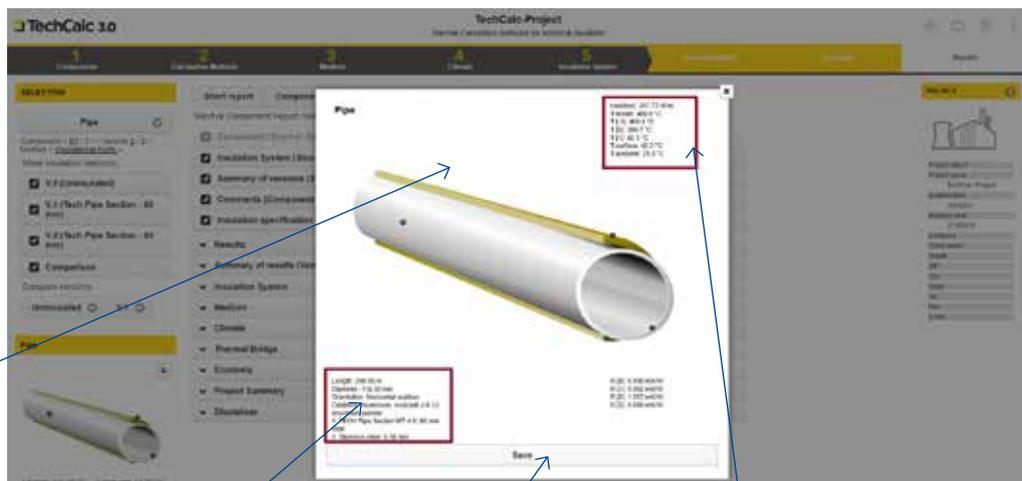
Length: 200 m Diameter: 114.3 mm
 Area uninsulated: 71.817 m²
 Area insulated: 172.348 m²
 he-Value: 15.35 W/(m²K)
 hi-Value: ∞ W/(m²K)
 Orientation: Horizontal outdoor

Insulation System Version 2

Cladding/Surface: Aluminium, oxidized
 ε:0.13

Insulation outside:
 1. TECH Pipe Section MT 4.0: 80 mm

Wall:
 1. Stainless steel: 8.56 mm



Solution graph: component view with the layers used for insulation

Case data: summary of scenario data

Save button: clicking on 'Save' this detailed view as .PNG file will be downloaded to download folder

Temperatures between layers: different temperatures profile for the different points in your system, from the wall to the cladding



D2. PRINT OUT

You can select between two kinds of files, .PDF (Short, Component or Full report) or .RTF (text report).

Short report	Component report	Full report	Text report
Short or Component Report Selection			
<input checked="" type="checkbox"/>	Component (Short or Component Report)		
<input checked="" type="checkbox"/>	Insulation System (Short or Component Report)		
<input checked="" type="checkbox"/>	Summary of versions (Short or Component Report)		
<input checked="" type="checkbox"/>	Comments (Component Report)		
<input checked="" type="checkbox"/>	Insulation specification (Component Report)		

1. SHORT REPORT

If you click it, the system will download a pdf file with the name of the “project + short” in the “Download folder”.

In this one-page report you will find information related just to the component (see ‘Component selector’) and insulation system chosen on the screen (see “Insulation System”) The report is split in three main parts:

- Boundary Conditions:** In the upper part of the page of the report is used to show which are the boundary conditions taken into account for the calculations (all the inputs made through steps 1-5) together with the calculation method, and the chosen component and
- Summary of results:** Summary of the results obtained depending on the calculation method chosen.
- Insulation System Version:** the down part of the page is dedicated to the more relevant information linked to the insulation system chosen.

TechCalc 3.0 **ISOVER**
SHORT REPORT

Project name: Steam Distribution Network 26/02/20
 Object: Pipework
 Regional Contact: Telephone: / Email:

BOUNDARY CONDITIONS

Calculation Method Acoustic Insulation Software, Energy efficient class (EN 12526) Medium Medium Type: Full Temperature mode: 200 °C N-Value: infinity W/m²K	Climate Standard: ISO 12941-02(2) Ambient temperature: 20 °C Cooling/Heating Aluminum, oxidized, Emissivity 0.13	Pipe Component No 1 Length: 100 m Diameter Selection: Stainless steel (ASTM) 4 Diameter: 114.3 mm Orientation: Horizontal indoor Insulation System: Version 1 Sum of insulation thickness: 60 mm
--	--	---

Version	V. 1	V. 2	
Temperature (Indoor/Outdoor area)	40.00	16.00	°C
Energy efficient class (EEC)	D	C	
Max. heatflow	75.69	42.01	W/m
Characteristic length (Real flow)	0.07	0.43	m
Characteristic length (Real forced)	0.00	0.00	m
Heatflow (Realflow)	67.89	34.10	W/m
Heatflow (Insulated version area)	81.95	42.01	W/m²
Total heatflow (Realflow)	6786.12	3410.80	W
U-Value	4.82	4.42	W/m²K

INSULATION SYSTEM

Layer	Type	Name	Thickness	Lambda	Boundary 1
1	Wall	Stainless steel	0.56 mm	17000 mW/(m.K)	200 °C
2	Insulation outside	TECH Pipe Section MF 4 T	60 mm	49.50 mW/(m.K)	150 °C

DISCLAIMER
DISCLAIMER_TEXT

Page 1 Software version 3.0.3
Database version 2.0.0.0

2. COMPONENT REPORT

If you click it, the system will download a pdf file with the name of the “project + component” in the “Download folder”.

In this report you will find information related just to the component chosen on the screen (see ‘Component selector’). The report is split in four main parts:

- › **Boundary Conditions:** the first part of the report is used to show which are the boundary conditions taken into account for the calculations (all the inputs made through steps 1-5).
- › **Insulation System Version:** second part is dedicated to the more relevant information linked to the different insulation system created. Information about thermal bridges defined is also shown, including F factor and $\Delta\lambda$ values and choices.
- › **Summary of the results:** the third part of the report is for summary of the results obtained depending on the calculation method chosen and comparison
- › **Insulation Products Specification:** fourth part is dedicated to describe the thermal properties of the insulation products used in the different defined insulation systems.



3. FULL REPORT

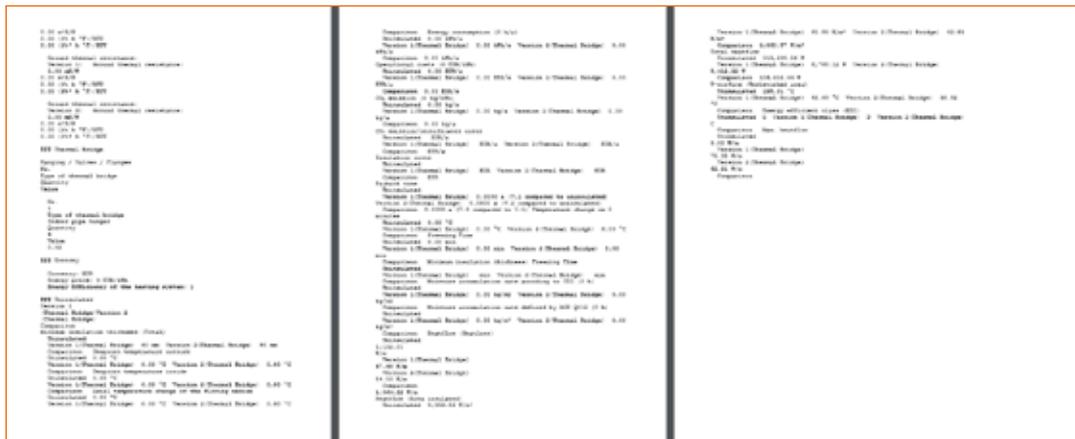
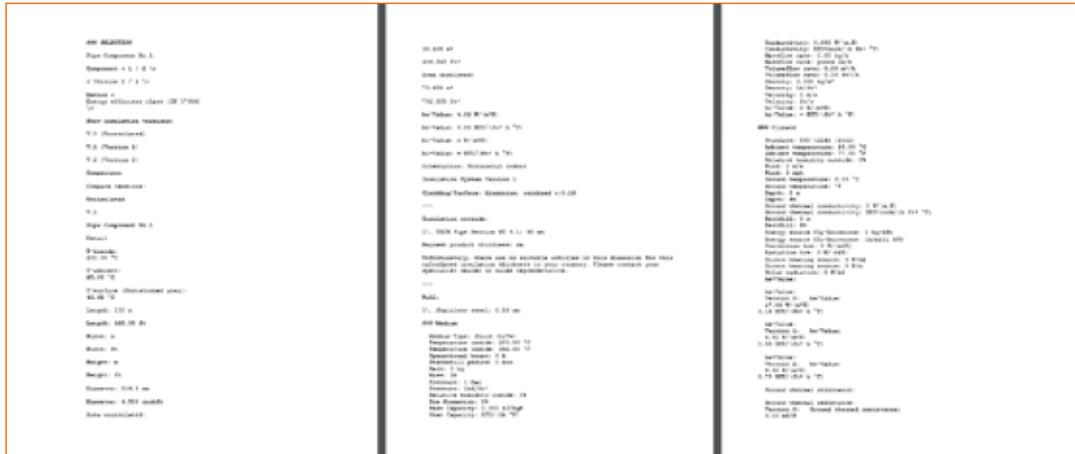
If you click it, the system will download a pdf file with the name of the “project + full” in the “Download folder”.

In this report you will find information related to the whole project, including results for all the components together. The structure is identical to the ‘Component report’, with detailed results for each component, but with the addition of the whole project summary:

PROJECT SUMMARY						
Component	Subcomponent	Version	Active	Total heatflow (Insulated area)	Total heatflow (Uninsulated area)	Total heatflow (Heatloss)
Pipe Component Nr.1	No	Version 1	Yes	6768.12 W	0 W	6768.12 W
	No	Version 2	No	5412.92 W	0 W	5412.92 W
Cylinder Component Nr.2	No	Version 1	Yes	74827.49 W	0 W	74827.49 W
	No	Version 2	No	79141.25 W	0 W	79141.25 W
Sum (only active versions)				81595.61 W	0 W	81595.61 W
Sum (Subcomponents only active versions)				0 W		

TEXT REPORT

This option is available in order to send text messages with the results of a calculation. TechCalc will generate a flat text file (.RTF) where you will find the highlights of your selected component calculations and boundary conditions:

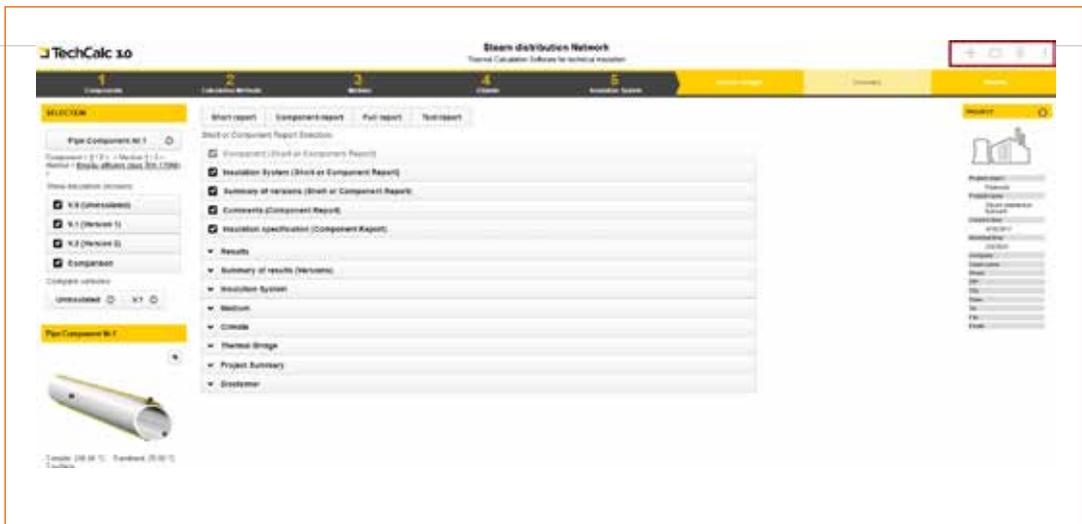


No matter which kind of print out output you select, TechCalc will always download the file to “Download Folder”.

E. OTHER FUNCTIONS

Aside from all the calculations functions, there are other important features inside TechCalc that will allow you to customize your needs.

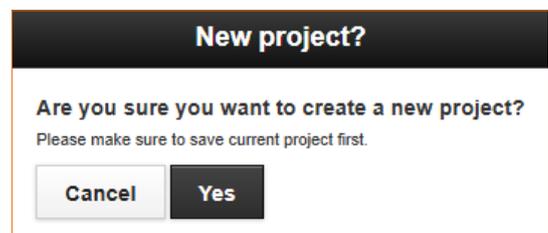
You can access to this special features through the icons based at the right upper part of your screen:



E.1 NEW PROJECT

To create a new project, starting from scratch, you can click on symbol  .

A dialog box will appear asking if you really want to start a new project (be careful because all information of the current project will be lost if it's not been saved previously (see e.2 for saving files)



Automatically you will be placed in the Step 1: Components, with everything cleaned up.

E.2 SAVE FILE

To save a file with all the information of your current project included, you need to click on symbol.  .

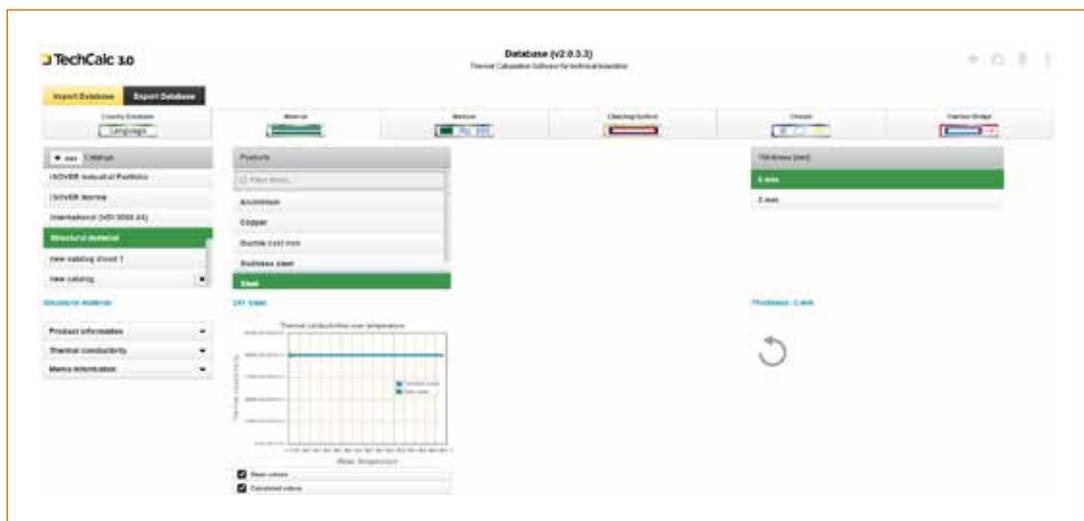
File extension for TechCalc files will be always .JSON, and the file will be download to the "Download folder" with name "TechCalc-project.json".

E.3 DATABASE ACCESS AND MANAGE

TechCalc database is an opened database, what means that you can create or delete your own Catalogs and Products. Catalogs and products set by default (ISOVER) are protected and you won't be able neither to edit them, nor to delete them.

Not only products can be managed but Materials, Mediums, Claddings, Climates and Thermal Bridges can be managed as well.

To access the database, just click on the symbol.  . Once you have clicked on this icon you will arrive to the database screen.



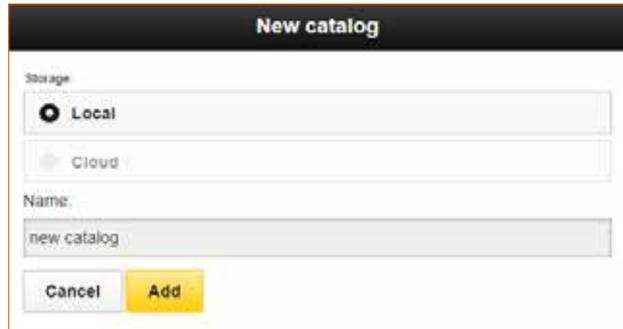
MATERIAL

Materials are split in three concepts: Catalogs, Products and Thickness (mm). A 'Catalog' is a compound of several products grouped by a concept. You can create as many Catalogs as you may need.

To create a new Catalog, click on .



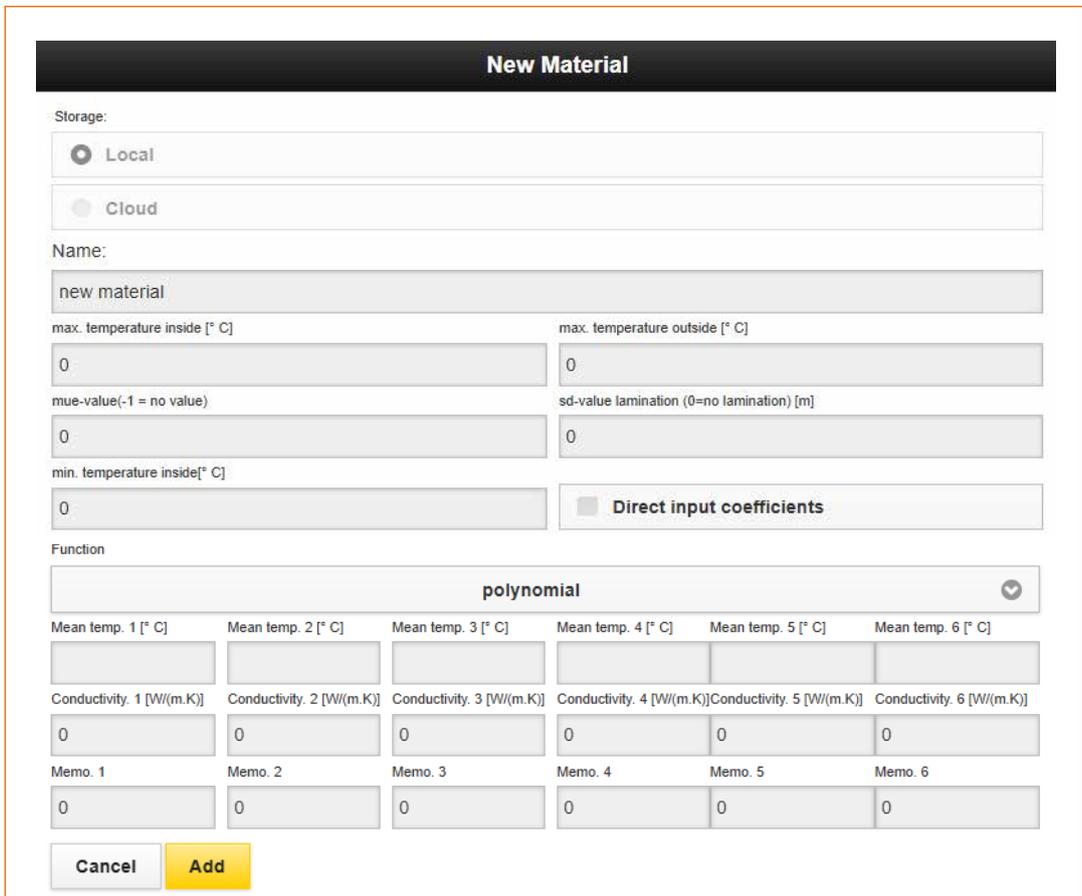
A new Catalog will appear and you will have to name it:



Once the Catalog is named, click on 'Add'. The new Catalog will be part of the Catalogs list.

This new Catalog is now empty, but you can create as many Products as you want inside this new created Catalog.

To create a product, you can repeat the steps for creating a Catalog but clicking on . A new dialog box will appear with the different parameters that characterized a product from the insulation point of view:



The fields you have in this screen are:

Name: Name you want to give to this new Product. (Mandatory field).

Max temperature inside (°C): This is what is usually called MST (Maximum Service Temperature) and it is the maximum temperature to what the insulation can be exposed in contact with the hottest part of your system. (Mandatory field).

Max temperature outside (°C): This is the maximum temperature your product can endure in the outer face. This is a limitation for those products using a facing that could be damaged, unglued, etc. in case of exceeding this temperature. In case of no facing, this temperature will be the same than the 'Max temperature inside °C'. (Mandatory field).

Mue-value: This is the water vapor resistance factor of your product. This value is only used in case of using the calculation method for 'Moisture accumulation on a cooling component'. The most common values for insulation materials given in ISO 10456 are:

Material	Water vapour resistance factor μ	
	dry	wet
Expanded polystyrene	60	60
Extruded polystyrene foam	150	150
Polyurethane foam, rigid	60	60
Mineral wool	1	1
Phenolic foam	50	50
Cellular glass	∞	∞
Perlite board	5	5
Expanded cork	10	5
Wood wool board	5	3
Wood fibreboard	5	3
Urea-formaldehyde foam	2	2
Spray applied polyurethane foam	60	60
Loose-fill mineral wool	1	1

Sd-value: This is the equivalent air layer thickness of your material/facing. As the 'Mue-value', it is just used in case of using the calculation method for 'Moisture accumulation on a cooling component'. Some examples of these values are also given in ISO 10456.

Product/material	Water vapour diffusion-equivalent air layer thickness s_d m
Polyethylene 0,15 mm	50
Polyethylene 0,25 mm	100
Polyester film 0,2 mm	50
PVC foil	30
Aluminium foil 0,05 mm	1 500
PE-foil (stapled) 0,15 mm	8
Bituminous paper 0,1 mm	2
Aluminium paper 0,4 mm	10
Breather membrane	0,2
Paint - emulsion	0,1
Paint - gloss	3
Vinyl wallpaper	2

NOTE 1 The water vapour diffusion-equivalent air layer thickness of a product is the thickness of a motionless air layer with the same water vapour resistance as the product. It is an expression of resistance to diffusion of water vapour.

NOTE 2 The thickness of the products in Table 5 is not normally measured and they can be regarded as very thin products with a water vapour resistance. The table quotes nominal thickness values as an aid to the identification of the product.

Min temperature inside (°C): This is an optional value to set a limit in the minimum temperature that your product can be exposed to.

Function: To create the Temperature vs Lambda values curve, TechCalc allows you to select the mathematical interpolation method you want to use.

You can select among this two methods: Constant or Polynomial

We recommend to always use the 'polynomial' approach because it is the most common approach to create a grade 3 polynomial function and it is the way how it is done in different recognized standards, as VDI 2055 or AGI Q 132.

Use "Constant" for materials as steel, aluminium, iron, concrete, etc.

Mean Temp (°C): There are 6 fields for mean temp in °C. Each of them will part of the 'pair' Temperature - Lambda value (Conductivity). (Mandatory fields). With only 4 values are enough to characterize the insulation material.

Conductivity (W/mK): There are 4 fields for conductivity in W/mK. Each of them will part of the 'pair' Temperature - Lambda value (Conductivity). With only 4 values are enough to characterize the insulation material.

Coefficient: In some specific cases instead of providing the ‘pairs’ Temperature - Lambda value, you can provide directly the polynomial coefficients.
This would be the coefficients corresponding to the polynomial function:

$$\lambda(\theta) = a_0 + a_1 \cdot \theta + a_2 \cdot \theta^2 + a_3 \cdot \theta^3$$

In case you introduce ‘pairs’ Temperature - Lambda values, once you have filled in the values, you must click on ‘Add’ .

Memo: In any of the 6 memo fields available you can write whatever information you consider important or interesting linked to your product (DoP code, Commercial information, etc.).

Once you have filled in, at least the mandatory fields, you can click on ‘Add’ and the product will be added to the product list inside your Catalog.

For deleting, either a Catalog or a Product, you just have to click on the symbol on the right. A dialog box will now appear to confirm you really want to delete it:

Delete entry?

Are you sure you want to delete this entry?
This action cannot be undone.

Cancel
Delete

MEDIUM

Steps for creating or deleting a Medium are exactly the same than for Products. What is now different are the technical parameters that define the Medium:

Medium information ▲

Fluid
Gaseous

Density [kg/m³]

Heat capacity [kJ/kgK]

Conductivity [W/m K]

Pressure [Pa]

Temperature [°C]

✎ Update

CLADDING

Steps for creating or deleting a Cladding are exactly the same than for Products. What is now different are the technical parameters that define the Cladding:



The screenshot shows a form titled "Cladding information" with the following fields and values:

Field	Value
Emissivity	0.13
Radiation coefficient CH	3.1
Radiation coefficient CV	3.3

All fields are mandatory.

CLIMATE

Steps for creating or deleting a Climate condition are exactly the same than for Products. What is now different are the technical parameters that define the Climate condition:

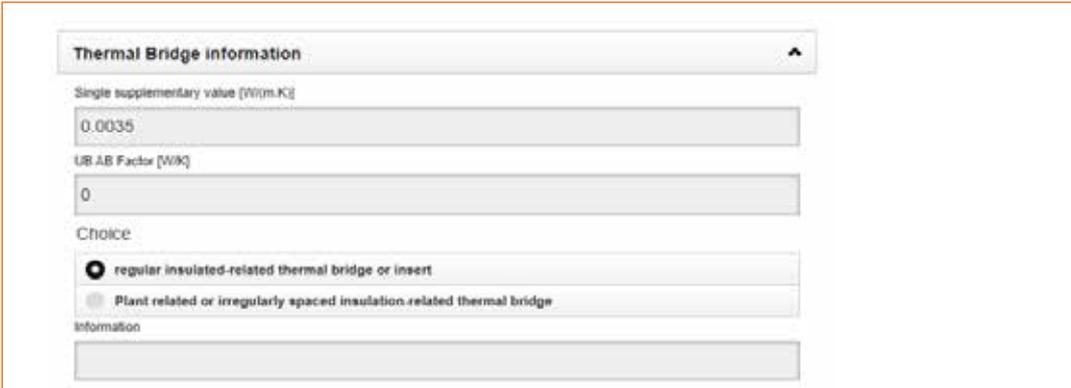


The screenshot shows a form titled "Climate information" with the following fields and values:

Field	Value
Ambient temperature [°C]	24
Relative humidity outside [%]	65
Wind [m/s]	0

THERMAL BRIDGE

Steps for creating or deleting a Thermal Bridge are exactly the same than for Products. What is now different are the technical parameters that define the Thermal Bridge:



The screenshot shows a form titled "Thermal Bridge information" with the following fields and values:

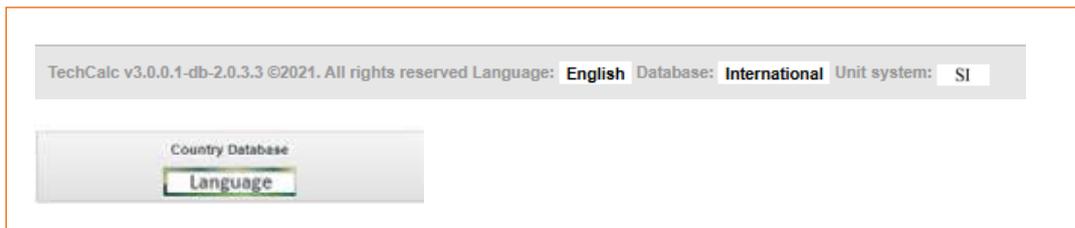
Field	Value
Single supplementary value [W/(m.K)]	0.0035
UB AB Factor [W/K]	0
Choice	<input checked="" type="radio"/> regular insulated-related thermal bridge or insert <input type="radio"/> Plant related or irregularly spaced insulation-related thermal bridge
Information	

In this case the only mandatory field is the 'Single supplementary value [W/ (mK)]' that is the value that will be used for the calculations.

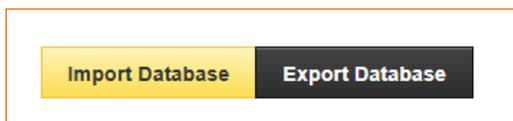
Values for 'UB AB Factor [W/K]' or the multiple choice field 'Choice' will be ready in future versions. These values are linked with the German standard VDI 4610. Information value can be filled in but is just an information field with no influence in the calculations.

DATABASE LANGUAGE

You can change Database Language you are working with. You have always the current active Database Language in the bottom part of your screen or in the part of database access:



Any new item you create (Material, Medium, Cladding or Thermal Bridge) will be saved only in our local database. It is necessary to save your changes in "Export database". To work again with your modified database, you must select "Import database" to work with it.



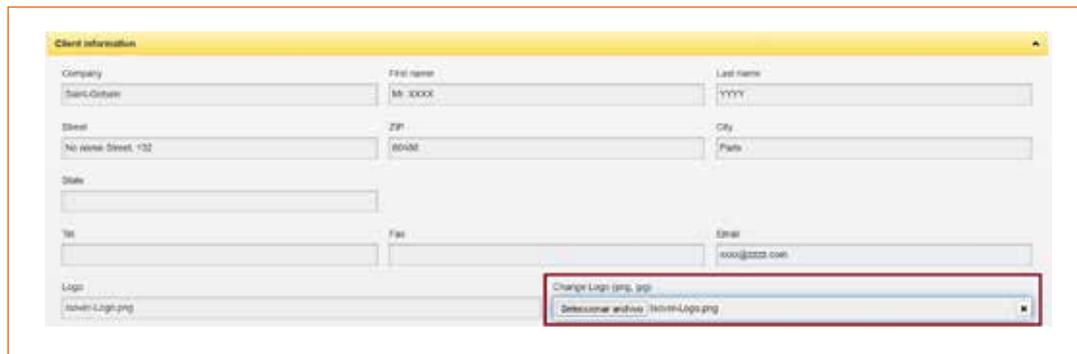
E.4 PERSONALIZE YOUR REPORT

With this feature you can set the information linked to your project (Project and Client information). For customizing your report click on symbol. 

Next screen will be shown:

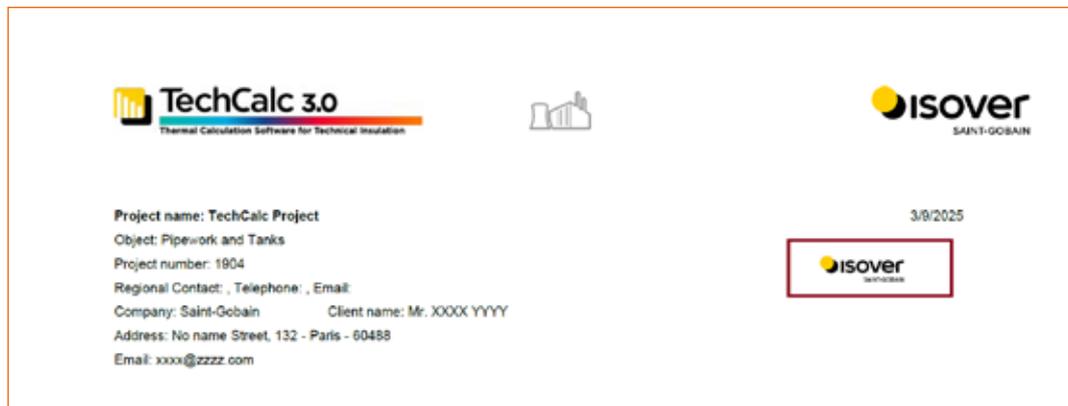


No fields are mandatory in this section. You can fill in whatever fields related to the information you want to appear later on in your report. As an example, we show you here how the final report will look like depending on what you have filled in.



Just as a remark, you can choose any image file you want to place a logo in your report.

Once you have filled in the different fields, click on 'Save' button and then press 'Back'.
With these entries, this is what you will find in header of your PDF report:



Note that the chosen logo will appear in the shadowed area of the image above.
Some additional information (Release) is available in this section, but you cannot edit it:



Change log: Documentation of new program versions with bug-fixes and new functions.
Calculation log: List of error and warning messages of the calculations.

E.5 CHANGE LANGUAGE OR DATABASE

For changing the software language see b3.- Language selection.

For changing database see e3.- Database access and manage.

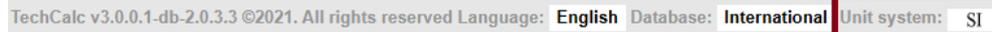
You can always change either the software language or database through the bottom ribbon in your screen by just clicking either in the Language or the Database Language:



TechCalc v3.0.0.1-db-2.0.3.3 ©2021. All rights reserved Language: **English** Database: **International** Unit system: **SI**

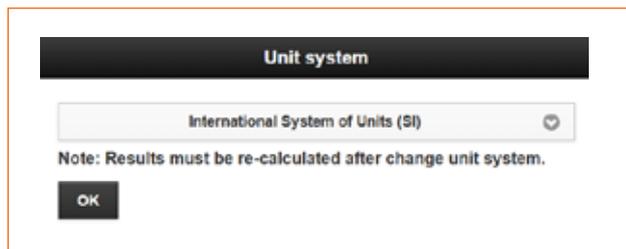
E.6 CHANGE UNITS

You can choose the units you want to use between two choices: SI (International System units) or IP (Imperial System units)



TechCalc v3.0.0.1-db-2.0.3.3 ©2021. All rights reserved Language: **English** Database: **International** Unit system: **SI**

By just clicking in the area pointed out with the arrow, a pop up message will appear:



Select the system you want to use and units will be change in all the different steps of the software. See how it looks like regarding results when you select 'Imperial System' units:

Summary of results (Versions)

	Uninsulated	Version 1	Comparison
Heatflow (Heatloss)	4,041.47 BTU/(ft h)	81.65 BTU/(ft h)	3,959.82 BTU/(ft h)
Heatflow (Area insulated)	2,330.09 BTU/(ft² h)	24.13 BTU/(ft² h)	7,326.34 BTU/(ft² h)
Total heatflow	19,889,133.94 BTU/h	401,834.07 BTU/h	19,487,299.88 BTU/h
T-surface	407.40 °F	82.10 °F	

Examples of different steps using IP units:

TechCalc 3.0 - Thermal Calculation Software for technical insulation

1 Components | 2 Calculation Methods | 3 Results | 4 Units | 5 Insulation System

Name: Pipe Component No. 1

Length (ft): 492.25

Diameter (inches): 158

Area of uninsulated surface (ft²): 2455.53

Pipe material: Steel (20)

Outside diameter (inches): 6.625

Insulated area of surface (ft²): 19191.527

Calculation standard: ISO 12241 (2004), VDI 2066 (2006), ASTM C 890 (2016), ISO 12241 (2022)

Select an orientation: Horizontal outdoor

Pipe Component No. 1

Heat transfer and surface properties

Length: 492.25 ft | Diameter: 6.625 in | Orientation: Horizontal outdoor

Material: 10200 °F | Insulation System: Version 1 | ISO-Plus Insulation RT 4.0

TechCalc 3.0 - Thermal Calculation Software for technical insulation

1 Components | 2 Calculation Methods | 3 Results | 4 Units | 5 Insulation System

Name: Pipe Component No. 1

Temperature (inches): 158 °F

Pressure (psi): 1000.00 psi

Heat capacity (Btu/lb°F): 0.12 Btu/lb°F

Conductivity (W/m·K): 0.07 W/m·K

Density (lb/ft³): 490.00 lb/ft³

Velocity (ft/s): 10.00 ft/s

Pipe Component No. 1

Heat transfer and surface properties

Length: 492.25 ft | Diameter: 6.625 in | Orientation: Horizontal outdoor

Material: 10200 °F | Insulation System: Version 1 | ISO-Plus Insulation RT 4.0

F. CALCULATION EXAMPLES

In this chapter you will find some real problems found in industrial/marine/ HVAC sites and how they have been solved by using TechCalc.

EXAMPLE 1: INDUSTRY



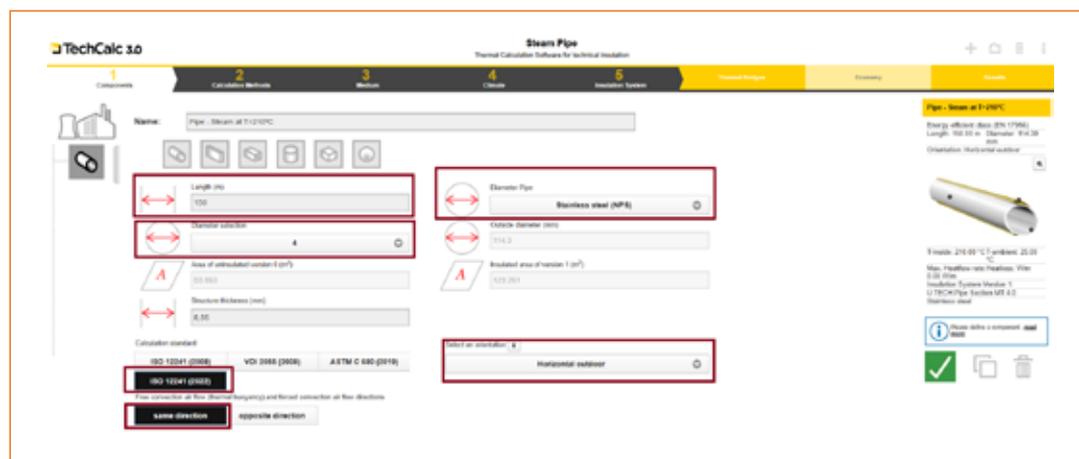
A comparison between two different insulation solutions wants to be carried out in a steam pipe with the next characteristics:

- › 150 ml of pipe \varnothing 4" of Stainless Steel NPS – Horizontal Outdoor (*)
- › Fluid: Steam at 210°C, 19 bar pressure, and 25 m/s of velocity of steam
- › Climate Conditions: Ambient temperature 25°C & 5 m/s wind speed
- › Insulation solutions to be compared:
 - › Version 1: U Tech Pipe Section MT 4.0 of 60 mm thick + oxidized aluminium cladding
 - › Version 1: U Tech Pipe Section MT 4.0 of 100 mm thick + oxidized aluminium cladding

Calculation: Heat losses, Surface temperatures, Energy Efficiency class for 2 versions of insulation.

Steps to solve the problem:

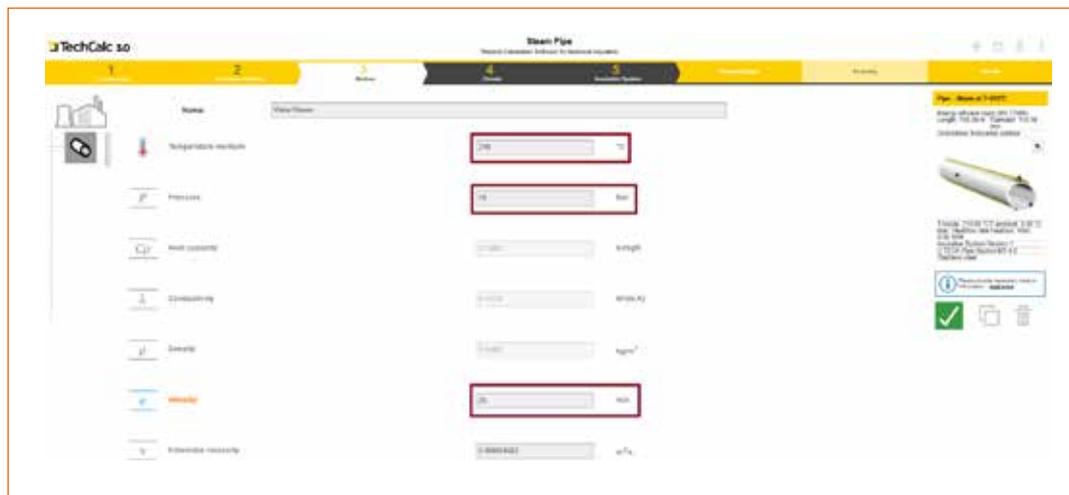
1) Define the component inside TechCalc. (See Chapter C.1- Components – Pipes)



(*). Please consider: ISO Standard 12241: 2002 and same direction for free convection air flow and forced convection air flow directions.

2) Choose the calculation Method. (See Chapter C2)

- Click Known Insulation Thickness
- Click on Heat loss/gain and surface temperature/condensation & Energy efficient class (EN 17956)



3) Define the characteristics of the medium / fluid. (See Chapter C3)

- Select medium type and choose water/steam, and fill in all data such as Steam temperature, pressure and velocity



4) Define Climate conditions. (See Chapter C4)



5) Define 2 versions of Insulation System. (See Chapter C5)



6) Output results. (See Chapter D)

Summary of results (Versions)

	Uninsulated	Version 1	Version 2	Comparison
Heatflow (Heatloss)	2,828.29 W/m	72.89 W/m	52.01 W/m	20.88 W/m
Heatflow (Area insulated)	7,876.36 W/m²	99.03 W/m²	52.68 W/m²	46.35 W/m²
Total heatflow	424,243.78 W	10,933.96 W	7,882.18 W	3,131.79 W
T-surface	204.78 °C	28.34 °C	26.92 °C	
Energy efficient class (EEC)	G	D	B	
Max. heatflow		79.90 W/m	56.79 W/m	



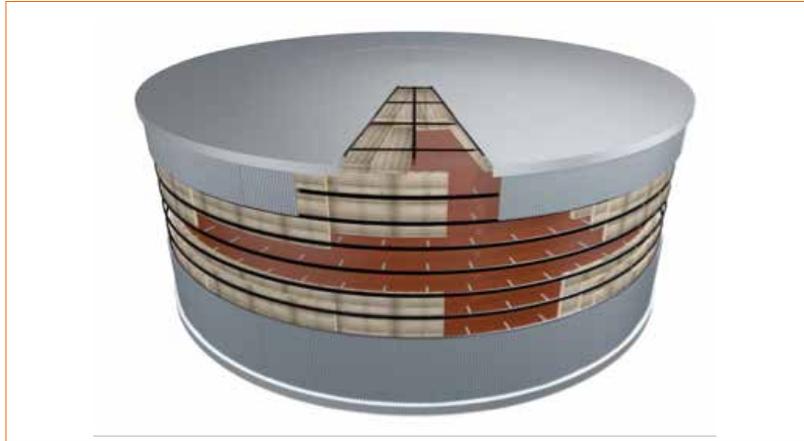
Version 1
**U TECH Pipe Section MT 4.0 - 60 mm -
 Energy efficiency Class D**



Version 2
**U TECH Pipe Section MT 4.0 - 100 mm -
 Energy efficiency Class B**

Total Heat flow savings Version 2 vs Version 1: **3.131,79 W**

EXAMPLE 2: INDUSTRY

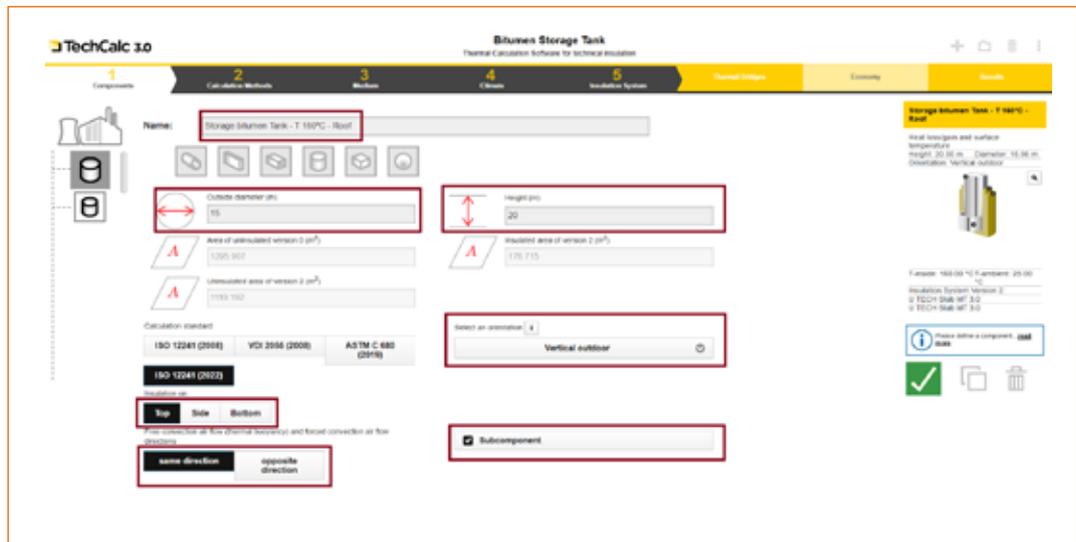


A comparison between two different insulation solutions wants to be carried out in an Asphalt storage tank with the next characteristics:

- › Asphalt storage tank \varnothing 15 m and 20 meters height – Vertical Outdoor (*)
- › Fluid: Heat capacity : 2,2 kJ/kgK; Conductivity : 0.20 W/(m.K); Density : 1020 kg/m³
- › Climate Conditions: Ambient temperature 25°C & 5 m/s wind speed
- › Insulation solutions to be compared:
 - › **For Roof:**
 - Version 1: 2 layers of TECH Lamella Mat MT 2.0 of 100 mm thick + oxidized aluminium cladding
 - Version 2: 2 layers of U TECH Slab MT 3.0 0 of 100 mm thick + oxidized aluminium cladding
 - › **For Wall:**
 - Version 1: 2 layers of TECH Crimped Roll 2.0 of 100 mm thick + oxidized aluminium cladding
 - Version 2: 2 layers of U TECH Wired Mat MT 4.0 of 100 mm thick+ oxidized aluminium cladding

Calculation: Total Heat losses and Surface temperatures for 2 versions of insulation.
Steps to solve the problem:

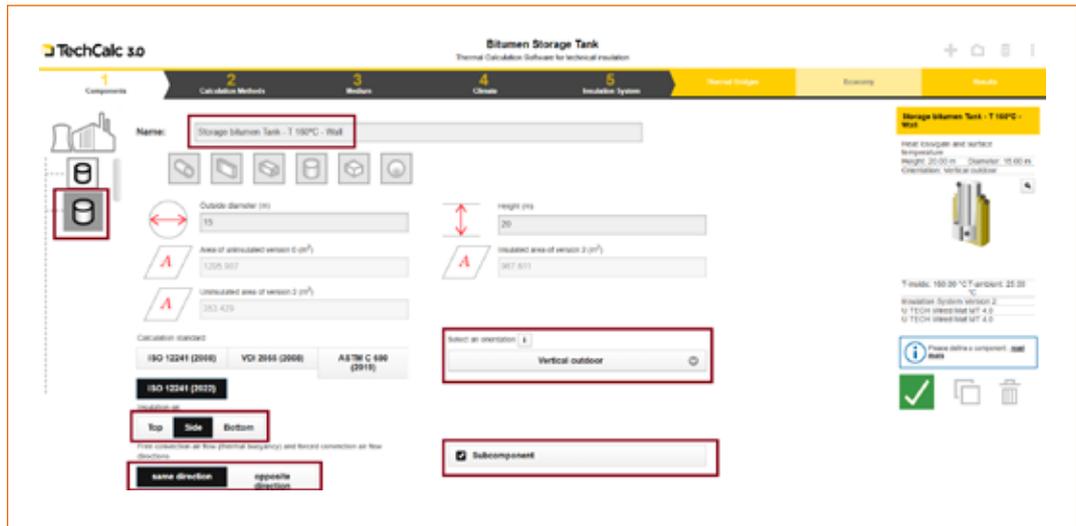
1) Define the component inside TechCalc. See Chapter C.1- Components – Cylinders)



(*). Please consider: ISO Standard 12241: 2002 and same direction for free convection air flow and forced convection air flow directions.

Choose Cylinder component, define name and the insulation on top (For roof) and click subcomponent.

Copy the same component with same characteristics to define Wall of Tank



Define name and the insulation on side (For wall) and click subcomponent.

If you click on subcomponent, it is possible to choose different insulation solutions for each subcomponent, and in the project summary you can visualize the Heat losses of different subcomponents and the total heat losses for whole tank (roof + wall)

2) Choose the calculation Method. (See Chapter C2)

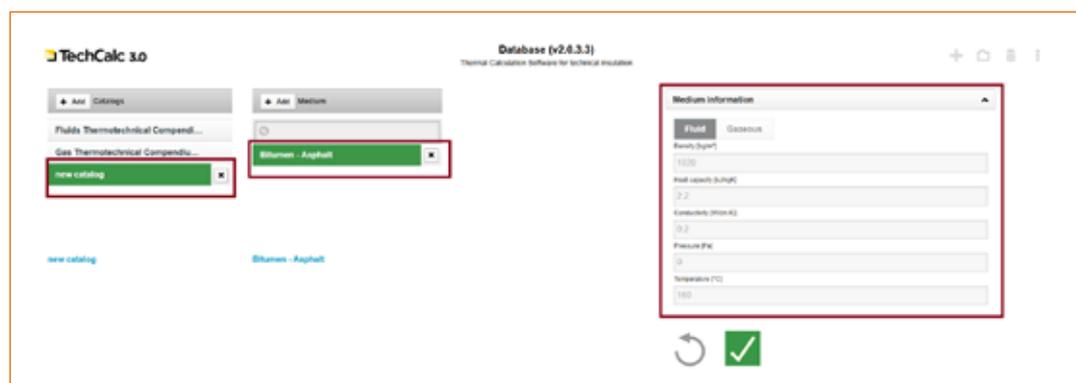
- Click Known Insulation Thickness
- Click on Heat loss/gain and surface temperature/condensation

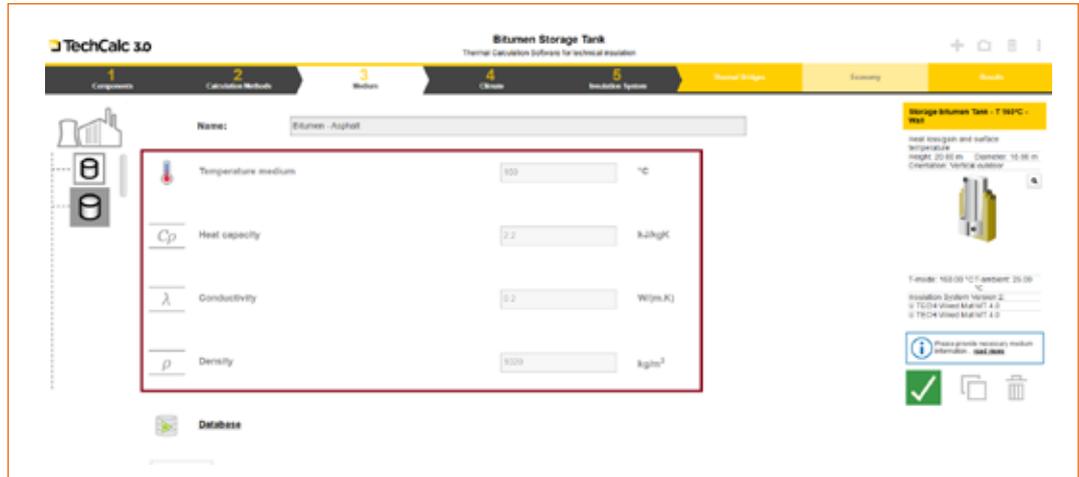
3) Define the characteristics of the medium / fluid. (See Chapter C3)

→ Create a new medium: Bitumen / Asphalt with next properties:

- Heat capacity : 2,2 kJ/kgK
- Conductivity : 0.20 W/(m.K)
- Density : 1020 kg/m³

Create a new medium in a new catalog





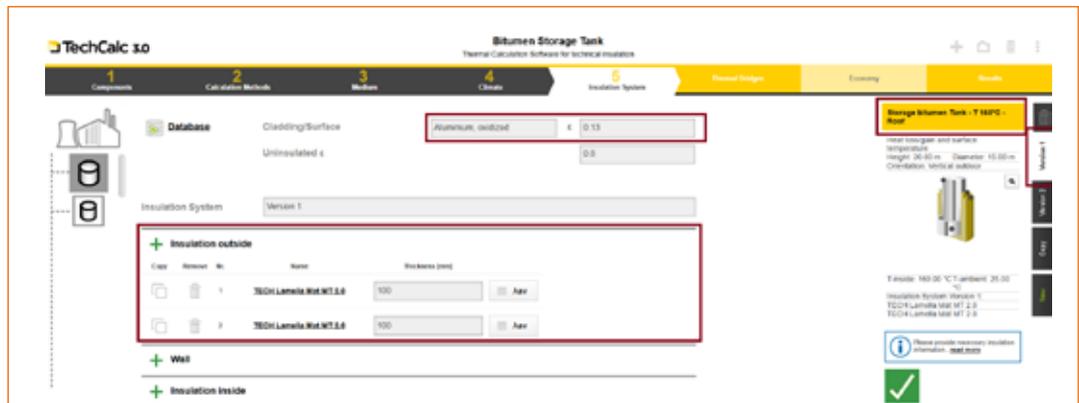
4) Define Climate conditions. (See Chapter C4)



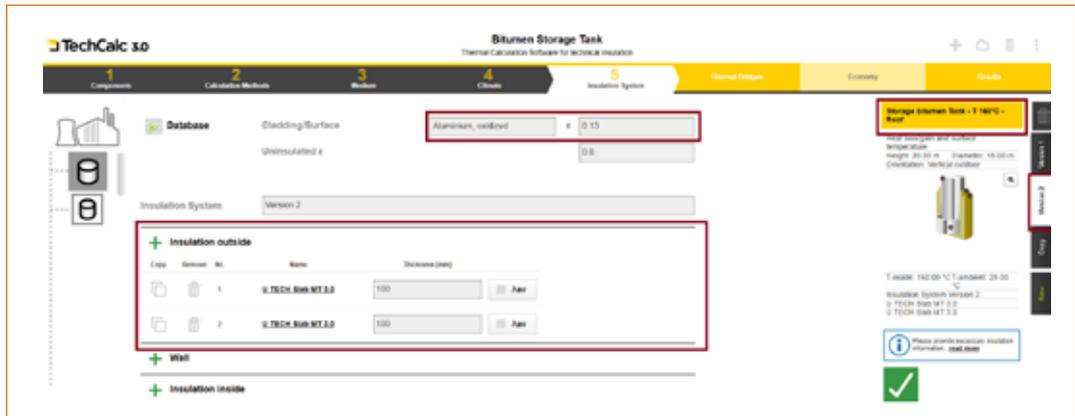
5) Define 2 versions of Insulation System for each subcomponent. (See Chapter C5)

For Roof:

VERSION 1: 2 layers of TECH Lamella Mat MT 2.0 of 100 mm thick + oxidized aluminium cladding

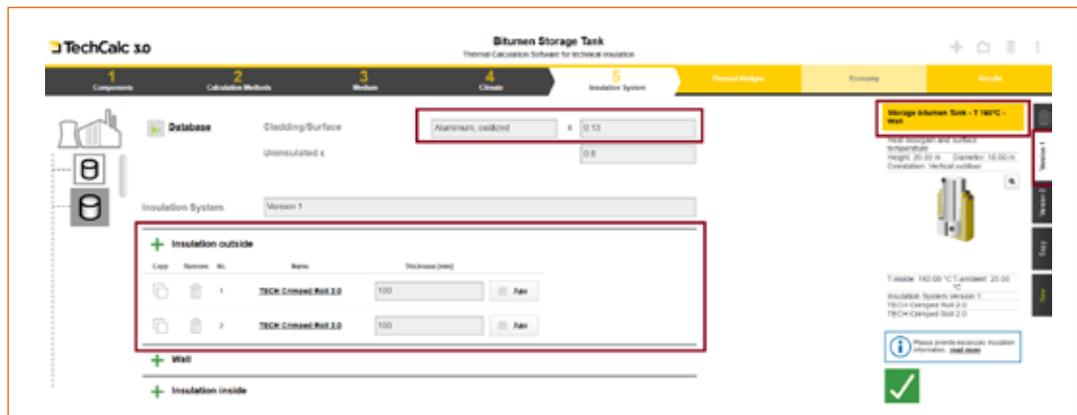


VERSION 2: 2 layers of U TECH Slab MT 3.0 of 100 mm thick + oxidized aluminium cladding

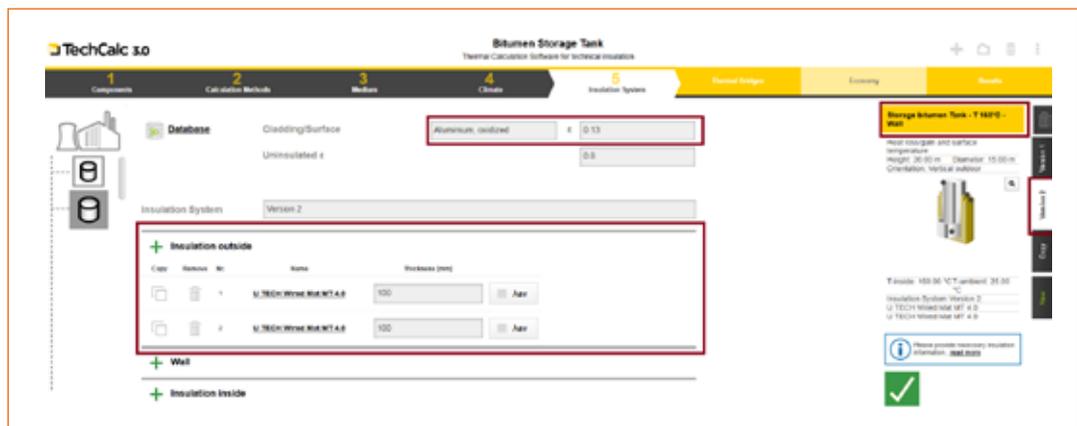


For Wall

VERSION 1: 2 layers of TECH Crimped Roll 2.0 of 100 mm thick + oxidized aluminium cladding



VERSION 2: 2 layers of U TECH Wired Mat MT 4.0 of 100 mm thick+ oxidized aluminium cladding



6) Output results. (See Chapter D)

For Roof:

Summary of results (Versions)				
	Uninsulated	Version 1	Version 2	Comparison
Heatflow (Heatloss)	2,469.20 W/m²	35.21 W/m²	29.68 W/m²	5.53 W/m²
Heatflow (Area insulated)	2,469.20 W/m²	35.21 W/m²	29.68 W/m²	5.53 W/m²
Total heatflow (Insulated area)	0.00 W	6,222.02 W	5,244.71 W	977.30 W
T-surface	159.88 °C	28.16 °C	27.66 °C	

For Wall

Summary of results (Versions)				
	Uninsulated	Version 1	Version 2	Comparison
Heatflow (Heatloss)	2,469.20 W/m²	34.39 W/m²	28.60 W/m²	5.80 W/m²
Heatflow (Area insulated)	2,469.20 W/m²	33.50 W/m²	27.85 W/m²	5.65 W/m²
Total heatflow (Insulated area)	0.00 W	32,415.85 W	26,951.65 W	5,464.20 W
T-surface	159.88 °C	28.08 °C	27.56 °C	

Project Summary
For Version 1 (Active)

Project Summary						
Component	Subcomponent	Version	Active	Total heatflow (Insulated area)	Total heatflow (Uninsulated area)	Total heatflow
Storage bitumen Tank - T 150°C - Roof	Yes	Version 1	Yes	6,222.02 W		
		Version 2	No		5,244.71 W	
Storage bitumen Tank - T 150°C - Wall	Yes	Version 1	Yes	32,415.85 W		
		Version 2	No		26,951.65 W	
Sum (only active versions)				38,637.86 W	3,636,192.02 W	3,674,829.89 W
Sum (Subcomponents only active versions)				38,637.86 W		

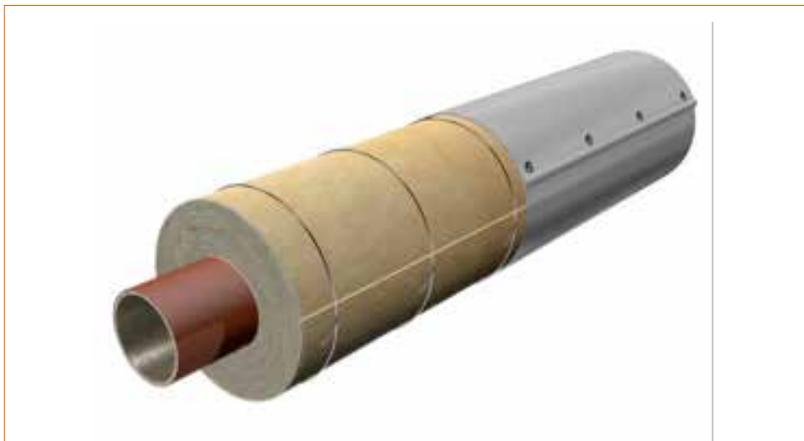
For Version 2

Project Summary						
Component	Subcomponent	Version	Active	Total heatflow (Insulated area)	Total heatflow (Uninsulated area)	Total heatflow
Storage bitumen Tank - T 150°C - Roof	Yes	Version 1	No			
		Version 2	Yes		5,244.71 W	
Storage bitumen Tank - T 150°C - Wall	Yes	Version 1	No	32,415.85 W		
		Version 2	Yes		26,951.65 W	
Sum (only active versions)				32,196.36 W	3,636,192.02 W	3,668,388.39 W
Sum (Subcomponents only active versions)				32,196.36 W		

Total Heatflow saving Version 2 versus Version 1 :

38.637,86 W - 32.196,36 W = 6.441,50 W

EXAMPLE 3: INDUSTRY



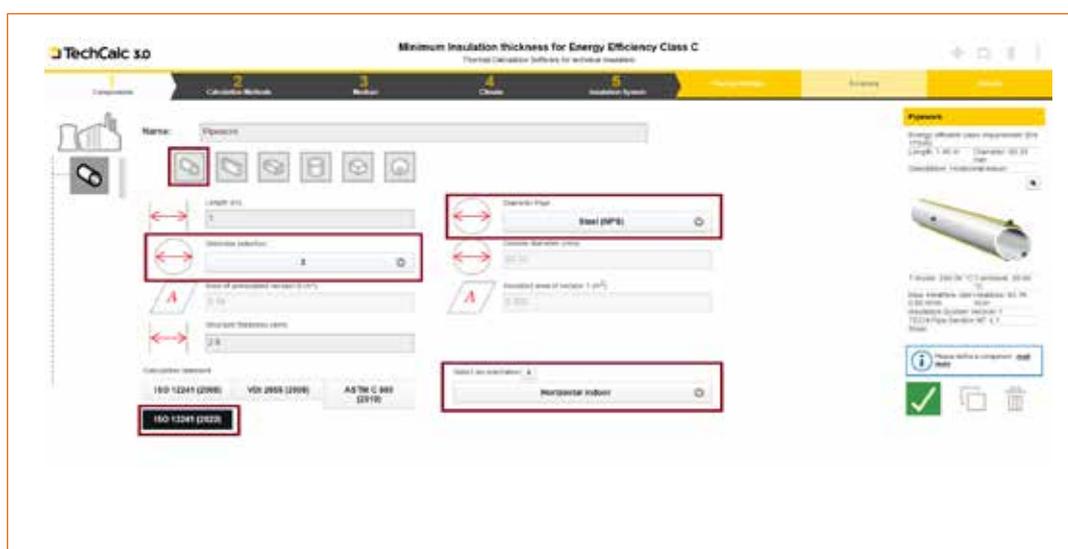
Calculate the minimum insulation thickness for all diameters of Steel NPS to comply Energy efficiency class C according to En 17956:

- › 1 ml of pipe Ø 2" of Steel NPS - Horizontal Indoor (*)
- › Fluid: Standard Fluid at 250°C; hi-Value: ∞ W/(m²K)
- › Climate Conditions: Ambient temperature 25°C
- › Insulation solutions to be compared:
 - Version 1: TECH PIPE SECTION MT 4.1

Calculation: Minimum insulation thickness to be Energy efficiency class C

Steps to solve the problem:

1) Define the component inside TechCalc. (See Chapter C.1- Components - Pipes)

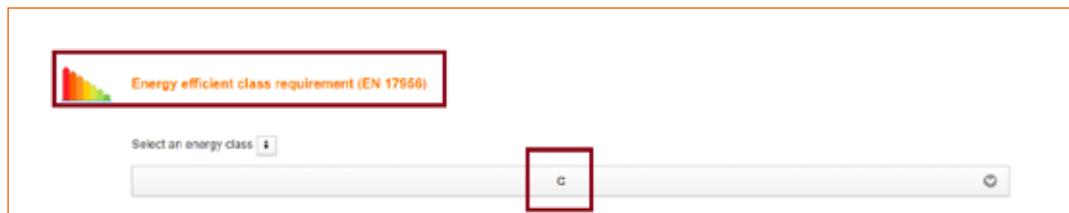


(*) Please consider: ISO Standard 12241: 2002.

2) Choose the calculation Method. (See Chapter C2)

→ Click Minimum Insulation Thickness

→ Click on requirement Energy efficient class (EN 17956). Select Class C



3) Define the characteristics of the medium / fluid. (See Chapter C3)

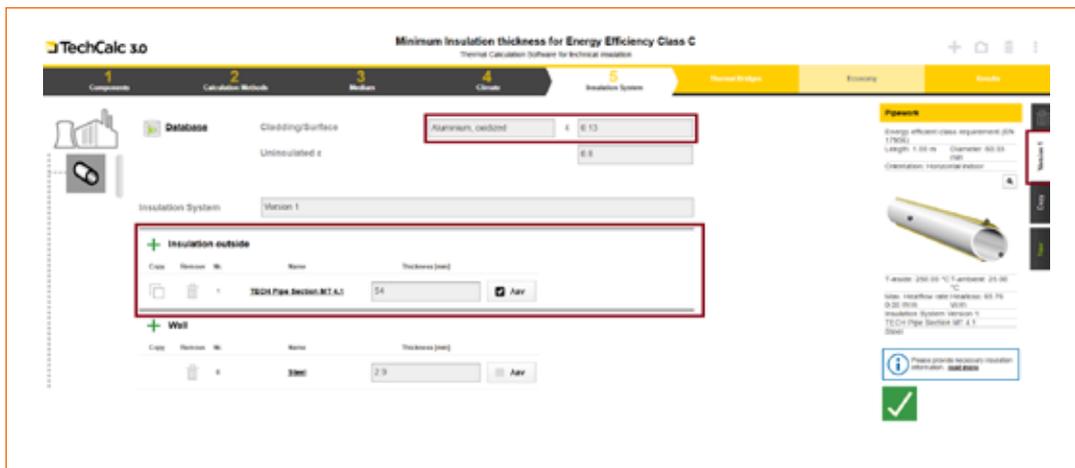
→ Select standard fluid with temperature at 250°C



4) Define Climate conditions. (See Chapter C4)



5) Define 1 version of Insulation System. (See Chapter C5)



6) Output results. (See Chapter D)

In Summary Results appear the results of the chosen diameter of Pipe (2")For Wall

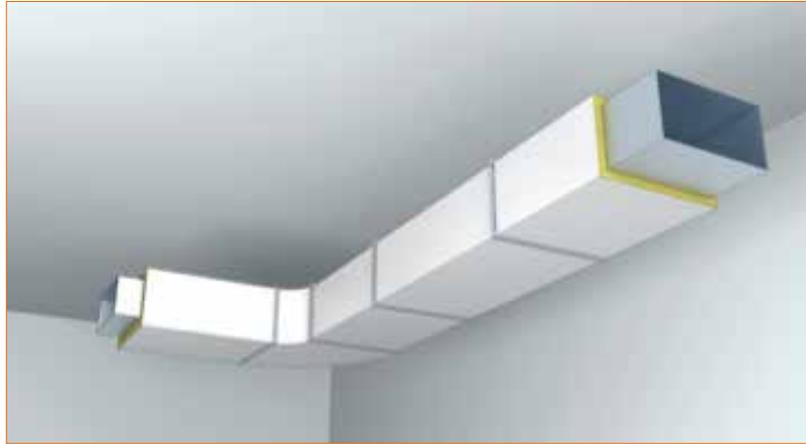
Summary of results (Versions)			
	Uninsulated	Version 1	Comparison
Minimum insulation thickness (Total)		54 mm	
Heatflow (Heatloss)	943.77 W/m	65.76 W/m	878.01 W/m
Heatflow (Area insulated)	4,967.21 W/m²	124.31 W/m²	4,842.90 W/m²
Total heatflow	943.77 W	65.76 W	878.01 W
T-surface	249.70 °C	48.61 °C	
Energy efficient class (EEC)	G	C	
Max. heatflow	66.31 W/m	66.31 W/m	

Results of all diameters (Version 1)

Table will contain all minimum insulation thicknesses (with 5 mm intervals); heat flow rate and Max. Heat flow rate for all diameters of pipes to comply with energy efficiency class C for the established requirements

Results of all diameters (Version 1)								
Selection	Diameter	Heatflow	Heatflow (Area insulated)	Max. heatflow	T-surface	Thickness	Up to next 5mm	To nearest 5mm
1/8	10.29 mm	49.51 W/m	458.38 W/m²	51.12 W/m	81.80 °C	12.00 mm	15 mm	10 mm
1/4	13.72 mm	51.29 W/m	356.19 W/m²	51.87 W/m	73.22 °C	16.00 mm	20 mm	15 mm
3/8	17.15 mm	52.50 W/m	291.66 W/m²	52.87 W/m	67.21 °C	20.00 mm	20 mm	20 mm
1/2	21.34 mm	53.44 W/m	238.55 W/m²	54.22 W/m	61.75 °C	25.00 mm	25 mm	25 mm
3/4	26.67 mm	55.45 W/m	203.85 W/m²	56.00 W/m	58.05 °C	30.00 mm	30 mm	30 mm
1	33.40 mm	57.54 W/m	173.83 W/m²	58.21 W/m	54.66 °C	36.00 mm	40 mm	35 mm
1 1/4	42.16 mm	60.81 W/m	153.57 W/m²	60.98 W/m	52.28 °C	42.00 mm	45 mm	40 mm
1 1/2	48.26 mm	62.76 W/m	142.31 W/m²	62.83 W/m	50.93 °C	46.00 mm	50 mm	45 mm
2	60.33 mm	65.76 W/m	124.31 W/m²	66.31 W/m	48.61 °C	54.00 mm	55 mm	55 mm
2 1/2	70.03 mm	70.14 W/m	111.66 W/m²	70.53 W/m	46.93 °C	62.00 mm	65 mm	60 mm
3	80.90 mm	73.35 W/m	103.74 W/m²	73.78 W/m	45.86 °C	68.00 mm	70 mm	70 mm
3 1/2	101.60 mm	76.60 W/m	98.48 W/m²	76.83 W/m	45.13 °C	73.00 mm	75 mm	75 mm
4	114.30 mm	79.45 W/m	93.59 W/m²	79.75 W/m	44.43 °C	78.00 mm	80 mm	80 mm
5	141.30 mm	85.48 W/m	86.26 W/m²	85.62 W/m	43.39 °C	87.00 mm	90 mm	85 mm
6	168.26 mm	91.02 W/m	80.84 W/m²	91.09 W/m	42.99 °C	95.00 mm	95 mm	95 mm
7	193.68 mm	95.80 W/m	76.70 W/m²	95.87 W/m	41.95 °C	102.00 mm	105 mm	100 mm
8	219.08 mm	100.60 W/m	73.59 W/m²	100.63 W/m	41.48 °C	108.00 mm	110 mm	110 mm
10	273.05 mm	109.73 W/m	68.07 W/m²	109.95 W/m	40.61 °C	120.00 mm	120 mm	120 mm
12	323.85 mm	117.66 W/m	64.15 W/m²	118.17 W/m	39.98 °C	130.00 mm	130 mm	130 mm
14	355.69 mm	122.87 W/m	62.50 W/m²	123.11 W/m	39.72 °C	135.00 mm	135 mm	135 mm
16	406.49 mm	130.41 W/m	59.96 W/m²	130.67 W/m	39.30 °C	143.00 mm	145 mm	145 mm
18	457.20 mm	137.87 W/m	57.95 W/m²	137.95 W/m	38.96 °C	150.00 mm	150 mm	150 mm
20	508.00 mm	144.67 W/m	56.03 W/m²	144.98 W/m	38.63 °C	157.00 mm	160 mm	155 mm
22	558.80 mm	151.62 W/m	54.54 W/m²	151.78 W/m	38.38 °C	163.00 mm	165 mm	165 mm
24	609.60 mm	158.08 W/m	53.10 W/m²	158.41 W/m	38.13 °C	169.00 mm	170 mm	170 mm
28	711.00 mm	170.43 W/m	50.85 W/m²	171.15 W/m	37.70 °C	180.00 mm	180 mm	180 mm
32	813.09 mm	183.04 W/m	48.91 W/m²	183.44 W/m	37.40 °C	189.00 mm	190 mm	190 mm
36	914.00 mm	195.13 W/m	47.49 W/m²	195.18 W/m	37.14 °C	197.00 mm	200 mm	195 mm

EXAMPLE 4: HVAC



In a building's heating and cooling system, a rectangular steel air duct (1 mm thick) with a cross-sectional area of 300 × 200 mm (width × height) is used. Determine the required thickness of ClimCover Roll Alu2 (30 mm or 50 mm thick) insulation to ensure that:

- › Heat losses do not exceed 5 W/ml in winter.
- › Heat gains do not exceed 5 W/ml in summer.

Additionally, the insulation must prevent condensation outside the duct due to humidity. To be verified.

Operating Conditions

› Winter:

- Supply air temperature: 25 °C.
- Ambient temperature: 20 °C

› Summer:

- Supply air temperature: 20 °C
- Ambient temperature: 25 °C, relative humidity: 75%

› Air velocity inside duct: 5 m/s

Steps to solve the problem:

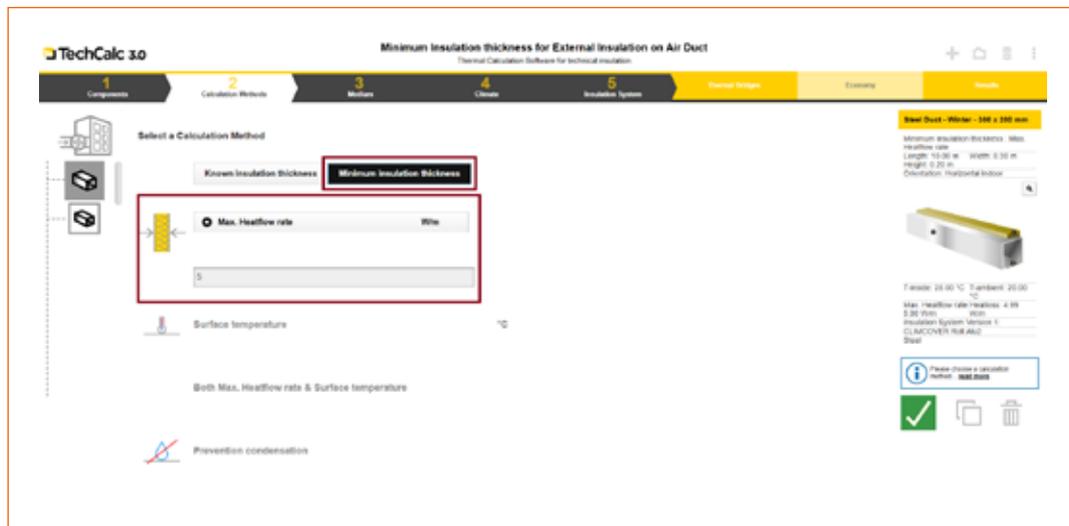
1) Define the component inside TechCalc. (See Chapter C.1- Components – Duct)
Choose HVAC market, and introduce the data of the air duct and winter conditions.



(*) Please consider: ISO Standard 12241: 2002.

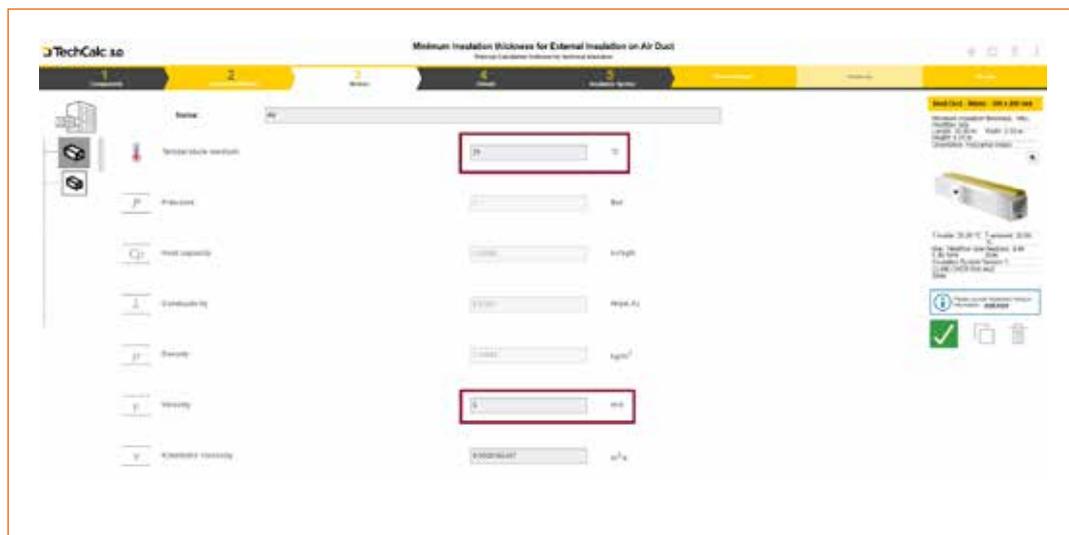
2) Choose the calculation Method. (See Chapter C2)

→ Click minimum Insulation Thickness for Heat loss



3) Define the characteristics of the medium / fluid. (See Chapter C3)

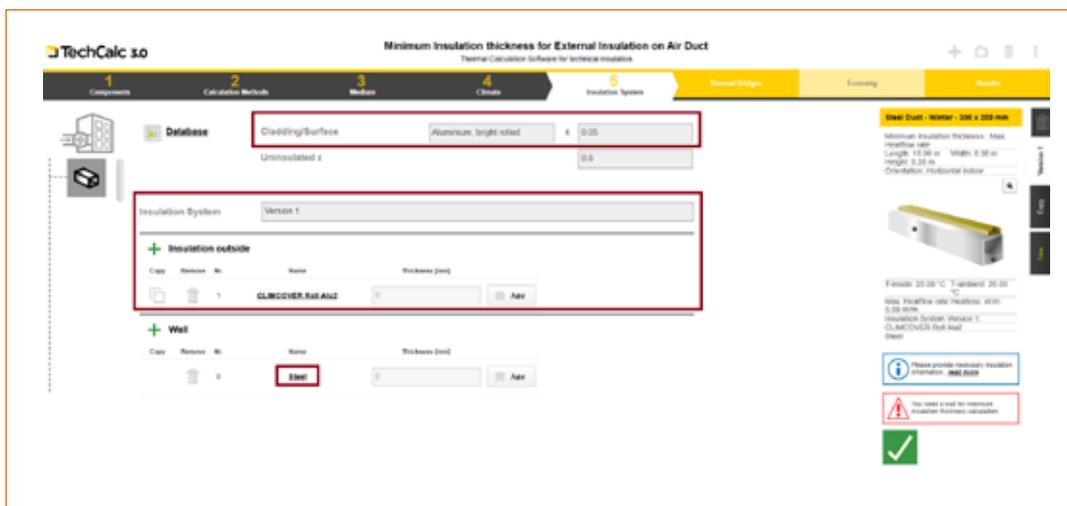
→ Select medium type and choose air, and fill in all data such as temperature and velocity



4) Define Climate conditions. (See Chapter C4)



5) Define 1 version of Insulation System. (See Chapter C5) and include the thickness of the steel duct (1 mm):



6) Output results. (See Chapter D)

Summary of results (Versions)			
	Uninsulated	Version 1	Comparison
Minimum insulation thickness (Total)		21 mm	
Heatflow (Heatloss)	23.86 W/m	4.99 W/m	18.87 W/m
Heatflow (Area insulated)	23.86 W/m²	4.28 W/m²	19.59 W/m²
Total heatflow	238.64 W	49.94 W	188.71 W
T-surface	23.50 °C	22.04 °C	

Results: Minimum Insulation thickness for ClimCover Roll Alu2 is 21 mm, and then We will propose 30 mm thick.
 It will be necessary to recalculate for 30 mm thick of ClimCover Roll Alu2 to determine the final reached Heat loss for Winter conditions.

Summary of results (Versions)			
	Uninsulated	Version 1	Comparison
Heatflow (Heatloss)	23.81 W/m	4.16 W/m	19.65 W/m
Heatflow (Area insulated)	23.81 W/m²	3.35 W/m²	20.46 W/m²
Total heatflow	238.08 W	41.56 W	196.52 W
T-surface	23.50 °C	21.69 °C	

Next Steps: Verify the minimum insulation thickness for summer conditions and verify for prevention condensation outside. Please, note that you have to introduce: -5 W/ml por Max Heat flow rate.

Output results for summer:

Summary of results (Versions)			
	Uninsulated	Version 1	Comparison
Minimum insulation thickness (Total)		21 mm	
Heatflow (Heatgain)	-24.10 W/m	-4.98 W/m	19.13 W/m
Heatflow (Area insulated)	-24.10 W/m²	-4.26 W/m²	19.84 W/m²
Total heatflow	-241.02 W	-49.77 W	191.25 W
T-surface	21.50 °C	22.97 °C	

For prevention condensation outside: at least 1 mm of insulation solution

Summary of results (Versions)			
	Uninsulated	Version 1	Comparison
Minimum insulation thickness (Total)		3 mm	
Dewpoint temperature outside	21.31 °C	21.31 °C	
Heatflow (Heatgain)	-24.10 W/m	-9.26 W/m	14.84 W/m
Heatflow (Area insulated)	-24.10 W/m²	-9.04 W/m²	15.06 W/m²
Total heatflow	-241.02 W	-92.59 W	148.43 W
T-surface	21.50 °C	21.33 °C	

It will be necessary to recalculate for 30 mm thick of ClimCover Roll Alu2 to determine the final reached Heat loss for Summer conditions.



	Uninsulated	Version 1	Comparison
Dewpoint temperature outside	21.31 °C	21.31 °C	
Heatflow (Heatgain)	-24.05 W/m	-4.14 W/m	19.90 W/m
Heatflow (Area insulated)	-24.05 W/m²	-3.34 W/m²	20.70 W/m²
Total heatflow	-240.46 W	-41.43 W	199.03 W
T-surface	21.50 °C	23.32 °C	

EXAMPLE 5: HVAC



In a building's air conditioning system, a rectangular Climaver Neto duct with a cross-sectional area of 400 × 300 mm (width × height) is used. Determine the minimum insulation thickness to prevent condensation outside under next site conditions:

Operating Conditions

› Summer:

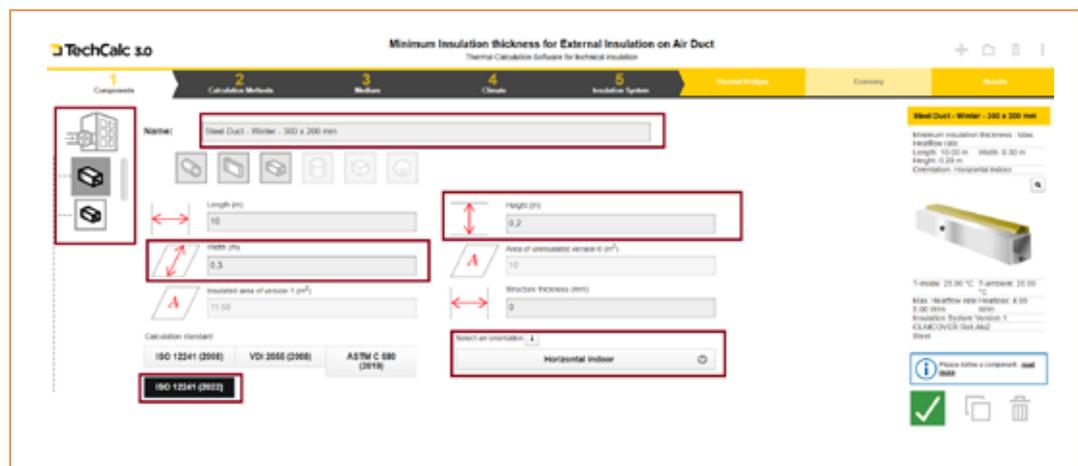
- Supply air temperature: 12 °C
- Ambient temperature: 30 °C, relative humidity: 75%

› Air velocity inside duct: 5 m/s

Steps to solve the problem:

1) Define the component inside TechCalc. (See Chapter C.1- Components – Duct)

Choose HVAC market and introduce the data of the Climaver duct and summer conditions.



(*). Please consider: ISO Standard 12241: 2002.

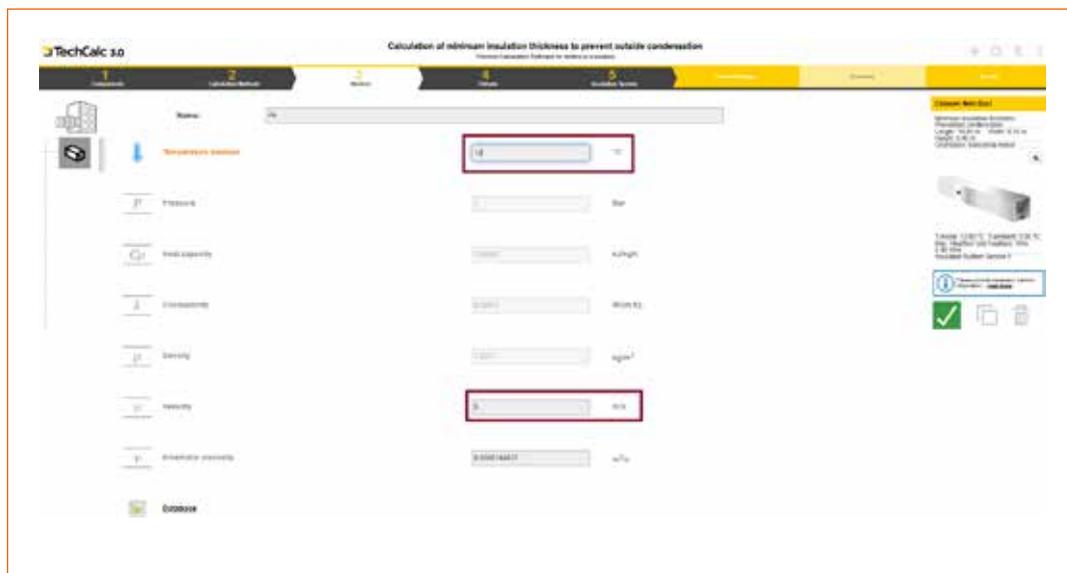
2) Choose the calculation Method. (See Chapter C2)

→ Click minimum Insulation Thickness for condensation outside



3) Define the characteristics of the medium / fluid. (See Chapter C3)

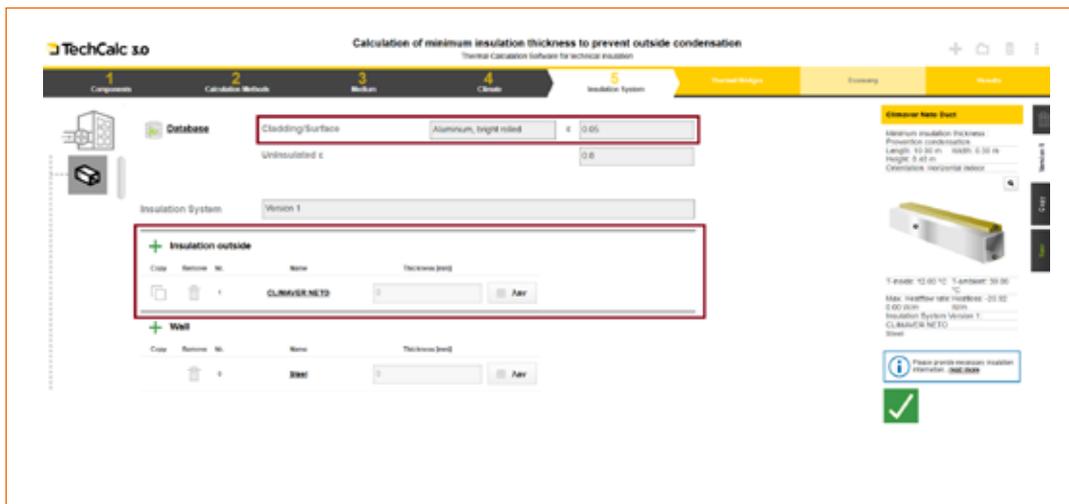
→ Select medium type and choose air, and fill in all data such as temperature and velocity



4) Define Climate conditions. (See Chapter C4)



5) Define 1 version of Insulation System. (See Chapter C5) and include the thickness of the steel duct (1 mm):



6) Output results. (See Chapter D)

The screenshot shows the 'Results' window for 'Version 1'. It lists various thermal parameters for a configuration with 29 mm of CLIMAVER NETO insulation. The dewpoint temperature outside is 25.08 °C, and the maximum relative humidity is 75.32%. Heatflow values are -20.92 W/m, -12.82 W/m², and -209.21 W. The surface temperature is 25.15 °C, and characteristic lengths are 0.46 m (free) and 0.00 m (forced). The wall consists of 1 layer of Steel (0 mm thick).

Version 1	
Minimum insulation thickness (Total)	29 mm
Dewpoint temperature outside	25.08 °C
Max. rel. humidity	75.32 %
Heatflow (Heatgain)	-20.92 W/m
Heatflow (insulated version area)	-12.82 W/m²
Total heatflow (Heatgain)	-209.21 W
T-surface	25.15 °C
Characteristic length (final free)	0.46 m
Characteristic length (final forced)	0.00 m
Insulation outside:	
1. CLIMAVER NETO	
Thickness: 29 mm	
Wall:	
1. Steel	
Thickness: 0 mm	

Results: Minimum Insulation thickness for Climaver Neto is 29 mm, and then We have to propose another type of Climaver to prevent condensation, for instance Climaver A2 Apta.

It will be necessary to recalculate for 40 mm thick of Climaver A2 Apta to determine the final reached Heat loss for Summer conditions.

The screenshot shows the 'Results' window for 'Version 1' with updated parameters for 40 mm of CLIMAVER A2 APTA insulation. The dewpoint temperature outside remains 25.08 °C. Heatflow values are significantly reduced to -17.01 W/m, -9.89 W/m², and -170.09 W. The surface temperature is now 26.04 °C, and the characteristic length (free) is 0.48 m. The wall configuration remains 1 layer of Steel (0 mm thick).

Version 1	
Dewpoint temperature outside	25.08 °C
Heatflow (Heatgain)	-17.01 W/m
Heatflow (insulated version area)	-9.89 W/m²
Total heatflow (Heatgain)	-170.09 W
T-surface	26.04 °C
Characteristic length (final free)	0.48 m
Characteristic length (final forced)	0.00 m
Insulation outside:	
1. CLIMAVER A2 APTA	
Thickness: 40 mm	
Wall:	
1. Steel	
Thickness: 0 mm	

EXAMPLE 6: MARINE



For the thermal insulation of exterior bulkheads, a calculation is necessary to determine the required U-values (thermal transmittance). To perform the thermal insulation calculations for both summer and winter conditions, the following ambient temperatures were used:

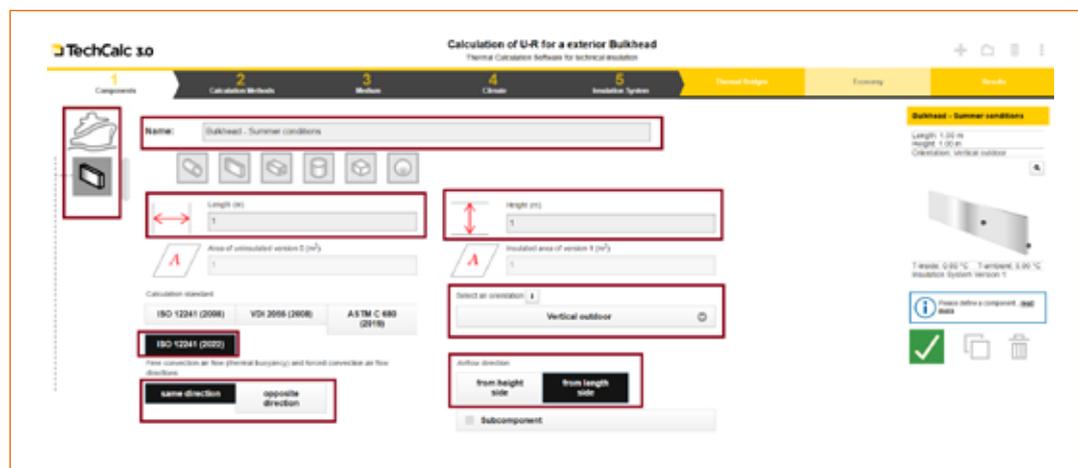
Operating Conditions

- › **Summer:** Outdoor ambient temperature: +40°C (50% humidity & 5 m/s wind speed).Indoor temperature: 21°C.
- › **Winter:** Outdoor ambient temperature: -5°C (50% humidity & 5 m/s wind speed).Indoor temperature: 24°C.
- › **Steel thickness:** 6 mm. Consider a bulkhead of 1 meter width and 1 meter height.
- › **Insulation solution:** 2 layers of 50 mm of U SeaProtect 24 AluI. First layer naked and second layer with Aluminium foil.

Steps to solve the problem:

1) Define the component inside TechCalc. (See Chapter C.1- Components – Wall)

Choose Marine market and introduce the data and summer conditions.



(*). Please consider: ISO Standard 12241: 2002 and same direction for free convection air flow and forced convection air flow directions. Airflow direction: from length side

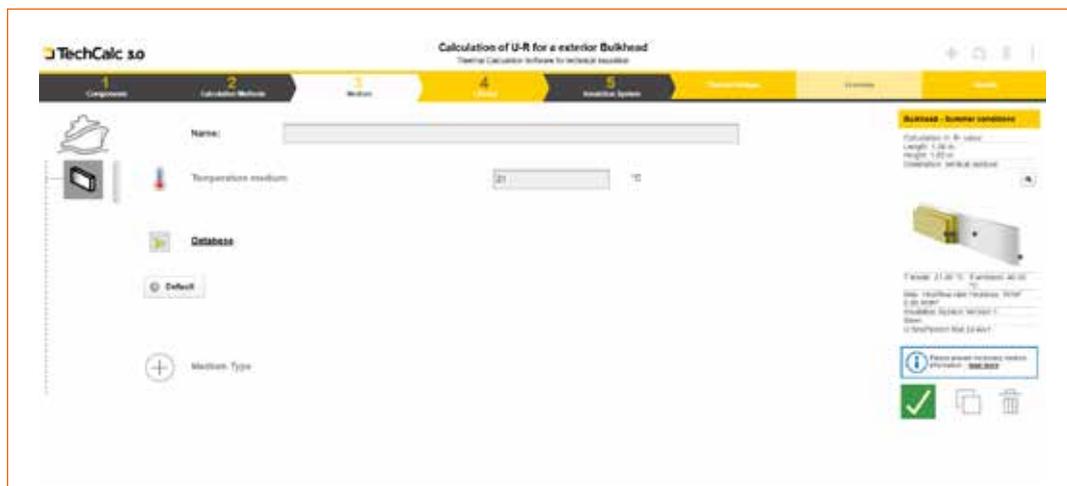
2) Choose the calculation Method. (See Chapter C2)

→ Click Known Insulation Thickness for Calculation U-R



3) Define the characteristics of the medium / fluid. (See Chapter C3)

→ Select medium type and choose air, and fill in all data such as temperature and velocity

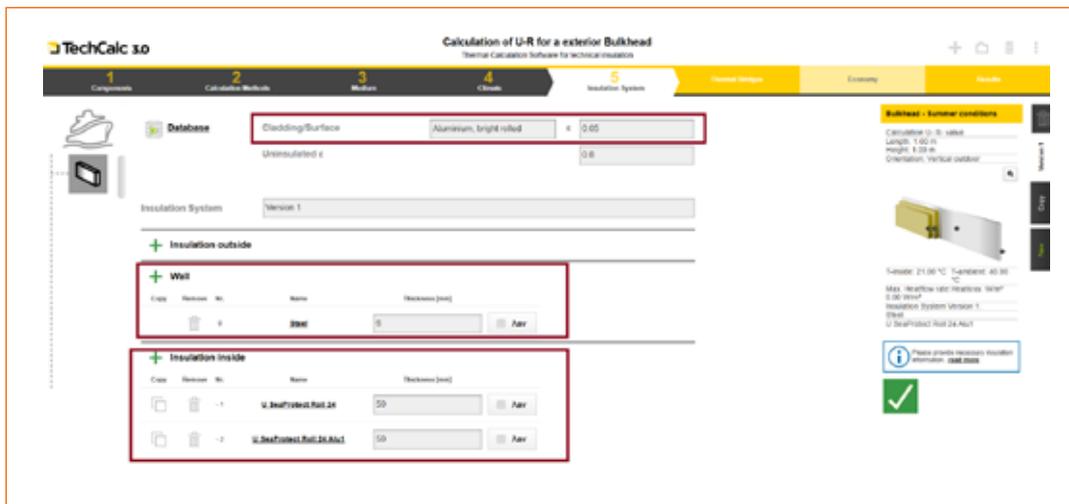


4) Define Climate conditions. (See Chapter C4)



5) Define 1 version of Insulation System. (See Chapter C5) and **and include the thickness of the steel bulkhead (6 mm):**

Please, note the insulation solution must be as Insulation inside



6) Output results. (See Chapter D)

Summary of results (Versions)			
	Uninsulated	Version 1	Comparison
U-Value		0.36 W/(m²K)	
R-Value		2.75 (m²K)/W	
Heatflow (Heatgain)	-511.56 W/m²	-6.77 W/m²	504.78 W/m²
Heatflow (Area insulated)	-511.56 W/m²	-6.77 W/m²	504.78 W/m²
Total heatflow	-511.56 W	-6.77 W	504.78 W
T-surface	21.03 °C	39.67 °C	

Results: U value: 0,36 W/m²K

Next Steps: Perform the same calculations for winter conditions

Summary of results (Versions)			
	Uninsulated	Version 1	Comparison
U-Value		0.34 W/(m²K)	
R-Value		2.94 (m²K)/W	
Heatflow (Heatloss)	772.90 W/m²	9.72 W/m²	763.18 W/m²
Heatflow (Area insulated)	772.90 W/m²	9.72 W/m²	763.18 W/m²
Total heatflow	772.90 W	9.72 W	763.18 W
T-surface	23.96 °C	-4.56 °C	

Results: U value: 0,34 W/m²K

Results without the influence of stiffeners and pins

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