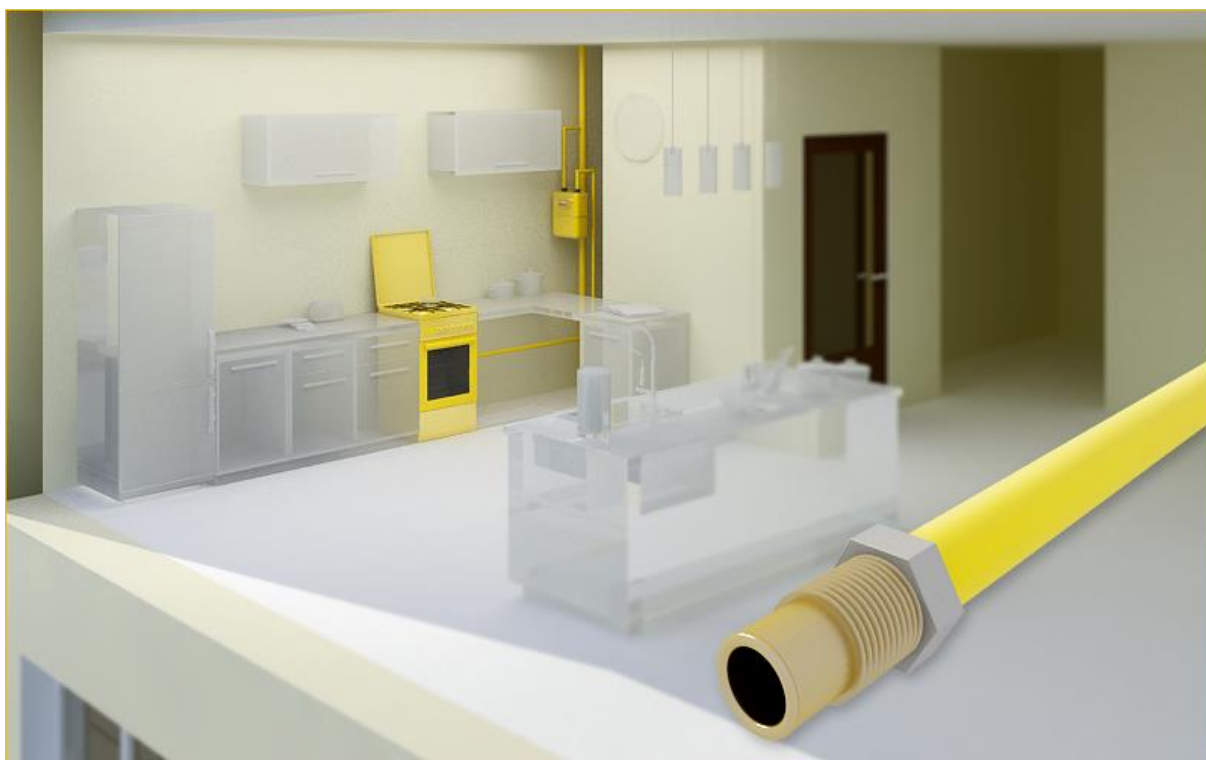


ArCADia-GAS INSTALLATIONS

ArCADia-GAS INSTALLATIONS
User Manual



2019-10-29

Introduction

Contents

1	Introduction.....	4
1.1	About.....	5
1.2	Features and functionalities of the program	5
2	Installing and running the program.....	7
2.1	Hardware requirements.....	8
2.2	Installing	8
2.3	Running.....	8
2.4	Opening a project (CAD).....	8
2.5	Saving a project (CAD)	9
2.6	Autosave and back-up copy (CAD)	10
3	Working with the software	11
3.1	Basic information about the software	12
4	Software element description.....	14
4.1	The Project Manager	15
	Adding and editing groups, managing objects	17
4.2	3D View	17
4.3	The ArCADia-GAS INSTALLATIONS toolbar.....	18
4.4	General software options.....	20
5	Describing and editing items.....	29
5.1	Introductory remarks to object edition.....	30
5.2	A gas box	39
5.3	A gas appliance.....	42
5.4	A gas valve	44
5.5	Gas meter	47
5.6	Gas filter	49
5.7	Pressure reducer	52
5.8	Vertical gas pipe	54
5.8.1	Odsunięcie równoległe.....	56
5.8.2	Wstaw pionowy odcinek	56
5.9	Vertical gas pipe	58
5.10	Editing and entering types	61
6	Selective calculations of elements	69
6.1	General assumptions for automatic selection made by the software	70

Introduction

6.2	Introducing items meant for selection.....	70
6.3	Starting the selective calculations of elements and setting the options of selective calculations.....	72
6.4	Selection criteria determination	73
7	Calculations and result interpretation	75
7.1	Verifying the validity of a drawn installation	76
7.2	Calculations	77
7.3	Calculation diagrams and reports	83
7.3.1	Gas installation extension	83
	Entire installation extension.....	83
	Installation section extension	88
7.3.2	Gas installation axonometry.....	88
	Entire installation axonometry.....	88
	Installation section axonometry.....	89
7.3.3	Lists and material lists	90

1 INTRODUCTION

Introduction

1.1 ABOUT

ArCADia-GAS INSTALLATIONS is a tool that extends INTERsoft-INTELLICAD/AutoCAD or ArCADia-START with the functionalities necessary to create professional internal gas installation designs. The software is meant both for gas network and installation designers, as well as all the people working in the sanitary branch and installations branch in the construction industry. When using the **ArCADia-GAS INSTALLATIONS** software the user has the possibility to create drawings of the internal gas installation in architectural building projections based on objects and automatically create calculation diagrams and extensions of the installations. The user may also employ a library of objects used when designing, along with an option to edit the objects and add technical parameters to them.

Apart from the option to efficiently create drawings of the installations, the software also carries out the calculations necessary for designing the installation correctly (validity checks for the assumed diameters, verifying the scope of pressure loss upstream from gas appliances), selects gas pipelines and receivers and enables drafting a professional technical report. This way it provides a perfect tool for designing internal gas installations.

1.2 FEATURES AND FUNCTIONALITIES OF THE PROGRAM

The technical scope of functionalities provided by the software and its basic functions:

- creating internal gas installation drawings in the scope of routing pipelines, shut-off fittings and gas appliances,
- creating extensions and calculation diagrams,
- determining gas flow in design sections of the gas installation,
- calculating the pressure loss in characteristic paths and comparing these to the maximum pressure loss for an installation,
- running validity checks on a designed gas installation,
- generating calculation reports,
- automatically generating a list of elements (legend) used in the project,
- generating lists of materials used in the project.

The **ArCADia-GAS INSTALLATIONS** software was developed based on the following regulations, standards and scientific and technical publications:

Legal acts:

- Regulation of the Minister of Infrastructure of 26 April 2013 on the technical conditions to be met by buildings and their locations (Polish Journal of Laws no. 75 item 690) as amended
- Ordinance of the Minister of Infrastructure of 30 July 2001 on the technical conditions to be met by gas networks and their location (Dz. U. 2013 r, poz.640).

Standards:

- PN-C-04750: 2002 – Gaseous fuels. Classification, marking and requirements.

Introduction

- PN-C-04753:2002 – natural gas. Quality of gas supplied to consumers from the local distribution system.
- PN-76/M-34034 – Pipelines. Pressure loss calculation principles.
- PN-EN 1057:2006 – Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary applications
- PN-74/H74200: 1998 - Steel pipes with seam, threaded
- PN-EN 10208-1:2009 Steel pipes for pipelines for combustible fluids - Technical delivery conditions - Part 1: Pipes Of Requirement Class A
- PN-EN 10208-2:2009 Steel pipes for pipelines for combustible fluids - Technical delivery conditions - Part 2: Pipes Of Requirement Class B
- PN-EN 10210-2:2007 - Hot finished structural hollow sections of non-alloy and fine grain steels - Part 2: tolerances, dimensions and sectional properties.

References:

- Bąkowski Konrad: Sieci i instalacje gazowe. Poradnik projektowania budowy i Wyd. III zmienione. WNT, Warsaw, 2002.
- Ryszard Zajda, Zdzisław Gebhard. Instalacje gazowe oraz lokalne sieci gazów płynnych. Projektowanie, wykonywanie, eksploatacja. Warsaw, 1995

2 INSTALLING AND RUNNING THE PROGRAM

Installing and running the program

2.1 HARDWARE REQUIREMENTS

- Pentium IV PC (PIV D recommended)
- 2GB RAM (4GB recommended)
- Approximately 1GB of free HDD space for the installation
- DirectX 9.0 compatible graphics card
- Windows Vista 32/64-bit OS, Windows 7 32/64-bit or Windows 8 32/64-bit
- DVD-ROM drive

2.2 INSTALLING

The program installation is started automatically when the CD is inserted into the CD drive. The installation should be started manually if the Autostart function is disabled. Open the CD content (Computer/CD drive), and run the Setup.exe file from the program folder. Once the installation is started, proceed according to instructions displayed on the screen.

2.3 RUNNING

The ArCADia software:

The software may be started by double-clicking on the ArCADia-START program icon located on the Desktop and then selecting one of the icons on the ribbon in the gas tab.

The AutoCAD or INTERsoft-INTELLICAD software:

The software may be started by double-clicking on the CAD program icon located on the Desktop and then selecting one of the icons in the **ArCADia-GAS INSTALLATIONS** toolbar.

2.4 OPENING A PROJECT (CAD)

Any of the following file types may be opened:

- A standard DWG drawing file.
- Any of the following sample drawings supplied with the ArCADia-START or INTERsoft-INTELLICAD software may be used.
- A DXF drawing exchange file.
- A DWF network transmission file.
- A DWT drawing template file.

In order to quickly access the last edited drawing choose File> <file name>. The software stores the names of the last four drawings. In order to quickly access a drawing from the Open drawing dialogue box, double-click the drawing name.

A drawing may be opened when browsing drawings on the computer using e.g. Windows Explorer. All you need to do to open the drawing in IntelliCAD is to double-click the file. Miniature drawings displayed when browsing facilitate the identification of the selected drawing.

Installing and running the program

Opening an existing drawing

The ArCADia software:

Use one of the following methods:


- Choose the Home ribbon and then in the Files logical group choose the Open button.



- Press the ArCADia button and then press the Open button

The AutoCAD or INTERsoft-INTELLICAD software:

Use one of the following methods:

- Choose File>Open.
- On the Standard toolbar select the Open  tool.
- Write *open* and then press Enter.

Common for the ArCADia, AutoCAD and INTERsoft-INTELLICAD software:

1. Choose the type of the file you want to open from the file type.
2. Choose the folder that contains the selected drawing.
3. Do one of the following:
 - Choose the drawing that you want to open and click Open.
 - Double-click the drawing you want to open.

If the drawing requires a password, provide the password, then click OK to verify the password and then click Open again.

2.5 SAVING A PROJECT (CAD)

A drawing may be saved at any moment.

In order to save a drawing use one of the following methods:

- On the Standard toolbar click Save.
- Choose File>Save.
- Write *save* and then press Enter.
- Write *qsave* and then press Enter.

When you save a particular drawing for the first time, the system will display a dialogue box Save drawing as, which enables you to select the folder and provide the name for the drawing. You can use any name at all when saving the drawing for the first time. In order to save the same drawing under a different name later, select File>Save as and then type in the new name.

Installing and running the program

2.6 AUTOSAVE AND BACK-UP COPY (CAD)

In order to avoid data loss in case of a power outage or another system error, it is necessary to save your drawing files often. The software may be configured to periodically save your drawings automatically. The *Autosave* setting determines the interval in minutes between automatic saves. The software resets this interval each time the user saves a drawing file (*feature available in INTERsoft-INTELLICAD and AutoCAD*).

When the *Autosave* feature is activated, the software creates copies of the drawing. This file is automatically saved to the folder provided under Options>Paths/Files>Temporary file and given the extension indicated in the Drawing autosave file extension (SV\$ by default).

Configuring INTERsoft-INTELLICAD to automatically save drawings

1. Do one of the following:
 - Select Tools>Options.
 - Write *config* and then press Enter.
2. Click the General tab.
3. In the *Autosave* area select one of the check boxes in order to enable the *Autosave* feature and select the autosave frequency.
4. Click OK.

3 WORKING WITH THE SOFTWARE

3.1 BASIC INFORMATION ABOUT THE SOFTWARE

ArCADia-GAS INSTALLATIONS allows the design of an external gas installation in the scope of determining the route of gas pipelines, location of fittings and gas appliances, as well as carrying out calculations to verify the correct selection of diameters based on an assessment of the pressure loss in the critical path and compared to the maximum pressure loss determined for the installation supplied with a particular type of gas from a HP or IP connection.

The first stage of a project is always to complete the drawing part. Inserting any gas installation item activates the software. The software was designed to ensure a flexible (free) course of action when creating a drawing.

You can start drawing any way you like:

Phase I - creating a drawing

1. Designing a gas installation may be started by defining the **Gas fuel** (type of gas) to be used for a given installation. It is at the same time completing the main gas box source element with initial parameters for the installation design: gas fuel parameters, connection parameters, installation parameters and calculation criteria.
2. Then the next building's gas "power source" element can be inserted – the **Main gas box** object. For a given element the correct type of gas should be selected, previously defined in the project settings.
3. Then you can insert the **Gas receiver** items in the architectural projection by providing them with geometric parameters, technical parameters, a gas consumption simultaneity group and assignment to the particular installation.
4. The next step is to trace the pipelines in the drawing and connecting the main box and the gas receivers with the installation (connecting elements by means of a system of gas installation pipelines). When drawing the route of pipelines in the architectural projection, the user assigns them parameters. At the same time shut-off fittings, filters and a pressure reducer need to be inserted. Elements may also be inserted with default parameters and later on, during the selection stage, indicate specific manufacturers' catalogues for selecting pipelines and shut-off fittings.
5. Once the installation is drawn you can run a validity check on the designed installation layout:
 - verifying the connection to the gas box
 - verifying the connection of all the designed items: gas receivers, shut-off fittings, measurement devices
 - verifying the continuity of the installation – connections between all the installation sections.

Phase II – calculations and material lists

1. Once drawings are ready and validity checks of the installation have been performed, the user may control and correct the assumed diameters for the design sections.
2. After clicking the **Gas installation calculations and report** icon the user generates tables that allow for choosing a calculation route including: critical one, longest one and the one with the highest load.

Working with the software

3. The user receives information on the total pressure losses, pressure recovery and pressure loss due to the difference in gas density and air density, total pressure loss, pressure upstream from the selected gas receiver.
4. Based on the calculations generated by the software the user may assess the correct selection of diameters. For each calculation path between the **main gas box** and the **gas receiver**, the software determines the unit pressure loss applicable for one meter of the calculation path, which allows the user to determine in which design section is the unit pressure loss the highest.
5. In the calculation table it is possible to introduce a new pipeline type, i.e. change the material, series of type and the diameter. After clicking the **Apply** button located in the **Gas installation report** window, all the changes introduced to the calculations table, the above-mentioned changes in the diameters will be transferred to the graphical part.
6. After confirming the correctness of the graphical part and the calculation part of the gas installation, the user may choose to generate:
 - an item list (legend) divided into symbols, number of pieces, marking, name
 - an RTF list of the materials and devices used in the project in order to allow for price estimations to be drafted for the installation.

4 SOFTWARE ELEMENT DESCRIPTION

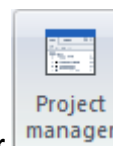
Software element description

4.1 THE PROJECT MANAGER

The **Project Manager** enables to manage all elements of the **ArCADia-GAS INSTALLATIONS** program: pipelines, fittings, receivers, etc. In order to run the **Project Manager**, select the following icon:

The ArCADia software:

- The **System** ribbon ⇒ the **Project** logical group ⇒ **Show/Hide Project Manager**



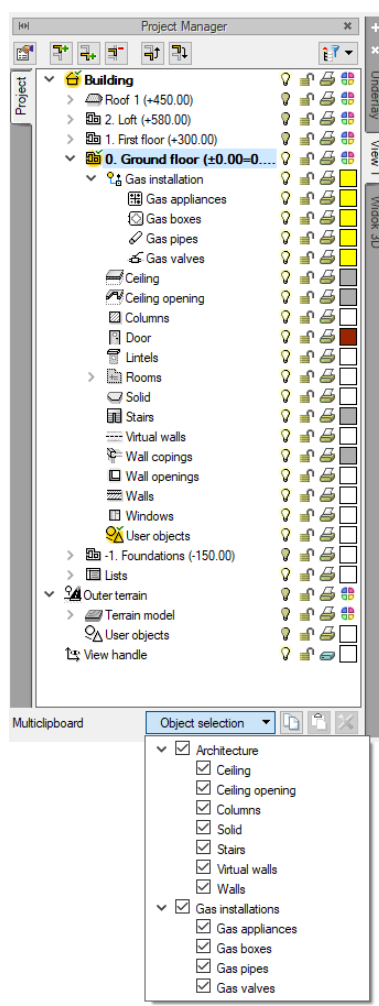
The AutoCAD or INTERsoft-INTELLICAD software:

- The **ArCADia-ARCHITECTURE** toolbar ⇒ **Show/Hide Project Manager**








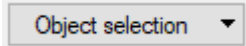
or type

- isa_tllv.



Drawing 1. The Project Manager window

Software element description

Icon	Description
	Add level above
	Add level below
	Delete level
	Move level up/down
	The View tab
	Multiclipboard/Object selection

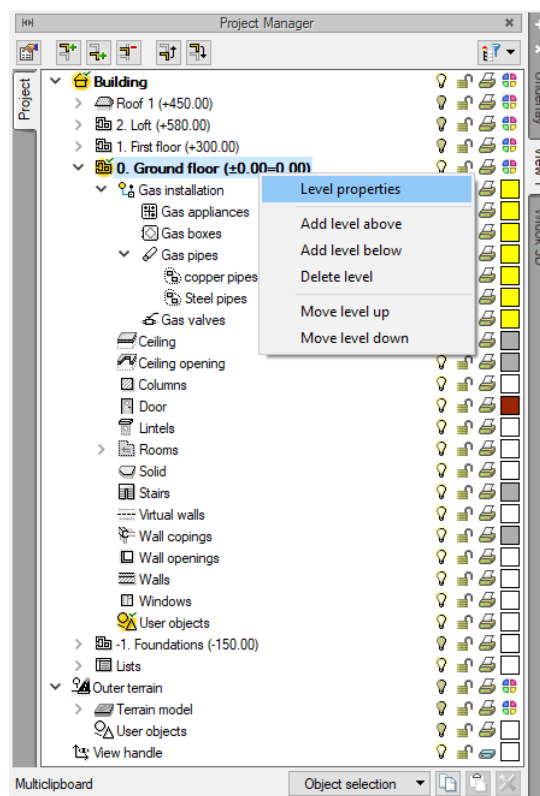
Tab. 1

Using the **Project Manager** window, the user can add and delete levels of the building or change their position in relation to each other. It is also possible to switch between views through the tabs situated to the right or to the left of the **Project Manager**.

In the **Project Manager** window, it is also possible to switch off the objects that are not necessary at the moment by pressing the shaded bulb next to an object name. After clicking the shaded padlock, the user will have no possibility to insert any changes to a given object. By clicking the printer symbol, selected objects can be turned off from printing out in the same way.

After selecting a level name in the tree in the **Project Manager** window, the **Multiclipboard** appears in the lower part of the window. It gives the user the possibility to copy objects from a given level. In order to be copied, they need to be selected in the object list. After the selection, they will be available to be pasted, e.g. into another level.

Software element description

Adding and editing groups, managing objects

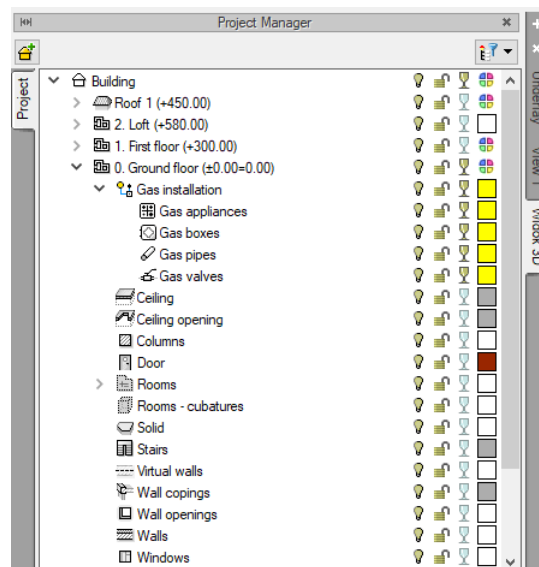
Drawing 2. The Project Manager window, managing objects

Using the window above, it is possible to change general settings for a given object group, such as the colour or the line thickness. It is also possible to select and edit the properties of all elements of a gas installation by clicking a group of objects, such as **Gas pipes/Copper**, with the right mouse button. The number of objects belonging to a group is given in [] brackets next to its name. After clicking a group with the right mouse button, the user can select the operations to be performed. Objects can be managed in the same way. In the **Manager** tree, it is possible to select e.g. all valves and to change the settings of descriptions, pens, fonts or run the renumbering, etc.

4.2 3D VIEW

Each object created in the **ArCADia-GAS INSTALLATIONS** is reflected in the 3D view. The 3D view tree is different from other views in that it gives no possibility to define object printing, as only a saved 3D image can be printed out. Instead of printing, it is possible to glaze an object using the "glass" icon next to its name.

Software element description



Drawing 3. The 3D View in the Project Manager window

To enable the 3D view, select the following icon:

The ArCADia software:

- The **System** ribbon ⇒ the **Project** logical group ⇒ **Show/Hide 3D view**



The AutoCAD or INTERsoft-INTELLICAD software:

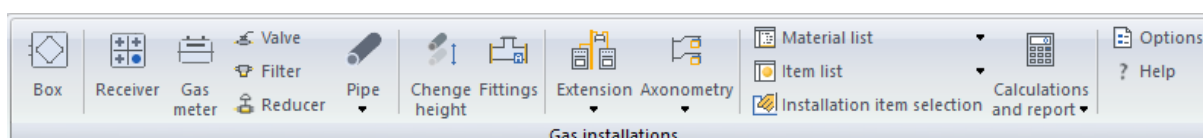
- The **ArCADia-ARCHITECTURE** toolbar ⇒ **Show/Hide 3D view**

or type

- isa_tv3d.



















The **ArCADia-GAS INSTALLATIONS** software adds its own tools to the INTERsoft-INTELLICAD/AutoCAD menu, as described in the tables below.

4.3 THE ARCADIA-GAS INSTALLATIONS TOOLBAR








Drawing 4. ArCADia-GAS INSTALLATIONS tool ribbon (*ArCADia software*)

Software element description

Drawing 5. ArCADia-GAS INSTALLATIONS toolbar (*AutoCAD or INTERsoft-INTELLICAD software*)

I	Option	Description
	Show/Hide Project Manager	Displays or hides the level management window. This feature is available in the View tab in the Show/Hide logical group.
	Show options	Enables settings the basic drawing options. This feature is available in the Home tab in the Modules logical group.
	Inserts gas box	Inserts a gas box along with a description.
	Insert gas appliance	Inserts a gas appliance along with a description.
	Insert gas valve	Inserts a gas valve along with a description.
	Insert gas meter	Inserts a gas meter along with a description.
	Insert filter	Inserts a gas filter along with a description.
	Insert gas reducer	Inserts a gas reducer along with a description.
	Inserts gas pipe	Inserts a gas pipe along with a description.
	Insert gas pipe with continuous route	Inserts a section of gas pipes along with a description.
	Insert vertical gas pipe	Inserts a vertical gas pipe along with a description.
	Change line into a gas pipe	The CAD command line inserted (dash) will be changed into a gas pipe with the given parameters.
	Change installation height	Enables changing the height of a group of objects of a gas installation.
	Gas installation extension	Generates a gas installation extension.
	Installation branch extension	Generates a gas installation branch extension.
	Gas installation axonometry	Generates a gas installation axonometry.
	Gas installation branch axonometry	Generates a gas installation branch extension.
	Insert material list*	Inserts a material lists table into the drawing.

Software element description

	Insert material list from selected elements*	Inserts a user defined material lists table into the drawing.
	Insert item list	Inserts a gas installation item list along with graphical symbols, names, markings and quantity.
	Selected items list	Inserts a user defined gas item list along with graphical symbols, names, markings and quantity.
	Gas installation calculations and report*	Displays the calculation tables and generates a report presenting the technical calculations and the validity of the designed network.
	Gas installation verification	Generates a list of erroneously designed elements.
	Selection of installation elements	Allows for automatic selection of gas installation elements.
	Help*	Displays the help window.

* Icons marked with a triangle are extendable icons that have more than one command

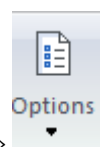
Tab. 1. Features of the **ArCADia-GAS INSTALLATIONS** toolbar

4.4 GENERAL SOFTWARE OPTIONS

To display the *ArCADia* general options dialog box, click the icon:

The ArCADia software:

- The **System** ribbon ⇒ **Modules** logical group ⇒



The AutoCAD or INTERsoft-INTELLICAD software:

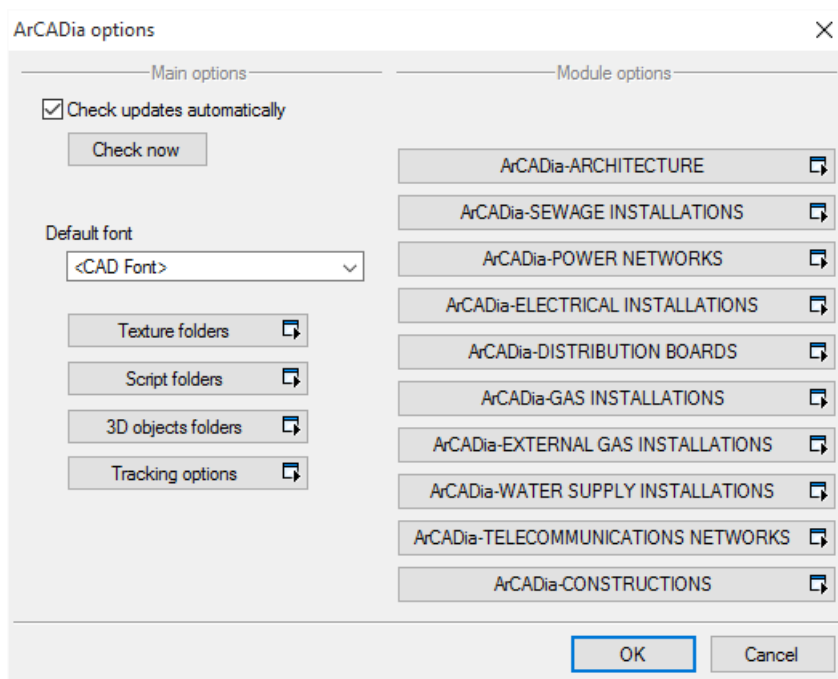
- The **System** toolbar ⇒ 

or type

- ISA_O.

This window includes the tabs of the available *ArCADia* software.

Software element description



Drawing 6. ArCADia system options window

Tracking options are displayed on the left (Drawing 7). In this window the user may define custom tracking and detection options.

The **Tracking precision** control group

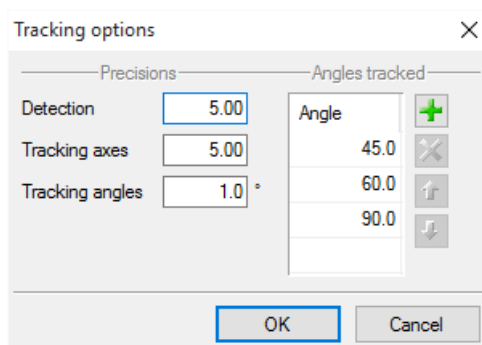
Elements – software's element detection precision (e.g. gas meter connectors)

Axes – elements' axes detection and tracking precision

Angles – detection and tracking precision of the angles set in the **Angles tracked** control.

The **Angles tracked** control group

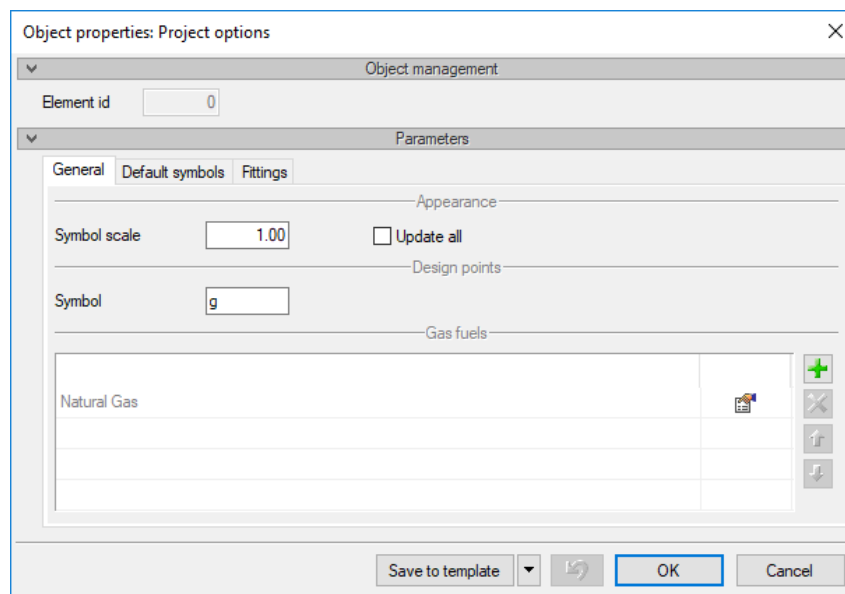
Here the user may add, using the **+** button, another item to the list of angles tracked and using the **×** button the user may remove the value of the angle tracked marked on the list. After adding an item, the total value of the angle should be input (the default value is 90.0°).



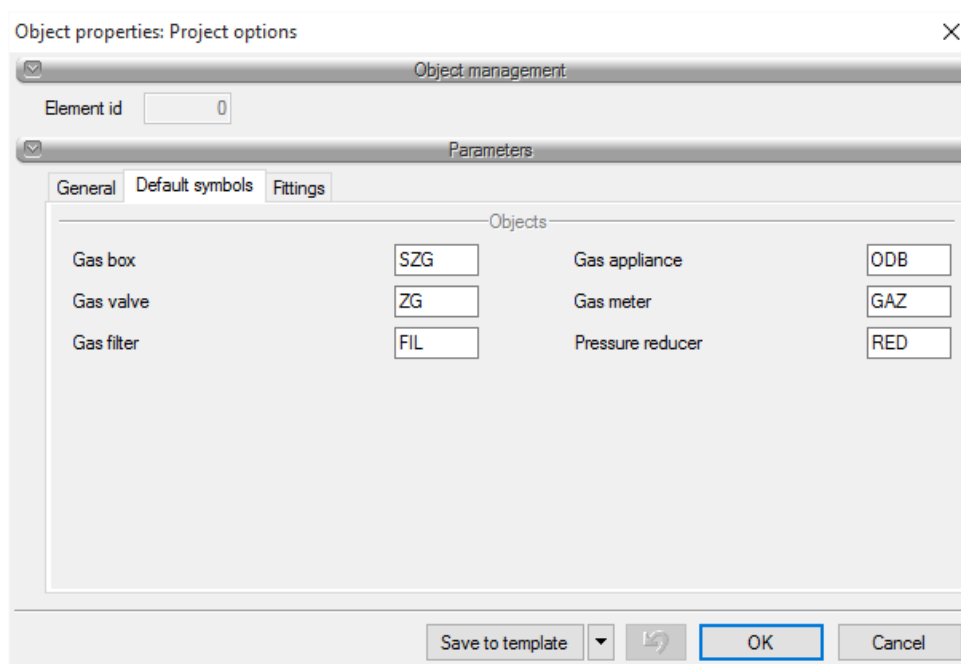
Drawing 7. Tracking options window

Software element description

After selecting the **ArCADia-GAS INSTALLATIONS** tab the software options window is displayed.

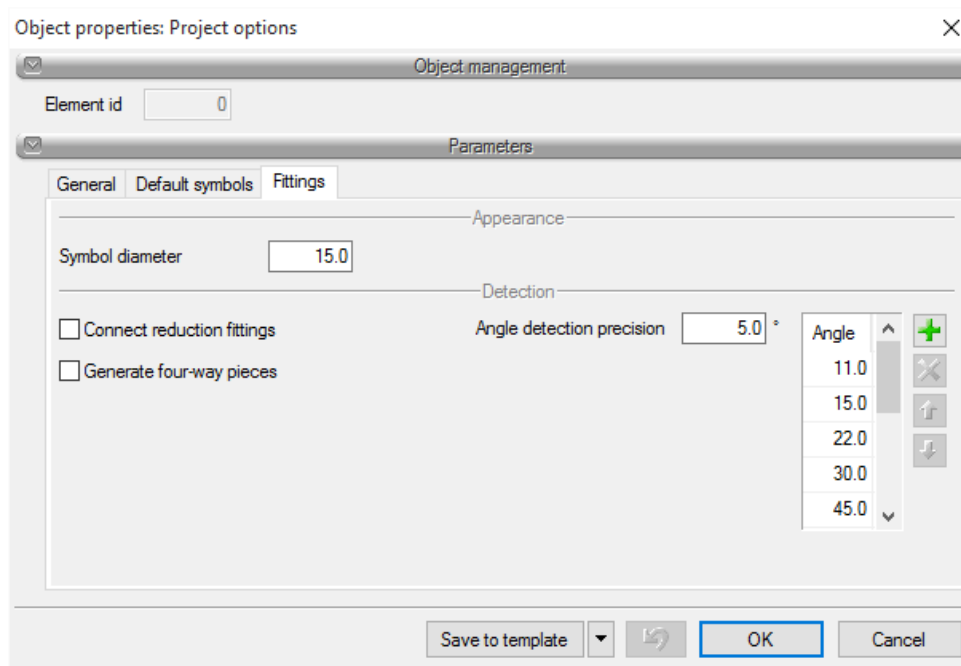


Drawing 8. Software options window for the ArCADia-GAS INSTALLATIONS, the General tab



Drawing 9. Software options window for the ArCADia-GAS INSTALLATIONS, the Default symbols tab

Software element description



Drawing 10. Software options window for the ArCADia-GAS INSTALLATIONS, the Fittings tab

In this window the user may define the settings in one of the three tabs:

The **General** tab (Drawing 8)

The **Appearance** control group

Symbol scale – setting the size of item symbols where the dimensions are not editable for the user.

- ☒ **Update all** – Marking this check box will change the scale of all previously inserted symbols to the one defined by the user in the editing field next to the check box.

The **Gas fuels** control group



After clicking the  button the software will display the **Gas fuel** element properties window.

Software element description

Drawing 11. Gas fuel element properties window

The **Gas fuel parameters** control group

The parameters listed in this section are used in calculating losses in the gas installation.

The **Gas fuel parameters** control group

Gas fuel family – the user selects the fuel family that will be used to power the installation from the drop-down list (in accordance with PN-C-04750:2002):

- Manufactured – family 1
- Natural – family 2
- Liquefied C3-C4 – family 3
- Hydrocarbon and air gas mixture – family 4
- Biogas – family 5

Gas fuel group – a drop-down list of gas fuel groups is assigned for every item from the list above. The user chooses the appropriate group.

Manufactured gases family:

- Low caloric – Sn group
- Medium caloric – Ss group
- High caloric – Sw group

Software element description

Natural gases family:

- Nitrogened – Ln group
- Nitrogened – Lm group
- Nitrogened – Ls group
- Nitrogened – Lw group
- High methane – E group

Family – Liquefied Gases C3-C4:

- Propane butane (P/B),
- Industrial propane (P).

Hydrocarbon and air gas mixture family:

- Mixtures of liquefied gasses C3-C4 with air (GGP),
- Natural gas and air mixture (GPZ).

Family – Biogas:

- Biogas BG.

According to their personal knowledge and the information contained in the technical requirements (if available), the user should type in the following parameters:

- Gas fuel density [kg/m^3],
- Gas fuel kinematic viscosity [m^2/s],
- Air density [kg/m^3],
- Normal conditions (after marking the checkbox the software will automatically assume air density as at normal conditions),
- Combustion heat or fuel value [MJ/m^3] – after marking one of these and inputting its value the second, unmarked parameter will be greyed out and calculated approximately.

The **Connection parameters** control group

Parameters listed in this section are used for checking if the installation was designed correctly. The user chooses the pressure listed in the technical requirements or other design guidelines from the allowed building supply pressure range:

- low pressure (up to 10kPa inclusive),
- medium pressure (from 10kPa to 500kPa),
- increased medium pressure (from 500kPa to 1600kPa).

After selecting the pressure in the connection, based on the conditions (or other guidelines), the user inputs the minimum and maximum pressure that may occur in reality in the gas connection. By default the software inserts hints about the range depending on the pipeline connection.

The **Gas installation parameters** control group

The parameters in this section are used for defining the criteria for selecting elements of the installation.

Permissible pressure loss – in the editing field the user enters the permissible pressure loss in the installation in Pa. These values are selected by the user according to their own technical knowledge. It is suggested to select parameter values according to literature references.

Software element description

This parameter constitutes the comparison base for assessing the validity of the pressure loss calculations carried out.

Permissible unit gas pressure loss – in the editing field the user defines the permissible unit pressure loss for one meter of installation in Pa/m. This value is selected by the user according to their own technical knowledge or by using the adjacent checkbox

☒ **Automatically**

After marking the checkbox the software will automatically calculate unit loss for the installation, taking into account the total length of the installation.

Maximum gas velocity in the pipelines – in the editing field the user inputs the maximum gas velocity in m/s, which may occur in the installation. This value is selected by the user according to their own technical knowledge.

Tab. 2. Permissible pressure losses were adapted as per the study of R. Zajda and Z. Gebhardt.

Gas fuel type			Permissible pressure loss in the gas installation in the path to the receiver with the least favourable location	
Gas fuel family	Gas fuel group		Values in the low pressure range [Pa]	Values in the medium pressure range [Pa]
Manufactured	Low caloric	Sn	Up to 100	150-250
	Medium caloric	Ss	Up to 150	150-250
	High caloric	Sw	Up to 150	150-250
Natural	Nitrogenated	Lm	Up to 100	150-250
		Ln	Up to 150	150-300
		Ls	Up to 150	150-300
		Lw	Up to 150	250-400
	High methane content	E	Up to 150	250-400
Hydrocarbon and air gas mixture	Mixture of liquefied C ₃ -C ₄ with air	GGP	Up to 100	150
	Natural gas and air mixture	GPZ	Up to 100	150

Tab. 3. Permissible pressure losses as per K. Bąkowski

Gas fuel type			Permissible pressure loss in the gas installation in the path to the receiver with the least favourable location	
Gas fuel family	Gas fuel group		Values in the low pressure range [Pa]	Values in the medium

Software element description

				pressure range [Pa]
Natural	Nitrogenated	Ls	Up to 100	Up to 150
		Lw	Up to 100	Up to 150
	High methane content	E	Up to 150	Up to 200
Liquefied C ₃ -C ₄	Propan butane	B/P	-	180
	Industrial propane	-	-	180

The **Default symbols** tab (Drawing 9)

The user may leave or insert his own markings for items in the gas installation that will be automatically inserted in the project.

The **Moulds** tab (Drawing 10)

Includes controls enabling the user to determine the manner of generating and presenting the moulds for installation geometry and material changes.

The **Appearance** control group

Symbol diameter – in this field the user determines the size of the symbol inserted at the point where the fittings set is generated (circle diameter).

The **Detection** control group

Connect into reduction moulds – ticking this box means that a change of diameter and direction or a change of diameter and a branch will be executed by means of a DN1/DN2 reduction elbow (three-way or four-way reduction fitting) and not by means of two separate fittings (DN1 elbow + DN1/DN2 reduction, three-way fitting or four-way fitting DN1 + DN1/DN2 reduction).

Generate four-way fittings – ticking this box means that four-way fittings and not three-way fittings pairs will be generated for nodes where four pipelines meet, as would be the case if the box is not ticked.

Typical angle detection precision and Angle – in this table the user determines the bends (Angles) to be treated as typical in the installation (e.g.: 30, 45, 60, 90°) and what angle value range (+/-) should be interpreted as a typical angle.

Tab. 4. Typical Angles table

Software element description

If in the case of the above example set of typical angles the users inputs 2° in the **Angle detection precision** field, then:

- angles in the range of 28-32° will be treated as 30°,
- angles in the range of 43-47° will be treated as 45°,
- angles in the range of 58-62° will be treated as 60°,
- angles in the range of 88-92° will be treated as 90°,

The remaining turn angle will be represented by values read from element geometry.

To summarize, as per the example angle settings assumed above:


- a 30° elbow will be generated for a 31.5° route turn,
- a 78.4° elbow will be generated for a 78.4° route turn.

5 DESCRIBING AND EDITING ITEMS

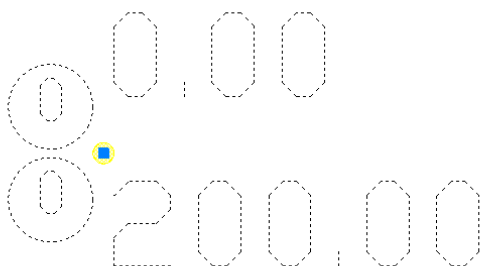
5.1 INTRODUCTORY REMARKS TO OBJECT EDITION

Each object of the ArCADia system, including **ArCADia-GAS INSTALLATIONS** objects, includes properties, or the information on an object's characteristic parameters: technical, technological and geometrical, that are necessary to make supplementary drawings, selective calculations, assess their accuracy and generate lists.

An object is inserted in the model by selecting the proper icon on the program toolbar (**Błąd! Nie można odnaleźć źródła odwołania.**). An object insertion window appears. For each object, the window enables to choose its location through defining a handle on its outline or in an object's characteristic point. It also enables entering the object height above the level (e.g. the bottom installation level).

By selecting the **Import from element**  checkbox, the user can insert an object through connecting it in a proper point with a connection element of another object that has already been inserted in the drawing.

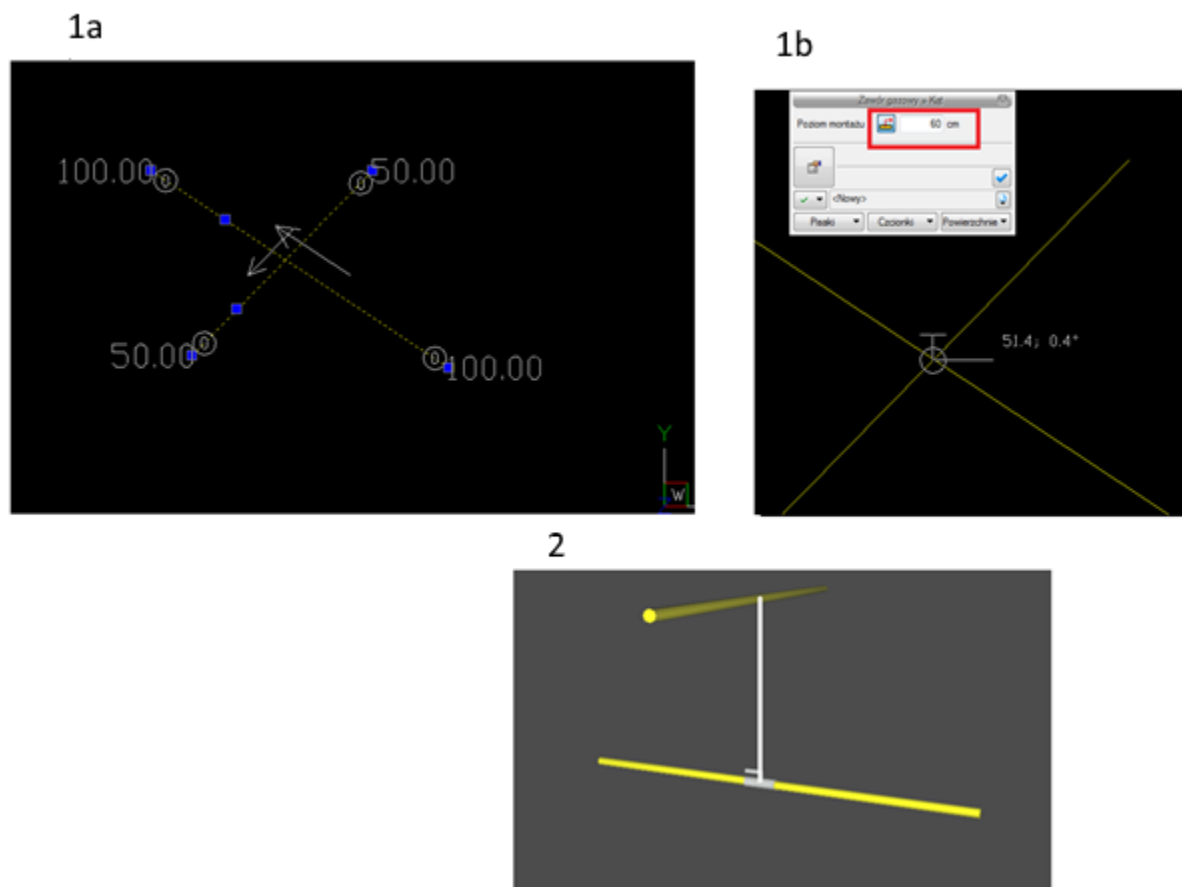
Import from element – If the button is active, clicking an earlier inserted element (such as a vertical pipe) will cause its characteristic points of the installation level to be imported and the inserted object (such as a valve) to be automatically attached, e.g. to one of the vertical pipe's ends, on a similar level. Examples can be found below:



Drawing 12. A vertical pipeline with ends at the 0 and 200cm installation levels

For example: If the user has inserted two pipelines at different levels, which intersect in a projection, and wants to insert a valve in one of them in the intersection point, it is necessary to activate the **Import from element** button. The object will be attached to the pipeline whose installation level is closer to the value typed in the edit box – an example can be found below.

Describing and editing items




Drawing 13. Using the Import from element feature to insert a valve in one of pipelines that intersect in the projection. 1a – Two intersecting pipelines that are situated at 50cm and 100cm, shown in the drawing area, 2b – Inserting a valve in the pipeline situated at 50cm, 2 – The effect of inserting a valve in the 3D view.

In this window, there are also options that facilitate the object insertion precision. These options are activated through the selection of a proper function of tracking or detecting other objects existing in the drawing.

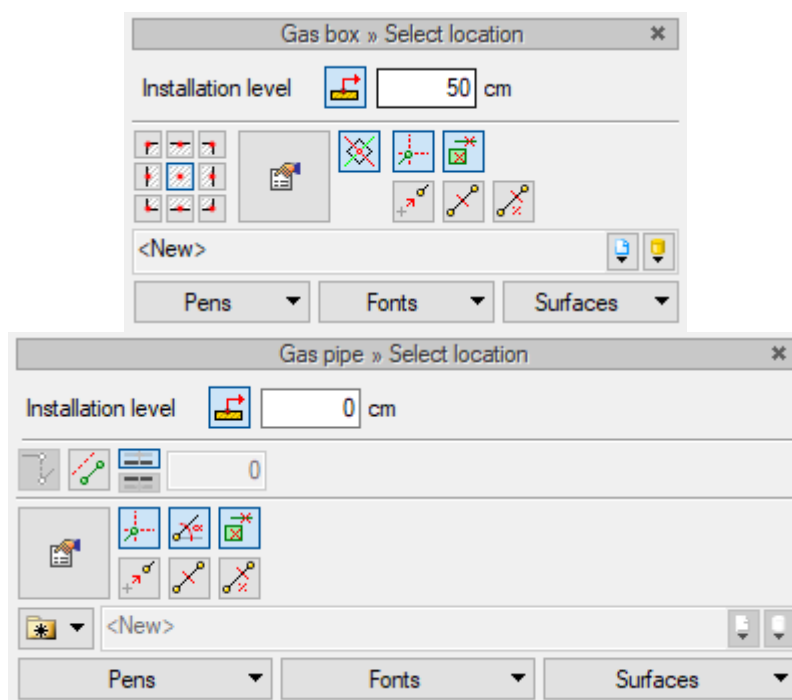
An object can be inserted in a drawing in two ways:

1. Method 1

The user selects a proper icon from the **ArCADia-GAS INSTALLATIONS** toolbar and then

moves to the edition of the object parameters by selecting the  button in the object insertion parameters window. An object properties dialog window will be displayed, and it will enable to set the object parameters. Once they are set, the user presses OK to return to the object insertion window, then clicks a selected location in the drawing area with the object symbol, which is attached to the cursor, and finally clicks again while entering the object's rotation angle. Such an insertion procedure causes saving the parameter settings for fonts, pens and surfaces for every next object from the same group of elements.

Describing and editing items



Drawing 14. An object insertion window – illustrative views for an object and a pipe

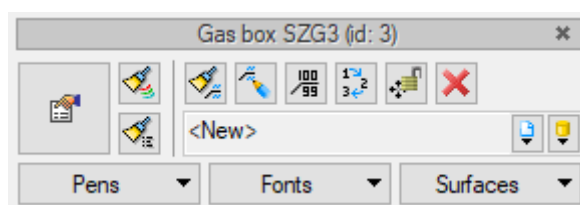
Tab. 5. The ArCADia-GAS INSTALLATIONS toolbar features

Icon	Description
	Changing the location of an object insertion handle.
	Moving to the object properties window.
	Imports the installation level value from previously inserted objects. For example, it allows to automatically connect two gas pipelines with their axes.
	The field for entering the installation level above the storey level.
	Tracking characteristic elements of objects that have been previously inserted in the objects' drawing area (e.g. tracking pipeline axes).
	Detecting objects that have been previously inserted in the drawing area (detecting edges or objects' characteristic elements).
	Inserting linear objects with the detection of angles to linear objects inserted before in order to connect them at a given angle. The values of angles and the accuracy of their detection are set in the Project options window.
	Inserting 2D and 3D objects, with their rotation on the Z axis.
	Inserting a selected object at a given distance from a selected point.
	Inserting an object halfway a selected distance.
	Inserting an object by a percentage breakdown of a given distance.

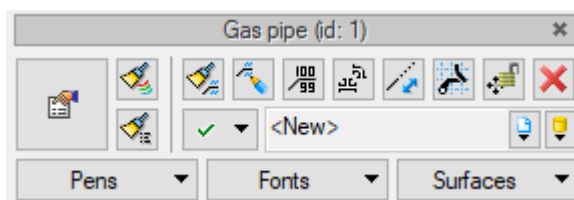
2. Method 2

Describing and editing items

The user selects a proper icon from the **ArCADia-GAS INSTALLATIONS** toolbar (**Błąd! Nie można odnaleźć źródła odwołania., Błąd! Nie można odnaleźć źródła odwołania.**) and inserts an object symbol using the snap object tool. After selecting an object, a window is displayed with a toolbar that allows to modify the selected object and to give it parameters by selecting a given type from the program libraries. Depending on the object type, in the modification window there are icons that are characteristic of a specific object. They allow to insert proper changes that only regard this object. The number and type of these icons may vary for a given object group.










Drawing 15. The toolbar to select object modification




Drawing 16. The toolbar to modify a gas pipe

Icon	Description
	Move to the object properties dialog window
	Font and pen painter
	Type painter
	Description painter
	Edit a description
	Set a description on a reference line
	Create the real view
	Renumber objects

Describing and editing items

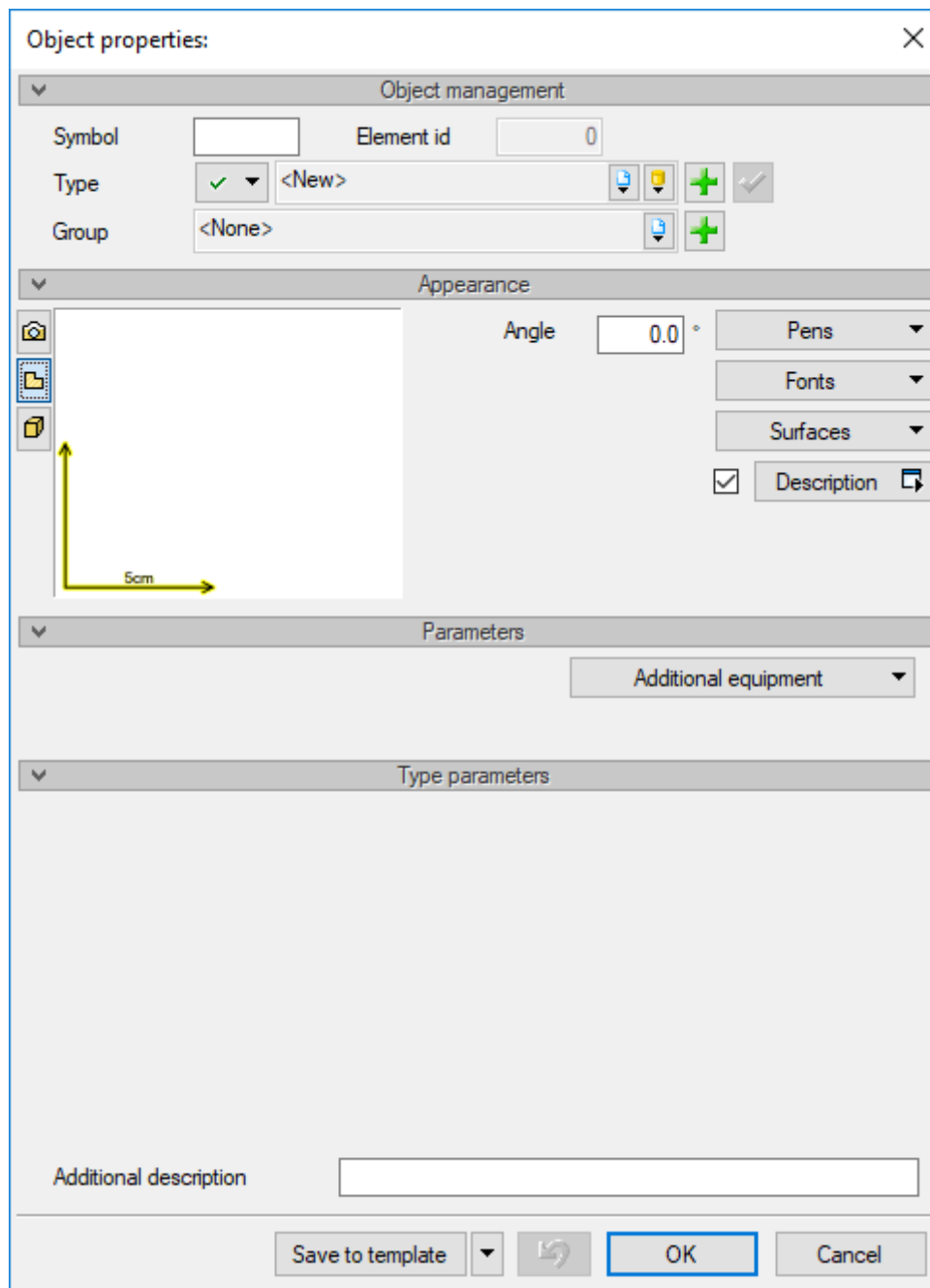
	Lengthen/Shorten pipe maintaining slope (applies to non-vertical pipes)
	Vertical pipe stretching. This function applies to vertical pipes and allows the installation level of the pipeline ends to be changed together with the floor change.
 	Move with connections Move without connections
	Remove selected objects
	Access to the project and global libraries
	Functions of selective calculations methods for object types intended for automatic selective calculations (e.g. pipelines, cut valves, gas filters) relating to technological parameters.

Moving to the object parameter edition can be performed through selecting the  button.

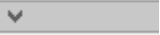
After selecting parameters in the **Object properties** window and pressing the **OK** button, the parameters of a previously inserted object will be modified.

The **Object properties** windows are divided into control groups:

Describing and editing items



Drawing 17. The object properties window of an example object

Each object properties window consists of icons grouped in panels. The panels can be pulled up, which hides a particular group. The  button pulls up a panel.

The **Object management** control group

Symbol/Type – setting the symbol/type that will be displayed in the projection along with the object number. If the user does not insert the change in the active window, the name will be generated in the **Options** window.








Element id – the number of the consecutive inserted element.

Type – it enables to insert objects using the main data control, which allows to insert objects from the main data library of object types (example objects, e.g. from producer catalogues) and to use the

Describing and editing items

object **Type library** created while working on the project and containing objects that have been used in the project before or moved to the **Project library** using the **Type editor**. In this control group it is possible to define the user's own example objects and add them to the **Project library**.




Group – it gives the possibility to create groups of objects, e.g. with various purposes, and to select them for edition at a later time.

Icon	Description
 	<p>The access to the project and global libraries.</p> <p>Saving a type to the library of a particular type on the basis of the current setting in the properties window.</p>
  	<p>Editing the type selection method for objects intended for automatic selection (pipelines, cut valves, gas filters) in relation to technical parameters.</p>
 	<p>Dropping down the list of object groups of a particular type.</p> <p>Adding a new object group of a particular type.</p>

The **Appearance** control group

The set of controls in this group is almost identical for all gas objects included in the program. It allows to set the general graphic properties of an object.

In the panel, there is view window for a particular object, with the possibility to change the view type.

Icon	Description
	Activating the schematic drawing
	Activating the projection view
	Activating the 3D view

Angle – setting the angle of 2D and 3D objects to the main coordinate system.

Pens – setting the type, thickness and colours of object drawing lines in a view.

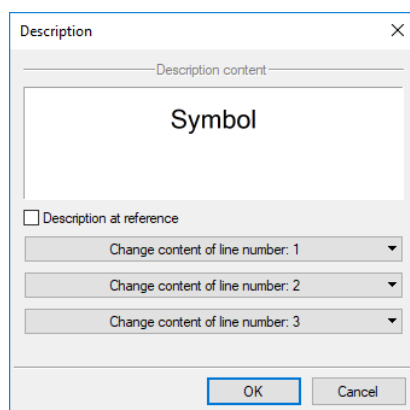
Fonts – setting the font format of the name displayed in projections.

Surfaces – setting colours and patterns of surfaces shown in the 3D view.

Description – the controls run the configurator for organising and setting the view and the content of a description.

After selecting the checkbox on the left, a button is activated which, in turn, activates the configurator window.

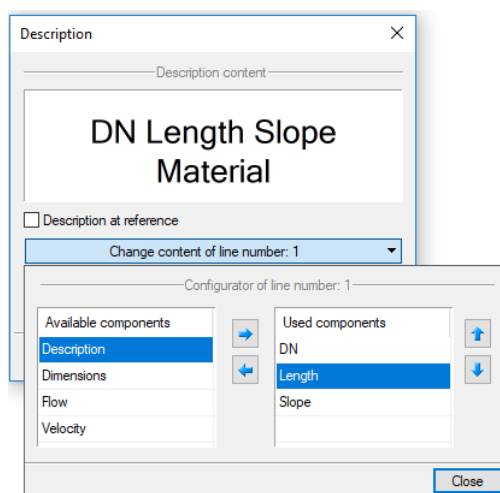
Describing and editing items



Drawing 18. The description configurator, the general window

The user has the possibility to set the substantive contents of description components (various for a given object), as well as their order and their location in relation to a description line.



After pressing the proper button for the line (upper or lower) contents, an additional window is displayed which allows for the proper selection of the layout and contents (Drawing 19 – an example setting of the bottom line description for a pipeline).



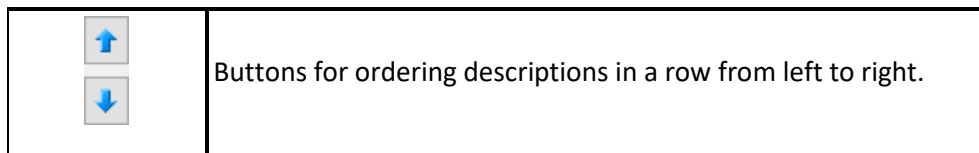
Drawing 19. The description configurator, the setting window

In the description configurator, there are two tables:

- On the left side, there are **Available components** – the available description variants.
- On the right side, there are **Used components** – the description variants for a selected line that have been used.

Icon	Description
 	Buttons for moving a given description component from the Available components window to the Used components window.

Describing and editing items

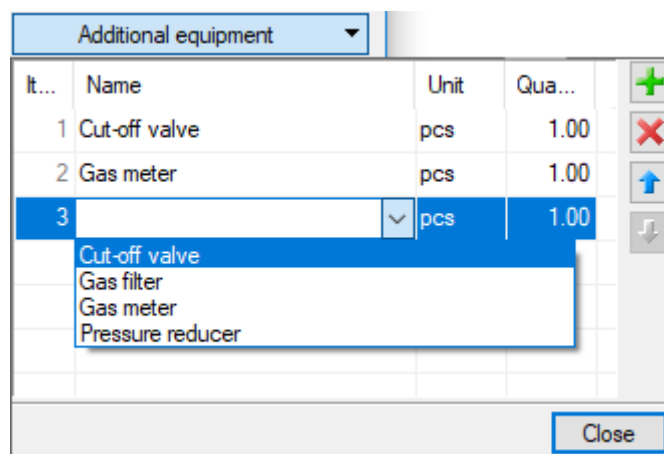


The availability of components for a particular line depends on introducing them into an inactive line. Inserting the desired line into the description is done by selecting the name of the description and pressing the arrow towards the line description content table. The selected description title will be transferred and therefore will not be visible in the **Available components** table. Should the user wish to share the component, he needs to act in a similar manner. He selects the description component in the line content table and then uses the left arrow to transfer it to the **Available components** table. The elements of the description sequence in a particular line are set from left to right as per the top-down sequence in the line contents table. You can change the sequence by marking a component in the line contents table and controlling the sequence change buttons, which causes the sequence of a particular component to be changed by one field. Each use of the arrow moves the item one field up or down. The changes will be applied after pressing the **Close** button.





The **Parameters** control group

This is a set of individual controls for each object. It allows the user to set the defining installation parameters, for example the item location, its functions, etc.

Additional equipment – a button opening a table where the user insert additional equipment whose elements should be included in the material lists, is available for some objects. It is also possible to insert any object name in the edit field.



Drawing 20. The additional equipment window

The  button may be used to add a relevant item from the drop-down list. At the same time, the user can insert their description into a table cell, changing the unit and quantity. The  button removes a selected item. The  and  arrows change the sequence of the selected element position.

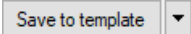
The **Type parameters** control group


This is a set of individual controls for each item. It allows the user to set the parameters that specify a particular object, for example technical or geometric parameters, or an object description.

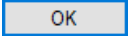
Additional description – the user can insert custom information, which may appear in drawing descriptions and material lists.

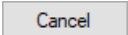
The window settings ending controls

Describing and editing items

 – This function allows for saving the type parameters of a defined object and, using the arrow, for choosing the name of a template in which the object will be saved.

 – Restoring the initial settings.

 – Leaving the window and confirming the object properties settings.

 – Leaving the window and cancelling the object properties settings.

5.2 A GAS BOX

To insert a **Gas box** into a model, select the icon:

The ArCADia software:

- The **Gas** ribbon ⇒ The **Gas installations** logical group ⇒ 

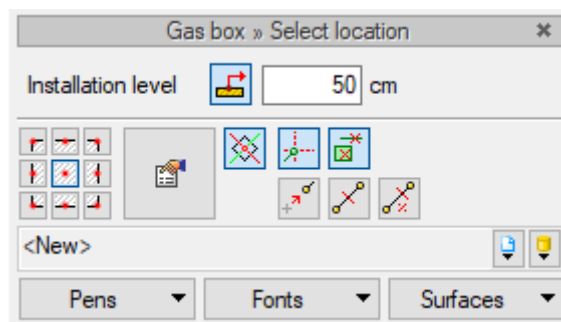
The AutoCAD or INTERsoft-INTELLICAD software:

- The **Gas installations** toolbar ⇒ 

or type:


- IGAS_GC.

An object insertion window is displayed:



Drawing 21. The Gas box insertion window

The window allows the user to set the appropriate box insertion position by:

- Setting the box bottom installation level – the  button allows the user to adjust the bottom height to the existing element (e.g. a pipeline). The user has to give an approximate height, especially when there are various elements at various heights in a given place. The installation level can be typed manually in the edit box.
- Selecting a handle on the box's outline or the middle point by clicking one of the nine possible points.


Describing and editing items

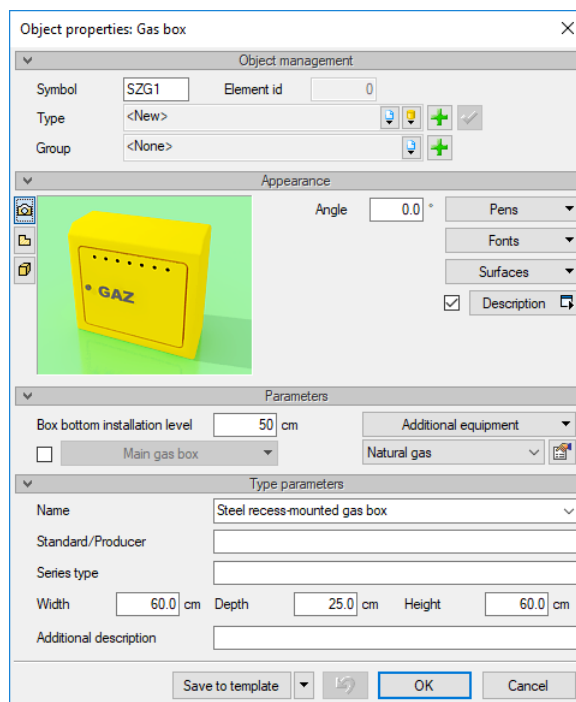
- Selecting the insertion relevant to the already drawn elements feature, i.e. setting the elements detection, elements tracking, sections detection and section ends tracking features.

The user can also give an approximate value of the connection level, which allows to find an object on the most similar level and to connect the box's bottom with the object's point that is on the most similar level.

The **Import from element** feature should only be used after selecting the **Element and section detection** button.

The window also allows the user to use the **Project library**. The user can select an example type of a gas box from the drop-down list of the **Project library** and use it in the project. When the gas box insertion window is active, a box symbol shows up on the model's drawing area (projection). Clicking a chosen spot inside the drawing area inserts the object. Another clicking sets the gas box insertion angle to existing elements.

The gas box properties editing window is displayed after selecting the  button or double-clicking the inserted element (Drawing 22).



Drawing 22. The Gas box properties window

In the gas box properties window the user can adjust the appearance of the object in the projection, as well as the installation and technical parameters necessary to execute the further calculations.

The **Parameters** control group

It allows the user to set the fitting and technical parameters of a gas box as the beginning of a gas installation.



Describing and editing items

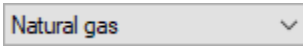

- ☑ After checking the **Main gas box** checkbox, the **Main gas box** button becomes active. After pressing it, a window to set the pressure parameters behind the gas box is displayed. The user has the possibility to decrease the pressure behind the gas box, compared to the pressure before the gas box, while taking into consideration the anticipated pressure losses on the gas box equipment elements. Additionally, giving it the function of the main gas box enables to connect it with objects and elements coming from the **ArCADia-EXTERNAL GAS INSTALLATIONS** module and becomes the component to combine the interior and exterior installation projects.

If the user inserts this gas box into a building (without connecting any objects), and then he inserts objects coming from the **ArCADia-EXTERIOR GAS INSTALLATION** module, it will be possible to connect the exterior gas installation pipes and, at the same time, to give the flow or check the **Calculate gas flow** checkbox.

Drawing 23. The window to set the pressure parameters for the main gas box

NOTE! If the main gas box is connected with the receivers with pipelines, the **Gas flow** field is not active.

Another two buttons,  , let the user to select the installation (gas fuel), in which a given box will be mounted. If the user has a few types of fuel added in the project options,

after a click, the list of available types of gas fuel will drop down  . Next to it, the  button to move to **Gas fuel properties** is situated. After entering the properties, it is possible to review or to change basic installation parameters (gas fuel, velocity criterions, permissible pressure losses).

The **Type parameters** control group

Standard/Producer – They are imported from the **Type library** or typed by the user in order to define a new object type.

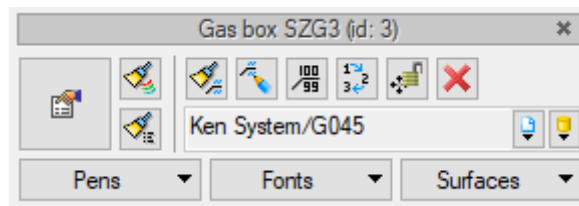
DN diameter – It is imported from the **Type library** or typed by the user to define a new object type.

Type/Series type – they are imported from the **Type library** or inserted by the user in order to define a new object type.

Width/Depth/Height – Edit boxes in which it is possible to give a gas box appropriate dimensions.

If a gas box has already been inserted, the user clicks on it to have the object modification window available.

Describing and editing items



Drawing 24. The Gas box modification toolbar

5.3 A GAS APPLIANCE

To insert a **Gas appliance** into a model, select the icon:

The ArCADia software:

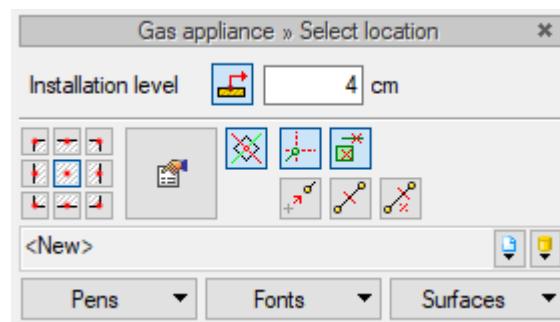
- The **Gas** ribbon ⇒ The **Gas installations** logical group ⇒

The AutoCAD or INTERsoft-INTELLICAD software:

- The **Gas installations** toolbar ⇒

or type

- GAS_GR.



Drawing 25. The Gas appliance insertion window


The window allows the user to set the appropriate gas appliance insertion position by:

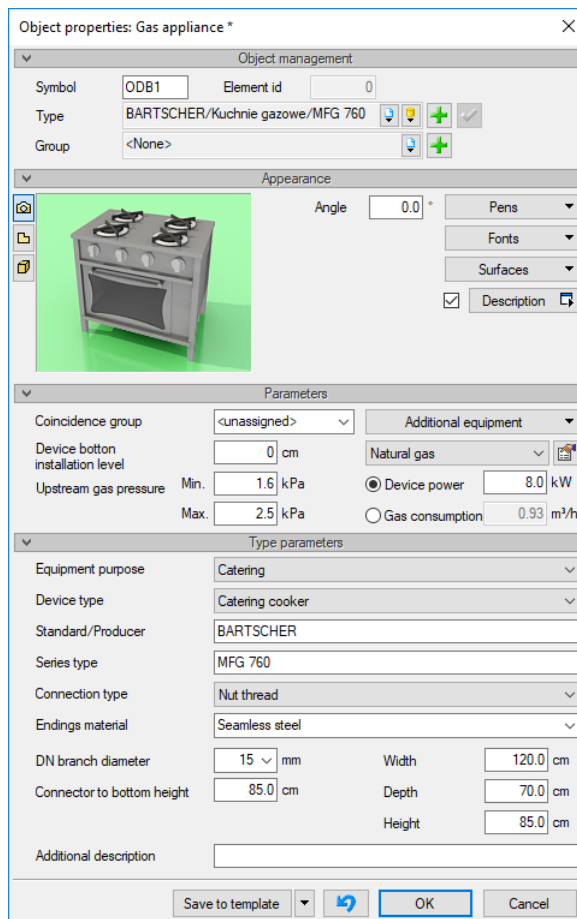
- Setting the gas appliance's ending's installation level – the button allows the user to adjust the bottom height to the existing element (e.g. a pipeline). The user has to give an approximate height, especially when there are various elements at various heights in a given place. The installation level can be typed manually in the edit box.
- Selecting a handle on the gas appliance's outline or the middle point by clicking one of the nine possible points.
- Selecting the insertion relevant to the already drawn elements feature, i.e. setting the elements detection, elements tracking, sections detection and section ends tracking features.

Describing and editing items

The user can also give an approximate value of the connection level, which allows to find an object on the most similar level and to connect the appliance's ending with the object's point that is on the most similar level.

The **Import from element** feature should only be used after selecting the **Element and section detection** button.

The gas appliance properties editing window is displayed after selecting the  button or double-clicking the inserted element.



Drawing 26. The Gas appliance properties window

The **Parameters** control group

Simultaneity group is an editable drop-down list, which enables the user to insert the designation of a simultaneity group for a given gas appliance. Appliances of the same simultaneity constitute a set of devices that might work simultaneously with high probability.

For a gas pipeline section, the program calculates the simultaneous fuel consumption coefficient, based on the number of fuelled groups.

Device bottom installation level is the device bottom installation distance from the reference level (the reference level is the level of the active storey, taken as 0cm).

Upstream gas pressure is the minimum and maximum gas pressure that may appear in the installation before a gas appliance.

Additional equipment – The user can insert here additional elements that should appear in the list, e.g. an elastic pipe connector.

Describing and editing items

Device power/Gas consumption – In this edit box, the user enters the value of the heat output of the gas appliance in kW. The value is entered based on the device specifications or literature data. Optionally, after switching the radio button, the user can enter gas consumption. Depending on the used gas heating value (setting gas parameters), the values are calculated.

The **Type parameters** control group

Equipment purpose – From the drop-down list, the user selects a group of devices due to their use. The devices are divided as follows: for domestic and gastronomic use, for domestic hot water, as well as for heating and technological use (any other devices with individual technological or heating use).

Device type – The selection from the drop-down list depends on the selection of the item from the **Equipment purpose** list. The user chooses the device due to its function.

Standard/Producer – They are taken from the **Type library** or entered by the user to define a new object type.

Type/Series type – They are taken from the **Type library** or entered by the user to define a new object type.

Connection type – It is taken from the drop-down list.

Endings material – It is taken from the **Type library** or entered by the user to define a new object type.

DN branch diameter – The nominal diameter of the ending of the gas appliance's connection to the gas installation. It is selected from the editable drop-down list. The value is entered based on the device specifications or literature data.

Geometric parameters (width, depth, height) – They are taken from the **Type library** or entered by the user to define a new object type.

Connector to bottom height – It is taken from the **Type library** or entered by the user to define a new object type. (When connecting the installation pipeline with the appliance parameters download function active, specifying the connection height will enable the pipeline to be turned on by clicking on any point on the object outline.)

Additional description – It is taken from the **Type library** or entered by the user to define a new object type.

5.4 A GAS VALVE

To insert a **Gas valve** into a model, select the icon:

The ArCADia software:

- The **Gas** ribbon ⇒ The **Gas installations** logical group ⇒ 

The AutoCAD or INTERsoft-INTELLICAD software:

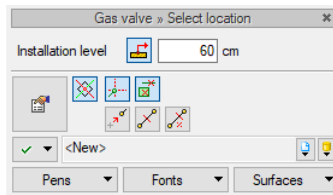
- The **Gas installations** toolbar The **Gas installations** toolbar ⇒ 

or type

- IGAS_GV.



An object insertion window is displayed (Drawing 27). A valve is always inserted into a projection with a handle located in the middle of its symbol.

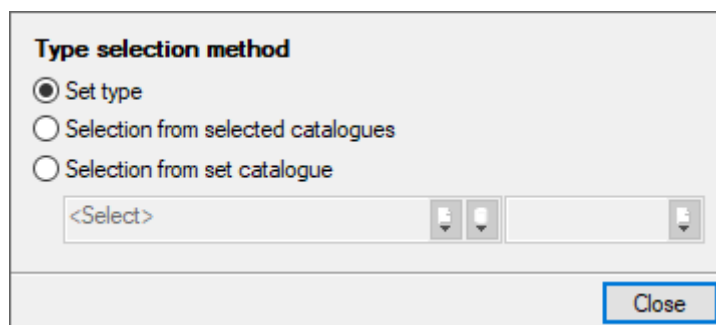
Describing and editing items



Drawing 27. The Gas valve insertion window

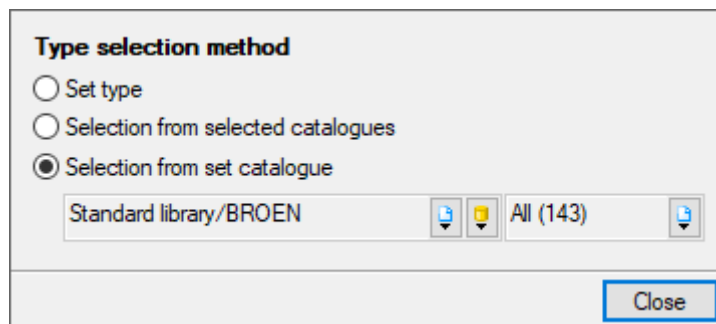
The window allows the user to set the appropriate gas valve insertion position by:

- Setting the valve installation level: The  button allows the user to adjust the bottom height to an existing element (e.g. a pipeline). It is necessary to enter the approximate height, especially if there are several elements at different heights in a given location. The installation height can be entered manually in the edit box.
- Selecting the insert relevant to the already drawn elements feature, i.e. setting the elements detection, elements tracking, sections detection and section ends tracking features.
- The user can enter the approximate value of the connection height, which allows to locate the closest element (object) and to connect the valve to the object's point which is closest and situated at the most similar height.
- The  icon indicates a certain state of the object regarding the calculations being made. After clicking this icon, it is possible to change the status according to one of the three options:



- **Set type** – With this option selected, the user can set the type for the selected element (the field with the **Type library** is unlocked).
- **Selection from selected catalogues** – With this option selected, the elements are taken from the catalogues selected in the **Project options**.
- **Selection from set catalogue** – With this option selected, the catalogue selection box is unlocked. The user can choose one of the catalogues from the **Project library** and the object will be selected from it, regardless of the settings in the **Project options**.

Describing and editing items

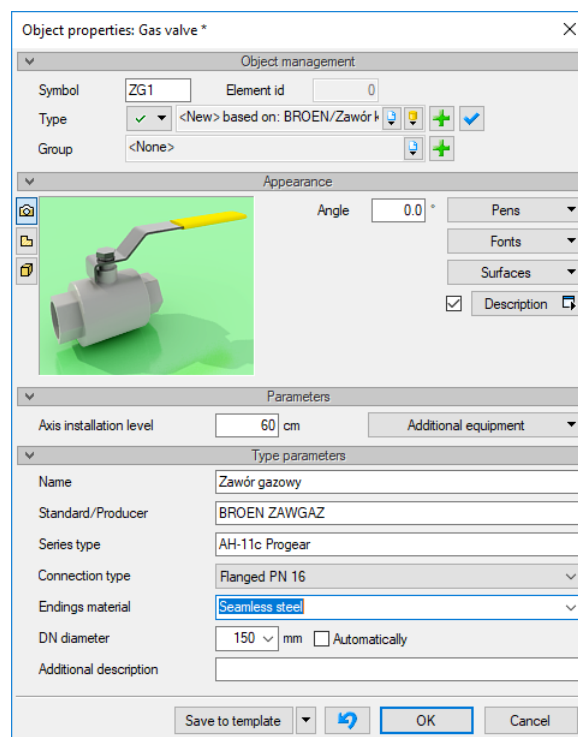


*The **Import from element** function should be used with the **Element and section detection** function selected.*

The gas valve properties editing window is displayed by selecting the




button or double-clicking the inserted element.



Drawing 28. The Gas valve properties window

The **Object management** control group

Type – This control allows the user to enter objects using the **Project library**. In addition, the valve has the  button for choosing the type selection method. This means that the program can automatically select the valve.

The **Parameters** control group

Axis installation level – The user enters the installation level of the valve axis in the edit box.

The **Type parameters** control group

Describing and editing items

Name – It is imported from the **Type library** or entered manually by the user in order to define a new object type.

Standard/Producer – They are imported from the **Type library** or typed by the user in order to define a new object type.

Type/Series type – They are taken from the **Type library** or entered by the user to define a new object type.

Connection type – It is taken from the drop-down list.

Endings material – It is taken from the **Type library** or entered by the user to define a new object type.

DN diameter – The nominal diameter of the ending of the gas appliance's connection to the gas installation. It is selected from the editable drop-down list. The value is entered based on the device specifications or literature data. If the **Automatically** checkbox next to the diameter is unchecked (the parameter is set by default), the selection of the valve diameter is blocked and the valve's diameter is set as equal to the diameter of the pipeline in which it is inserted.

Additional description – It is taken from the **Type library** or entered by the user to define a new object type.

5.5 GAS METER

To insert a **Gas meter** into a model, click the icon:

The ArCADia software:

- The **Gas** ribbon ⇒ The **Gas installations** logical group ⇒



The AutoCAD or INTERsoft-INTELLICAD software:

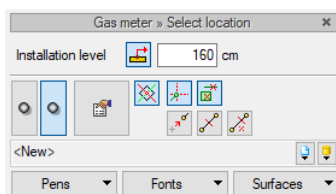
- The **Gas installations** toolbar ⇒



or type

- IGAS_GV.

An object insertion window is displayed (Drawing 29).





Drawing 29. The Gas meter properties window


The window allows the user to set the appropriate gas meter insertion position by:

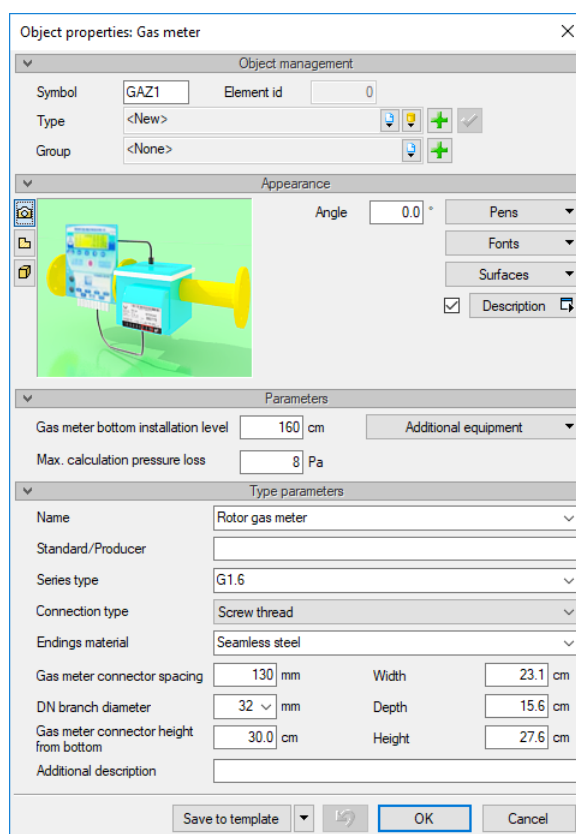
- Setting the gas meter installation level: The installation level can be entered manually in the edit box.

Describing and editing items

- Using the  gas meter ending selection button when inserting into the drawing area.
- Using the  button, which allows the user to adjust the endings' height to an existing element (e.g. a pipeline). It is necessary to enter the approximate height, especially if there are several elements at different heights in a given location.
- Selecting a handle at the place of the defined connection endings of the gas meter (left or right ending).
- Selecting the insert relevant to the already drawn elements feature, i.e. setting the elements detection, elements tracking, sections detection and section ends tracking features.

The window also allows the use of the **Project library**. From the drop-down list of a given library, the user can choose an illustrative type of a gas meter. When the gas meter insertion window is active, a gas meter symbol appears in the model drawing area (projection). Clicking a selected place in the drawing area inserts the object. Then, the user can rotate the gas meter about one of the endings to get the correct insertion angle and click again.

The gas meter properties editing window is displayed by selecting the  button or double-clicking the inserted element.



Drawing 30. The Gas meter properties window

The Parameters control group

Setting the gas meter installation and technological parameters.

Describing and editing items

Gas meter bottom installation level – The user inserts the gas meter installation height counting from the floor level to the gas meter bottom.

Max. calculation pressure loss – Based on technical (trade catalogue) knowledge, the user enters the maximum calculation pressure loss.

The **Type parameters** control group

Name – It is imported from the **Type library** or entered manually by the user in order to define a new object type. The name is editable and the user can enter his own. Additionally, the drop-down list includes a few types of the most often used gas meters.

Standard/Producer – They are imported from the **Type library** or entered by the user in order to define a new object type.

Type/Series type – They are taken from the **Type library** or entered by the user to define a new object type. The type is editable and the user can enter his own. Additionally, the drop-down list includes a few types of the most often used gas meters.

Connection type – It is taken from the drop-down list.

Endings material – It is taken from the **Type library** or entered by the user to define a new object type.

Gas meter connector spacing – It is taken from the **Type library** or entered by the user to define a new object type.

DN branch diameter – The nominal diameter of the ending of the gas appliance's connection to the gas installation. It is selected from the editable drop-down list.

Gas meter connector height from bottom – The level difference between the bottom of the gas meter and the connections.

Geometric parameters (width, depth, height) – They are taken from the **Type library** or entered by the user to define a new object type.

Additional description – It is taken from the **Type library** or entered by the user to define a new object type.

5.6 GAS FILTER

To insert a **Gas filter** into a model, click the icon:

The ArCADia software:

- The **Gas** ribbon ⇒ The **Gas installations** logical group ⇒ 

The AutoCAD or INTERsoft-INTELLICAD software:

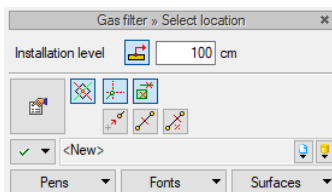
- The **Gas installations** toolbar ⇒ 

or type

- IGAS_GF.


An object insertion window is displayed (Drawing 31).


Describing and editing items

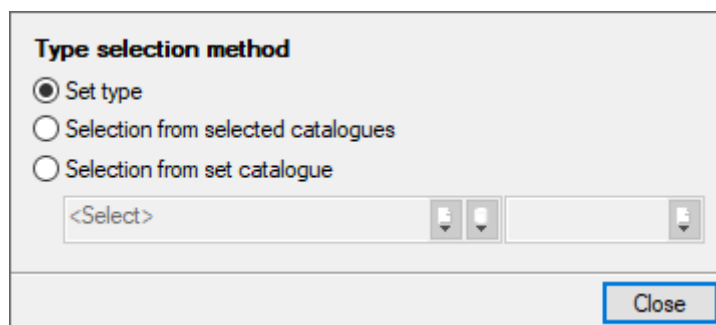


Drawing 31. The Gas filter properties window

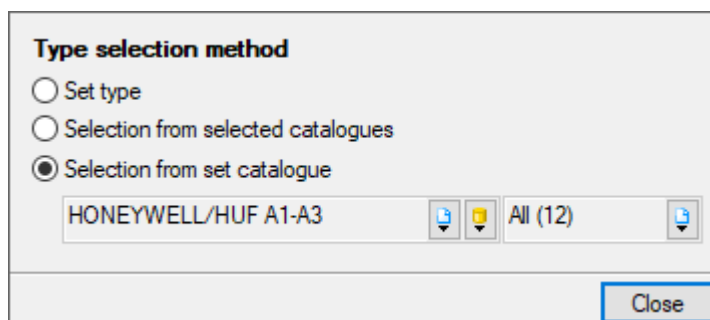
The window allows the user to set the appropriate gas filter insertion position by:

- Setting the gas filter installation level: It is possible to enter the installation level manually in the edit box, The  button allows the user to adjust the height to an existing element (e.g. a pipeline). It is necessary to enter an approximate height, especially if there are several elements at different heights in a given location.
- Selecting the insert relevant to the already drawn elements feature, i.e. setting the elements detection, elements tracking, sections detection and section ends tracking features.

The  icon indicates a certain state of the object regarding the calculations being made. After clicking this icon, it is possible to change the status according to one of the three options:




- **Set type** – With this option selected, the user can set the type for the selected element (the field with the **Type library** is unlocked).
- **Selection from selected catalogues** – With this option selected, the elements are taken from the catalogues selected in the Project options.
- **Selection from set catalogue** – With this option selected, the catalogue selection box is unlocked. The user can choose one of the catalogues from the **Project library** and the object will be selected from it, regardless of the settings in the **Project options**.

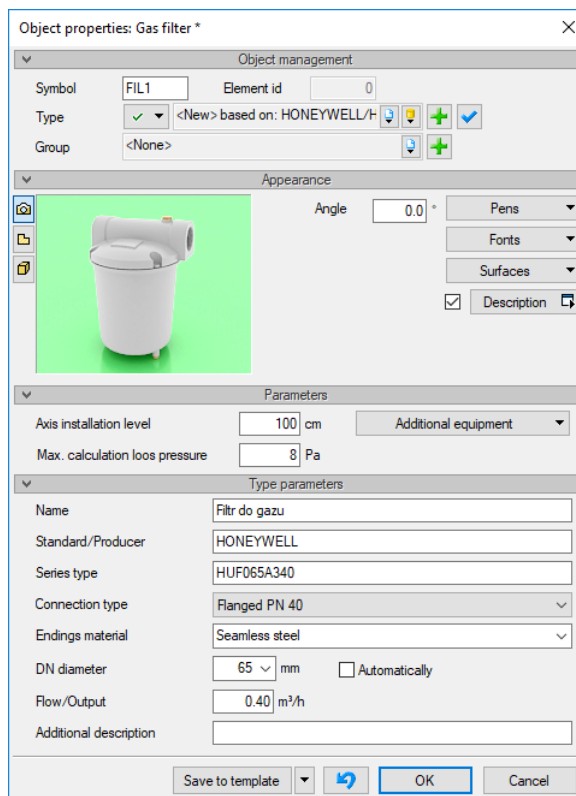


Describing and editing items


*The **Import from element** function should be used with the **Element and section detection** function selected.*

The window also allows the use of the **Project library**. From the drop-down list of a given library, the user can choose an illustrative type of a gas filter and use it in the project.

The gas filter properties editing window is displayed by selecting the  button or double-clicking the inserted element.



Drawing 32. The Gas filter properties window

Type – This control allows the user to enter objects using the **Project library**. In addition, the filter has the  button for choosing the type selection method. This means that the program can automatically select the filter.

The **Parameters** control group

Setting the gas filter installation and technological parameters.

Axis installation level – The user inserts the gas filter installation height counting from the floor level to the gas filter axis.

Max. calculation pressure loss – Based on technical (trade catalogue) knowledge, the user enters the maximum calculation pressure loss.

The **Type parameters** control group

Name – It is imported from the **Type library** or entered manually by the user in order to define a new object type.

Standard/Producer – They are imported from the **Type library** or entered by the user in order to define a new object type.

Series type – It is taken from the **Type library** or entered by the user to define a new object type.

Connection type – It is taken from the drop-down list.

Describing and editing items

Endings material – It is taken from the **Type library** or entered by the user to define a new object type.

DN diameter – The nominal diameter of the ending of the gas appliance's connection to the gas installation. The value is entered based on the device specifications or literature data. If the **Automatically** checkbox next to the diameter is checked (the parameter is set by default), the selection of the filter diameter is blocked and the filter's diameter is set as equal to the diameter of the pipeline in which it is inserted.

Row/Output – They are taken from the **Type library** or entered by the user to define a new object type.

Additional description – It is taken from the **Type library** or entered by the user to define a new object type.

5.7 PRESSURE REDUCER

To insert a **Pressure reducer** into a model, click the icon:

The ArCADia software:

- The **Gas** ribbon ⇒ The **Gas installations** logical group ⇒ 

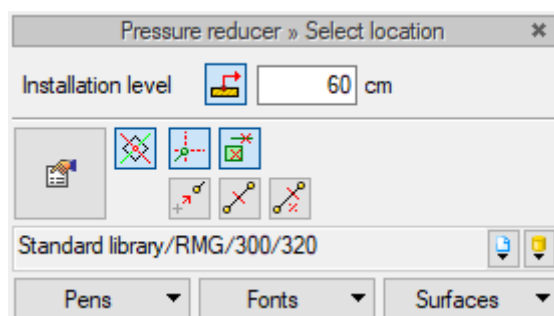
The AutoCAD or INTERsoft-INTELLICAD software:

- The **Gas installations** toolbar ⇒ 

or type


- IGAS_GRD.

An object insertion window is displayed (Drawing 33).



Drawing 33. The Pressure reducer properties window


The window allows the user to set the appropriate pressure reducer insertion position by:

- Setting the pressure reducer installation level: It is possible to enter the installation level manually in the edit box. The  button allows the user to adjust the height to an existing element (e.g. a pipeline). It is necessary to enter an approximate height, especially if there are several elements at different heights in a given location.

Describing and editing items

- Selecting the insert relevant to the already drawn elements feature, i.e. setting the elements detection, elements tracking, sections detection and section ends tracking features.

The window also allows the use of the **Project library**. From the drop-down list of a given library, the user can choose an illustrative type of a pressure reducer and use in the project

The pressure reducer properties editing window is displayed by selecting the  button or double-clicking the inserted element.

Drawing 34. The Pressure reducer properties window

The **Parameters** control group

Setting the pressure reducer installation and technological parameters.

Axis installation level – The user inserts the pressure reducer installation height counting from the floor level to the pressure reducer axis [cm].

Required outlet pressure – Based on technical knowledge, the user enters the outlet pressure required for the installation, from the range of outlet pressures entered in the type parameters, in kPa.

Grupa kontrolek **Parametry Typu**

Name – It is imported from the **Type library** or entered manually by the user in order to define a new object type.

Standard/Producer – They are imported from the **Type library** or entered by the user in order to define a new object type.



Series type – It is taken from the **Type library** or entered by the user to define a new object type.

Inlet/Outlet – The lower part of **Type parameters** is divided into the inlet and outlet of the reducer.

Connection type – It is selected from the drop-down list.

Describing and editing items

Ending material – It is imported from the **Type library** or entered by the user in order to define a new object type.

NOTE! The connection type and ending material may differ for the reducer inlet and outlet. To enter different parameters on either side, click the  padlock to set it in the open position .

DN diameter – The nominal diameter of the connection ending to the gas installation, [mm]. It is selected from the editable drop-down list.

Pressure range – **Min.**, **Max.** – The range is taken from the **Type library** or entered by the user, [kPa].

Row/Output – They are taken from the **Type library** or entered by the user to define a new object type, [m³/h].

Additional description – It is taken from the **Type library** or entered by the user to define a new object type.

5.8 VERTICAL GAS PIPE

To insert horizontal distribution pipelines and connecting pipes, click the icon:

The ArCADia software:

- The **Gas** ribbon ⇒ The **Gas installations** logical group ⇒ 

The AutoCAD or INTERsoft-INTELLICAD software:

- The **Gas installations** toolbar ⇒ 

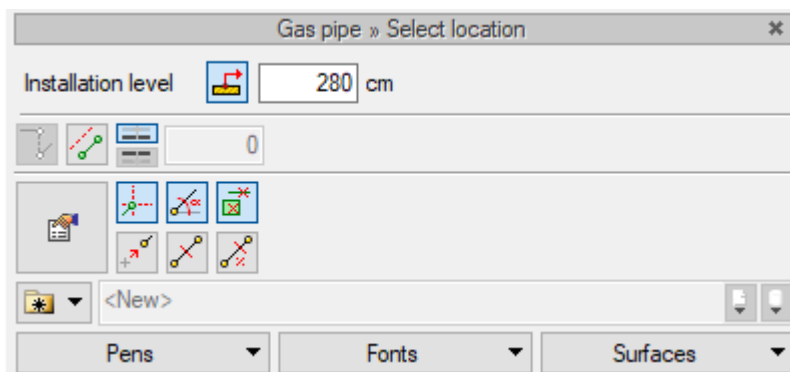
or type

- IGAS_GP.

The pipe insertion window is then displayed. The pipeline is inserted in two stages, divided into the beginning and the end of the pipeline.

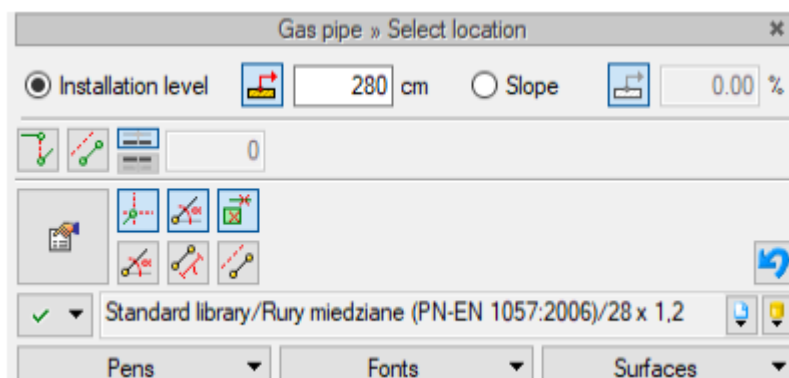
As in previous cases, by unchecking the appropriate check box, the tracking and detecting functions of previously drawn objects are activated.

Pipeline insertion procedures are determined by the appropriate function setting in the gas pipe insertion window.



Describing and editing items


Drawing 35. The view of the horizontal gas pipe insertion window – insertion of the first point

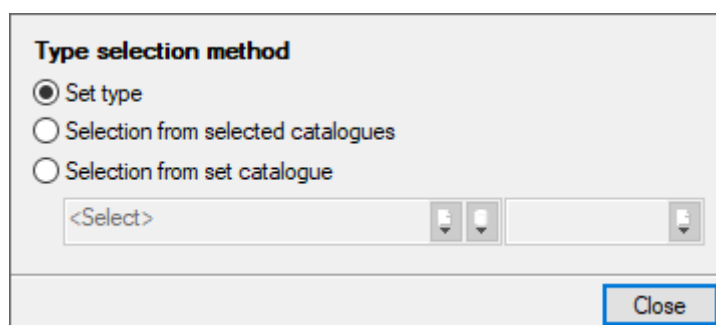


Drawing 36. The view of the horizontal gas pipe insertion window – insertion of the second point

Icon	Description
	Parallel offset (e.g. off a wall)
	Setting the offset direction and value
	Automatic switch-over from a horizontal pipeline to drawing a vertical section

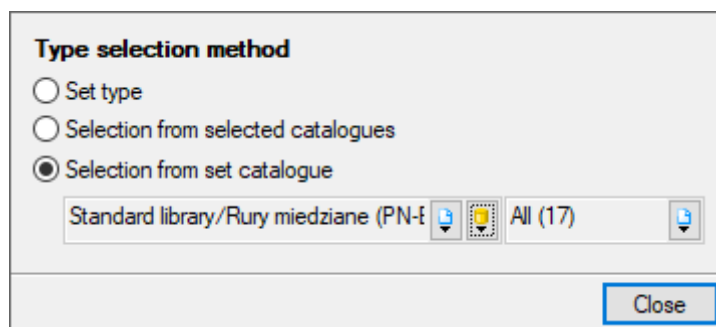
Having selected the pipeline insertion icon from the toolbar, the user can insert the first point of the gas pipe. After clicking in the drawing area, the beginning of the pipeline is inserted and another window is opened to insert the end of the pipeline. After entering the value of the axis installation height for the second point of the pipeline, the user clicks in the drawing area while inserting the pipe section.

- If the user wants to insert a pipeline with a specific slope, he selects the Slope button and enters the slope value, [%]. If the user wants the end of the pipeline to be higher than the beginning, he enters the slope with the “–” sign.
- The **Import from element** checkboxes give the possibility to attach pipeline sections to the previously drawn elements.
- The  icon indicates a certain state of the object regarding the calculations being made. After clicking this icon, it is possible to change the status according to one of the three options:



Describing and editing items

- **Set type** – With this option selected, the user can set the type for the selected element (the field with the **Type library** is unlocked).
- **Selection from selected catalogues** – With this option selected, the elements are taken from the catalogues selected in the **Project options**.
- **Selection from set catalogue** – With this option selected, the catalogue selection box is unlocked. The user can choose one of the catalogues from the **Project library** and the object will be selected from it, regardless of the settings in the **Project options**.



Additionally, there is a possibility to insert a gas pipeline using the so-called continuous route. To do it, click the icon:

The ArCADia software:

- The **Gas** ribbon ⇒ The **Gas installations** logical group ⇒

The AutoCAD or INTERsoft-INTELLICAD software:

- The **Gas installations** toolbar ⇒

or type

- IGAS_GPR.

The tool enables to insert a few sections of various directions in a continuous way, with the heights of the beginning of the first section and the ending of the last sections set.


5.8.1 Odsunięcie równoległe


In the horizontal pipeline insertion windows, there is also the **Parallel offset** function (Drawing 35), available. Selecting this function allows the user to draw a pipeline offset by a given distance, e.g. from another installation or a wall surface line. It is possible to set an offset value in the edit box in the insertion insert window and to indicate the direction of the pipeline offset using and .

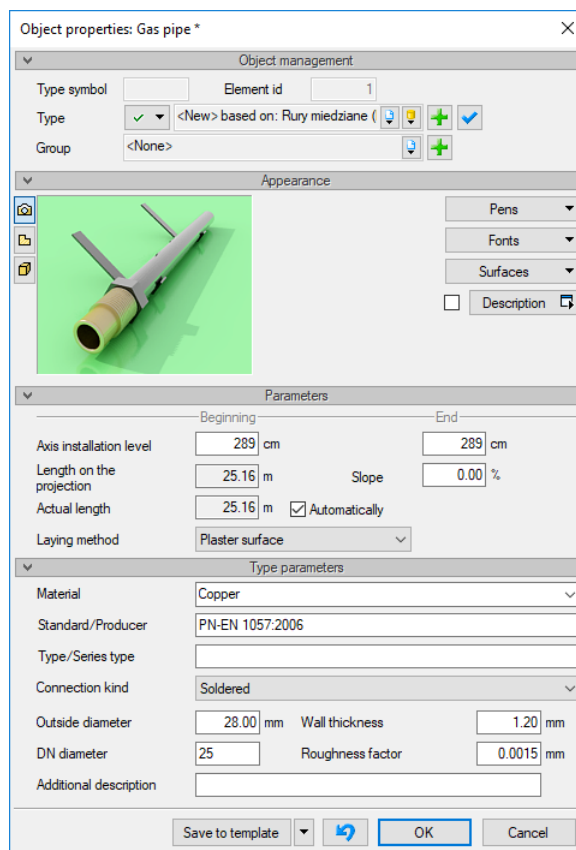
5.8.2 Wstaw pionowy odcinek

During the horizontal gas pipelines insertion, without interrupting the command, vertical sections of the installation can be inserted too. When drawing, after clicking the next point, e.g. the end of a

Describing and editing items

horizontal pipeline (which will also be the beginning of a vertical pipeline), press the  **Insert vertical section** button and enter the height of the end of the vertical section. After clicking, the user can continue entering further horizontal sections.

The gas pipe properties editing window is displayed by selecting the  button or double-clicking the inserted element.



Drawing 37. The Gas pipe properties window

The **Parameters** control group

Axis installation level; Beginning, End – This edit box gives the possibility of entering the appropriate heights of the beginning and end of the pipeline.

Length on the projection – The pipeline length that the pipeline takes up on the projection.

Actual length – The value of the pipeline length that the pipeline actually takes in while taking into account the slope. If the **Automatically** checkbox is selected, the actual lengths calculated by the program will be included in the bill of materials. After deselecting the checkbox, the user can enter any length of the pipeline and this value will be included in the bill of materials.

Laying method – From the drop-down list the user can choose the laying method:

- Plaster surface,
- Plaster flush,
- In channel/service space,
- In sling/brackets.

The **Type parameters** control group

Describing and editing items

Material – It is imported from the **Type library** or entered by the user in order to define a new object type.

Standard/Manufacturer – They are imported from the **Type library** or entered by the user in order to define a new object type.

Type/Series type – They are taken from the **Type library** or entered by the user to define a new object type.

Connection type – It is selected from the drop-down list.

Outside diameter – It is imported from the **Type library** or entered by the user in order to define a new object type.

Wall thickness – It is imported from the **Type library** or entered by the user in order to define a new object type.

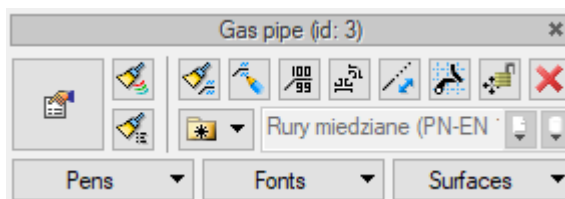
DN diameter – It is imported from the **Type library** or entered by the user in order to define a new object type.

Roughness factor – Its default value is set for steel pipelines ($k = 0.045\text{mm}$). The user can set a different value:

- for copper pipelines $k = 0.0015\text{mm}$,
- for polyethylene pipelines $k = 0.007\text{mm}$.

Additional description – It is imported from the **Type library** or entered by the user in order to define a new object type.

NOTE! When inserting pipelines, it is recommended to select their types from the libraries contained in the project. After selecting a given type, the parameter boxes are filled in automatically.



Drawing 38. The Gas pipe properties window

An additional modifying function is the possibility of lengthening or shortening the pipe while maintaining a slope. – Shorten/lengthen pipe maintaining slope.

The **Insert fittings** function allows the user to generate symbols of fittings that were used to create a connection. After clicking on the circle of fittings, a window opens that allows checking and editing the connection type.

After selecting the **Horizontal pipe** object and after choosing the icon shown on the figure above, the user clicks on a chosen end of a pipe and drags the marker in a chosen direction along the pipeline axis or along the pipeline axis trace.

5.9 VERTICAL GAS PIPE

To insert **vertical distribution gas pipelines (risers)** and **vertical receiver connections**, click the icon:

The ArCADia software:

Describing and editing items

- The **Gas** ribbon ⇒ the **Gas installations** logical group ⇒ 

The AutoCAD or INTERsoft-INTELLICAD software:

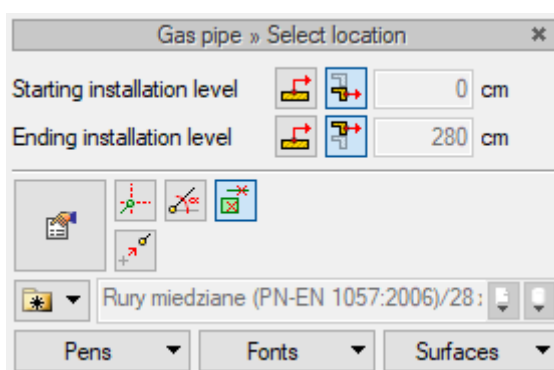
- The **Gas installations** toolbar ⇒ 

or type

- IGAS_VGP.

The window to insert vertical pipes is displayed. As in previous cases, by unchecking the appropriate checkbox, the tracking and detection functions of previously drawn objects are activated.

Pipeline insertion procedures are determined by the appropriate function setting in the vertical gas pipe insertion window.



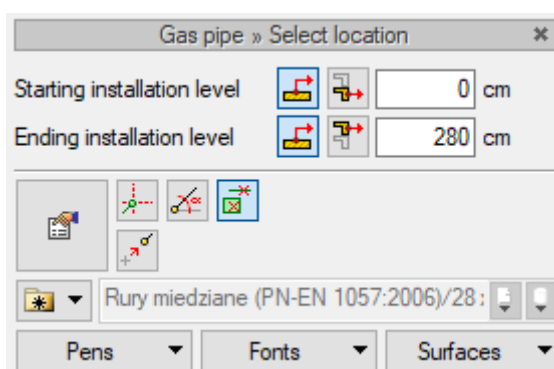
Drawing 39. The Vertical gas pipe insertion window with the feature drawing with height import from the active level



– Import from below level



– Import from above level



Drawing 40. The Horizontal gas pipe insertion window with height import from drawn elements



– Import from element

Inserting a "vertical" pipeline with the manual value entry feature consists in the user entering the starting and ending height of a section in the editing fields.

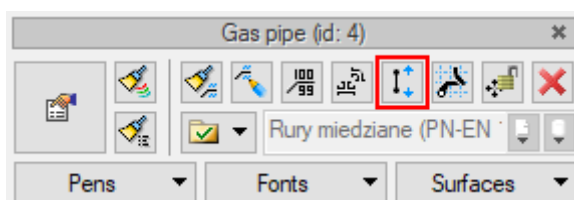
Describing and editing items

Inserting a "vertical" pipeline with the import height from the level activated for the drawing feature allows "punching" the pipeline through building ceilings. A trace (the so-called reference) of the vertical pipe is plotted in the projections of the levels below or above the level where the pipe is inserted. You can continue drawing the riser in the level above from this trace.

The **Import from element** fields allow the user to add pipeline sections to the points of previously drawn elements. For this method, inserting is done in the same way as in the case of horizontal pipes.

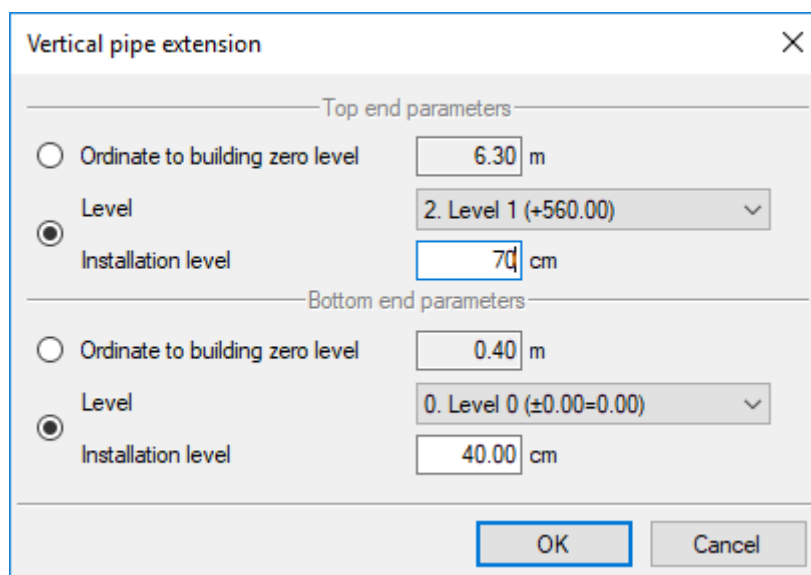
The designed gas pipeline section properties defining window is displayed by selecting the button or double-clicking the inserted vertical pipe section. The window and the functions are the same as in the case of a horizontal pipe. The only difference is the lack of drop (vertical pipe).

The **Extend pipe** icon is located in the vertical gas pipe modification window.



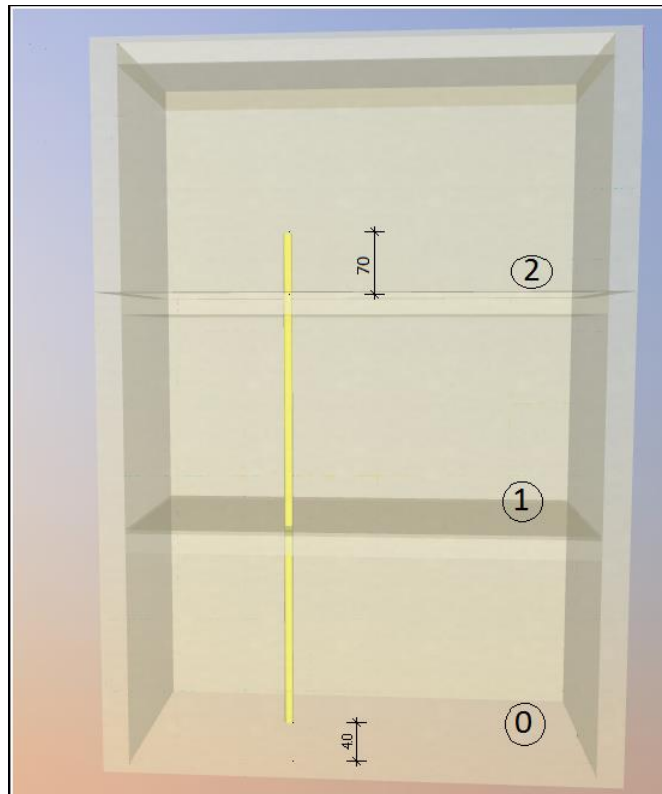
Drawing 41. Vertical pipe modification window view

After the user selects this function, a window appears that allows for changing the position of the vertical pipeline endings with the option of selecting the level on which the pipeline beginning and ending will be located. Below is an example of a vertical pipe extension and a 3D visualisation.



Drawing 42. Vertical pipe extension window

Describing and editing items



Drawing 43. Stack 3D view stretched onto other levels using the Expand stack function.

5.10 EDITING AND ENTERING TYPES

To display the **Type library editor window**, click the icon:

The ArCADia software:

- The **System** ribbon ⇒ The **Libraries** logical group ⇒



The AutoCAD or INTERsoft-INTELLICAD software:

- The **ArCADia-SYSTEM** toolbar ⇒



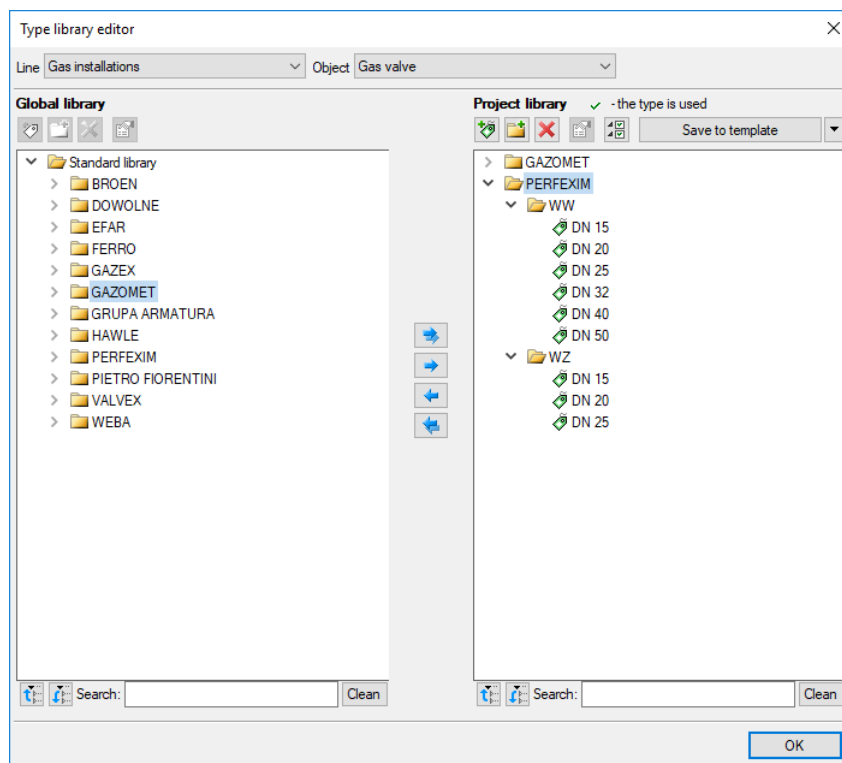
or type

- ISA_ETL.

The **Type library editor** is used to edit and introduce new item types into the **ArCADia** software. It facilitates access to manufacturers catalogues and enables selecting only those catalogues which the user uses most often when designing. Additionally, types are divided into the **Standard library** (i.e.

Describing and editing items

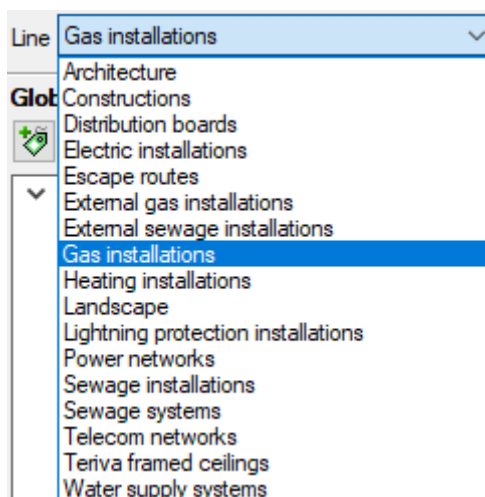
the library provided with a given software version) and the **User library**, where all the new or user-modified element types are saved.



Drawing 44. The Type library editor window

In the upper part of the type editor window (Drawing 44) the user has the possibility to select a branch

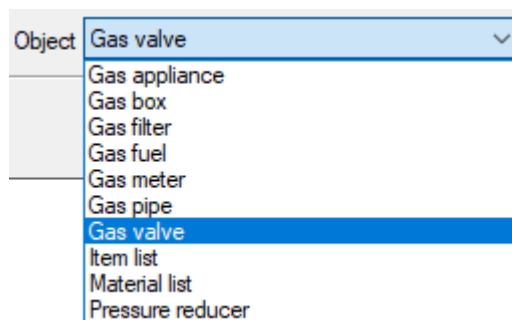
from the drop-down list where all the branch-modules available in **ArCADia** are listed.



Drawing 45. The drop-down list of branches available in the ArCADia system

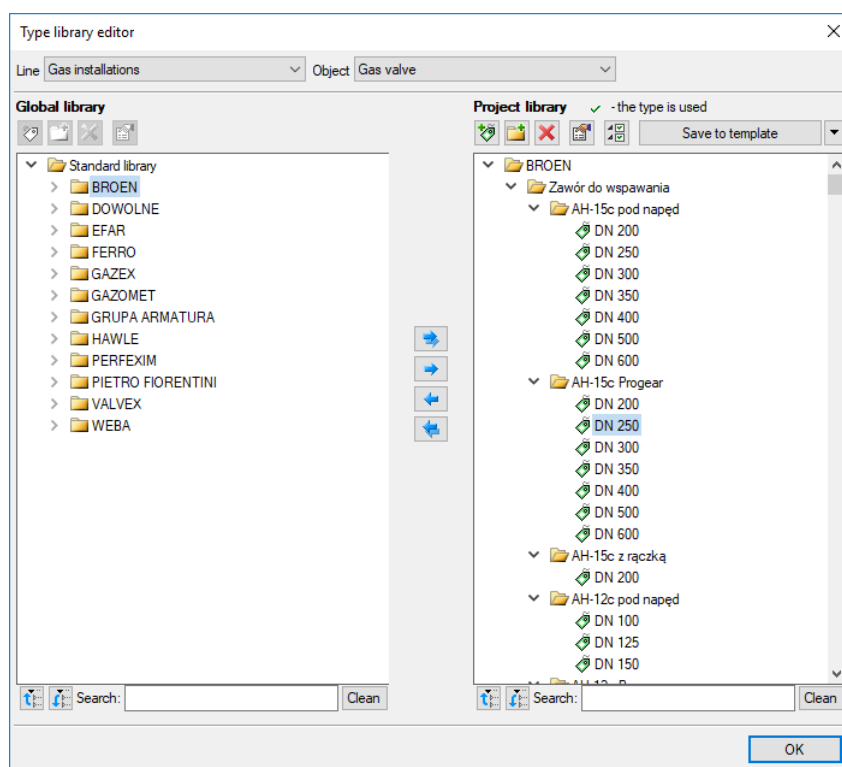
After selecting the desired branch, the user has access to all the objects available in the selected branch (module), e.g. a drainage pipe (Drawing 47).

Describing and editing items



Drawing 46. The list of objects available in gas installations in the ArCADia system

After clicking on a selected item, all types of items will be available in the **Global library**. On the first launch of the program, these will be the **Standard library** types (files included with a given program version). During the design process, it is possible to add additional types to create the **User library**.



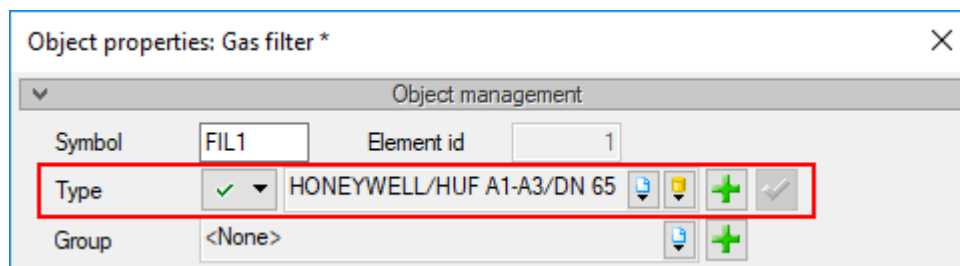
Drawing 47. The Type library editor window after selecting a desired branch and one of its objects

The lower part of the editor window is divided into the **Global library** side (on the left) and the **Project library** side (on the right).

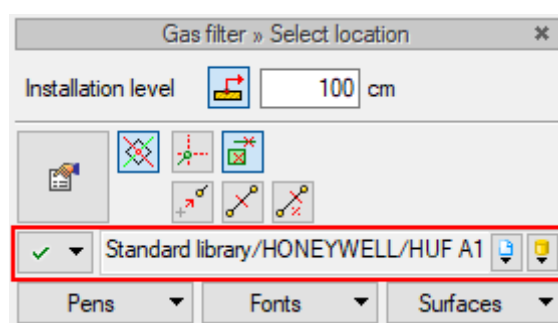
The **Global library** is the place where all types of objects available to the user are added by default, and during the work with the program they are divided into the **Standard library** (not changed by the user and attached to a given software version) and the **User library**, which contains elements (types) entered by the user while working with the program.

Describing and editing items


The **Project library** is the place where all types of objects used in the project or available for use can be found. A type can be given to an element from the element properties window (Drawing 48, Drawing 49):




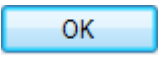
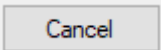
Drawing 48. Type insertion point from the object properties level and in the modification and insertion window



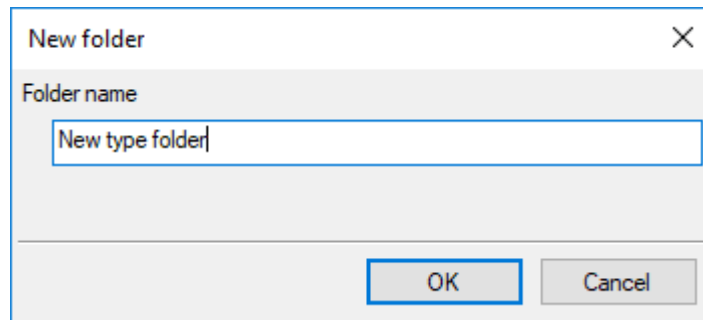
Drawing 49. Type insertion point from the object modification and insertion window level

Add new type  – after clicking this icon the user has the possibility to add a new type to the **Global library** or the **Project library** (to the **User library**). It is also possible to edit type properties for the particular element, where the user may determine all the element's characteristic parameters, including type parameters, view.

NOTE! Clicking the **Add new type** icon when a type has been previously highlighted in the **library** will add a new type based on the highlighted one. This facilitates entering a catalogue of items to the library, e.g. supplied by one company, where the only distinctive feature is e.g. the diameter.

Add new folder  – After clicking this icon, the user can add a new folder, to which he will then be able to add object types. A window will appear with the option of entering the folder name. After typing the name, the user presses the  button to add the folder to the library or  to abort the command.

Describing and editing items



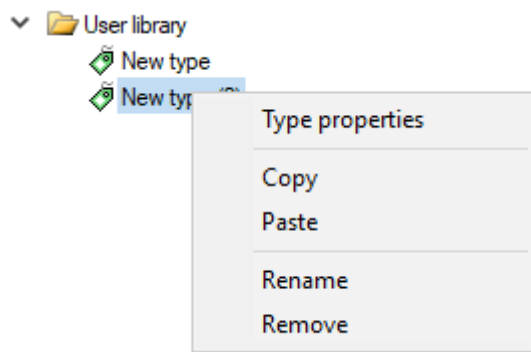
Drawing 50. The inserted type folder window

Delete – after clicking this icon the user may delete the selected type or folder.

Type properties – after clicking this icon the user will have access to the properties of the selected type. These values can be edited and saved here.

Leave only the types used in the project – after clicking this icon in the **Project library**, only the types used in the project (in any object) will remain visible.

After clicking a type with the right mouse button, a menu becomes available:



Type properties – works in the same way as the icon described above.

Copy – copies the type.

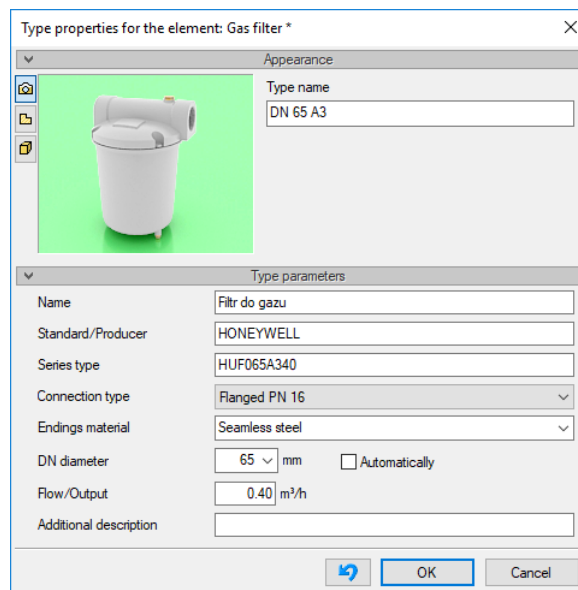
Paste – pastes a previously copied type and inserts it with the same name and subsequent number.

Rename – the user may rename an already inserted type.

Delete – works in the same way as the icon described above.

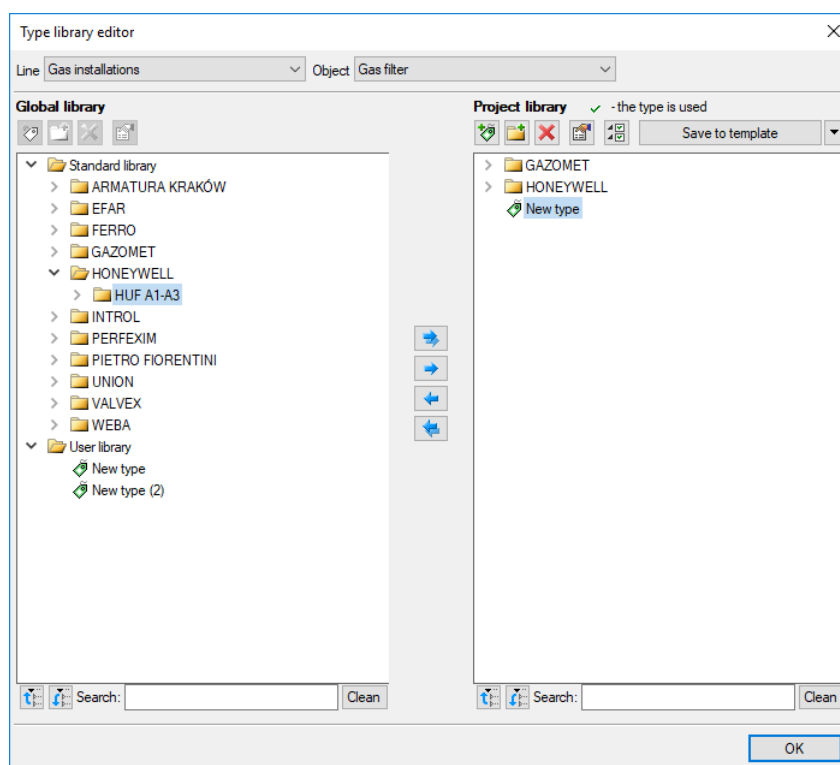
The button is located above the project library. Once you click this button, the **Project library** settings will be saved in the template and will be accessible for future projects using this template. Next to it there is an icon – when clicked, it provides the user with a list of available templates.

Describing and editing items




Drawing 51. An illustrative properties window

In the **Project library** window it is also possible to check which types of a given object are currently used in the project; the ✓ symbol is displayed to the left of such a type name.




Drawing 52. The Type library editor window after entering a type in the Project library

The following icons are available below the two libraries:


Hide everything . After clicking the same icon the types tree in a given library will be hidden down to the main catalogues.


Describing and editing items


Extend everything  After clicking this icon, the type tree in a given library will be extended.


The user may also search the library by typing a part or the entire name of the desired type in the **Search:** field. The **Clean** button is located next to the field. After clicking the button, the editing search field will be cleared.

After selecting types or folders, the transfer buttons located between the libraries are activated.

Copy all to the project library  – copies the entire global library content to the project library.

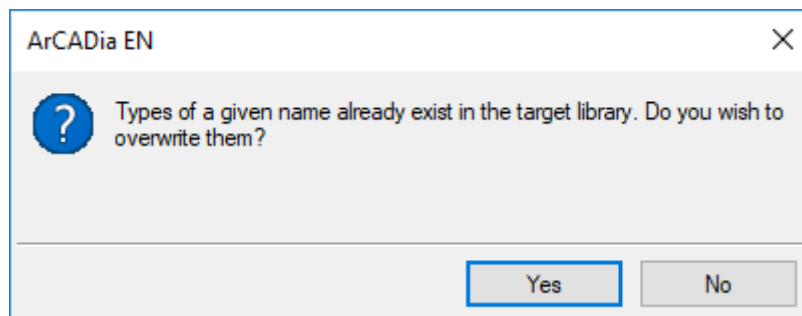
Copy to the project library  – copies the selected elements to the project library.

Copy to the global library  – copies the selected elements to the global library.

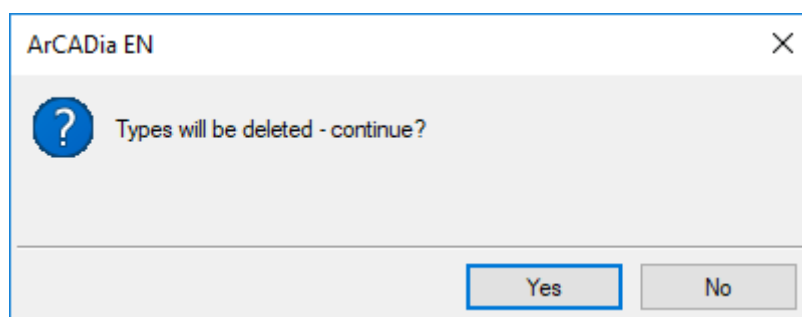
Copy all to the global library  – copies the entire project library content of the selected element to the global library.

Messages that may be displayed when working with the **Type library editor**:

1. This message informs that a type with this name already exists. After clicking the **Yes** button, the data contained in the new type will be saved and will replace the data contained in the previously existing type.

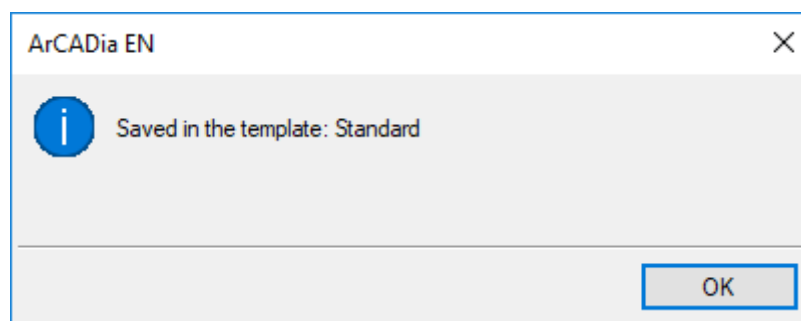


2. This message informs that the types the user selected will be deleted. The **Yes** button confirms deleting types.



3. This message informs that the **Project library** layout has been saved to the project template, e.g. Standard.

Describing and editing items



NOTE! If the user has made any changes in the **Project library** while working with the project, modified existing types or expanded the library by adding new types, the new types will become available for future projects. The user should add the new types to the **Global library** using the transfer buttons.

6 SELECTIVE CALCULATIONS OF ELEMENTS

6.1 GENERAL ASSUMPTIONS FOR AUTOMATIC SELECTION MADE BY THE SOFTWARE

The designer will find it extremely useful when carrying out process calculations that technical parameters of the main elements in the gas installation can be automatically selected by the software.

Objects which have their parameters selected are:


- internal gas installation pipelines
- internal gas installation stop valves
- internal gas installation gas filter.

The selection of items was configured in a manner ensuring that all the borderline conditions determined by the user are met, i.e. conditions for minimum and maximum velocity for design flows in pipelines, permissible unit gas pressure loss and permissible total gas pressure loss.

If the pressure upstream of the receiver is lower than the minimum pressure defined for a given receiver, the user will see the following message: **Minimum pressure not met upstream of the receiver ODB1 (1.59kPa < 1.6kPa).**

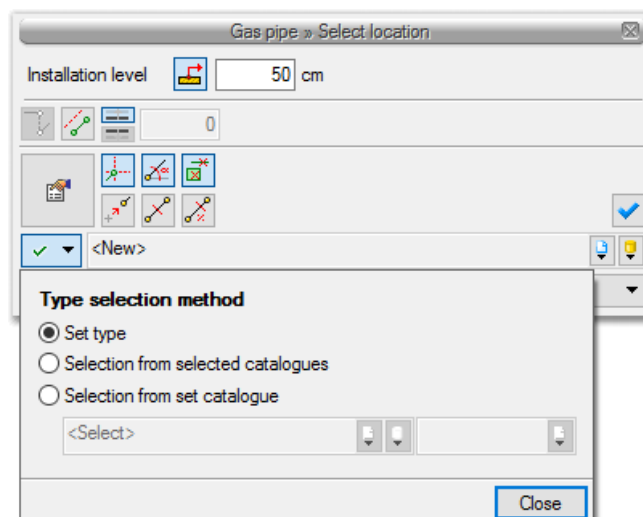
If the maximum pressure upstream of the receiver is exceeded, the user will see the following message: **Maximum pressure exceeded upstream of the receiver ODB1 (4.99kPa < 2.50kPa).**

6.2 INTRODUCING ITEMS MEANT FOR SELECTION

At the beginning the user must input into the **Project library** the types of items they will use in the project, i.e. they select entire catalogues from the pipes and appliances database or select only specific series of type. This is done via the **Type library editor** . From among the selected catalogues the software will select the appropriate item types that meet all the borderline conditions, both for the item, as well as globally.

Each item meant for automatic selection is introduced by defining the state of its technical parameters. In the item insertion window and in the properties window in the **Item management** part you will find a button to extend the selection window – **Type selection method**.

Selective calculations of elements

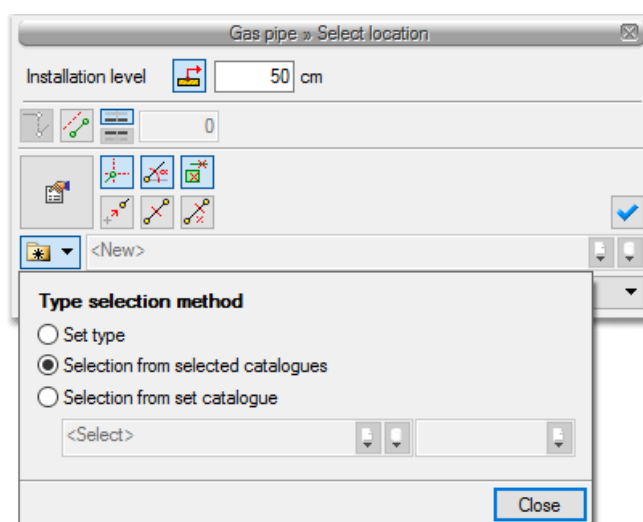


Drawing 53. Parameter selection method switching window – selection method for Set type

After pressing the button a list containing three methods of setting the parameter selection method is extended.

Set type – in this method the users determines the type of an item, i.e. selects exactly one item. Selecting this method activates the **Project library** button, which allows extending the list. From a list of item types the user selects one item type (one pipeline). After starting automatic selection this item will be included in the calculations, however it will not change its parameters and will not be replaced, even if it does not meet the selection criteria. This way the user “freezes” the item.

Selection from selected catalogues – this method is the default for each item. This involves the full range of item selection.

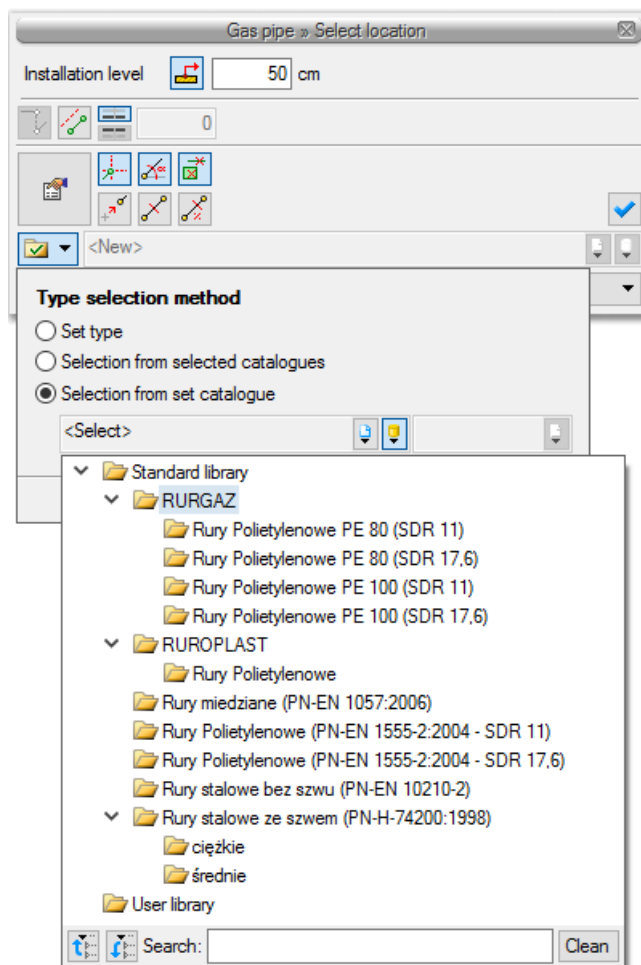


Drawing 54. Parameter selection method switching window, selection method for Selection from selected catalogues

The **Project libraries** lists are greyed out. Parameters are selected from the catalogue of items selected in the Selection options, which is activated with the button from the toolbar.

Selective calculations of elements

Selection from set catalogue – this selection feature enables selecting an item from a single pre-determined catalogue, independent of the catalogues selected in the options.



Drawing 55. Type selection method switching window – the Selection from set catalogue method

This method of selection enables the user to automatically select a type of item from a particular catalogue. In the case of pipelines, when using this selection option the user may ensure that a section will be made of steel, regardless of the entire installation be made of pipes of a different material. Only the section diameter will be selected then, with the pre-determined material and series of type.

6.3 STARTING THE SELECTIVE CALCULATIONS OF ELEMENTS AND SETTING THE OPTIONS OF SELECTIVE CALCULATIONS

After drawing the installation and checking the correctness of the connections, the user can run the selective calculations of pipelines and fittings. To start **Installation item selection**, click the icon:

The ArCADia software:

- The **Gas** ribbon ⇒ the **Gas installations** logical group ⇒



Selective calculations of elements

The AutoCAD or INTERsoft-INTELLICAD software:

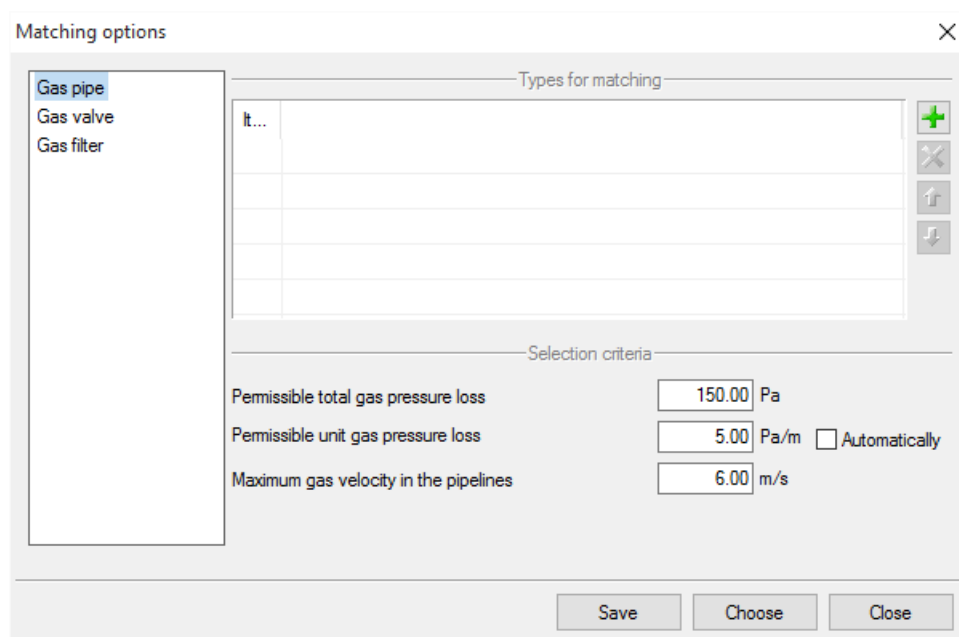
- The **Gas installations** toolbar ⇒ 

or type

- IGAS_MAT.

6.4 SELECTION CRITERIA DETERMINATION

Once the icon is pressed, the following selection options window is activated:

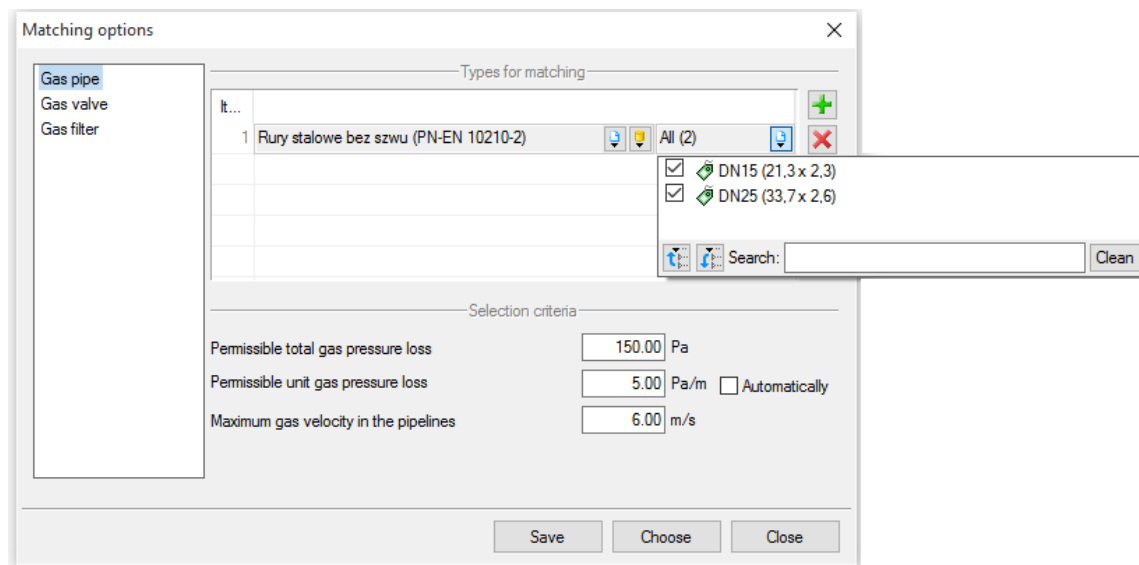


Drawing 56. Selection options window – determining selection criteria

Before pressing OK the user may use the default selection criteria or input their own item selection criteria. The basic criteria determined by the user are the velocity in the pipelines and permissible pressure losses: total and unit.

Should the user make a full selection of pipelines or other items, they must indicate the catalogues or items for selection from the **Project library**.

Selective calculations of elements



Drawing 57. Matching options window, selection of element types for matching

Once a particular group of items is selected (e.g. **Gas pipe**), the user may add catalogues by marking the selected ones. To select another catalogue of types, a new item needs to be added by clicking **+**.

After setting all the items included in a project and pressing the **Match** button, an item will be selected.

The user may preview calculations in the calculations table, where he can introduce the necessary corrections.

7 CALCULATIONS AND RESULT INTERPRETATION

7.1 VERIFYING THE VALIDITY OF A DRAWN INSTALLATION

After an installation is drawn you can verify the design for connections between pipelines and connections between the installation and the main gas box and receivers. To start the installation verification feature, click the following icon in the software toolbar:

ArCADia software:

- **Gas ribbon** ⇒ **Gas installations** logical group ⇒ 

AutoCAD or INTERsoft-INTELLICAD software:

- **Gas installations** toolbar ⇒ 

or write

- IGAS_VER.

The table contains information concerning the number of discontinuities in the installation. The program detects elements of the installation that are not connected or pipeline sections that are not connected to a gas box or receiver.

After clicking the error information, the user will activate the drawing error detection feature. The software will highlight the routes and elements where errors occur. The designer can correct the drawing by connecting elements in order to ensure continuity of the installation. After the corrections are implemented, the software will prepare a report informing the user about the validity of the designed installation.







In the left part of the window the user may filter errors and display only the selected descriptions. The user may select the main gas box from the previously added items in the **Installation** drop-down list. The user may limit the range of errors displayed for a particular level in the **Placement** drop-down list. The **Elements** drop-down list gives the user the possibility to choose one of the several element groups that were not connected. If there are connection errors in receiver or valves groups, the user may select e.g. only the valves. From the **Category** drop-down list the user selects the error type that occurs in the project: unconnected elements, faulty connection.

After selecting from the drop-down lists the user can select the items that are not connected and that have been assigned to a particular grouping in the drawing. To do that, press the **Show selected** button. The installation projection view area will then be moved to the particular part of the installation drawing that includes the group of connection errors and the erroneously connected elements will be marked with dotted lines with the handles visible.

Calculations and result interpretation

Message window: 6 of 6



Filters		Messages		
Installation	Location	Elements	Category	Show selected
All	All	All	All	

Icon	Installation	Location	Description
	SZG1	PARTER	The installation design is correct
	SZG2	PARTER	Gas box without any flow
	SZG2	PARTER	Outdoor gas installation must be correctly calculated to automatically calculate installi
		PARTER	Unconnected pipeline
		PARTER	Unconnected pipeline
		PARTER	The element is not connected to any path: Gas appliance ODB6





OK

Drawing 58. Table – Designed installation validity gas installation report

Message types (message icons differ):

- Information 
- Warning 
- Error 

Message content - Interpretation

-  **The installation design is correct**
The message appears when there is a main gas box present in the installation and all the items which are directly or indirectly connected to that point are creating an installation that is correctly designed in terms of connections.
-  **Unconnected pipeline**
The message appears when there is an unconnected pipeline in the project.
-  **Unconnected items: e.g. Gas valve ZG2**
The message appears when an item is not connected to any pipeline.
-  **Item unconnected to any path: Receiver ODB2**
The message appears when an item (also a pipeline) is not directly or indirectly connected to the main gas box. (It can be connected to the pipelines, although these pipelines are not connected to the box).

7.2 CALCULATIONS

After verifying the validity of the installation model created and selecting diameters, you can carry out calculations. In order to do that press the following icon in the software toolbar:

ArCADia software:

Calculations and result interpretation

- **Gas** ribbon ⇒ **Gas installations** logical group ⇒



AutoCAD or INTERsoft-INTELLICAD software:

- **Gas installations** toolbar ⇒

or write

- IGAS_CALC.

Then a calculation table window appears. The window includes two tables.

The top table is used to select the calculation path where the pressure losses and pressure value upstream from the gas receiver will be calculated. By ticking the check box at the particular receiver the user selects the path where they will carry out the calculations. The user is then informed about the total design section length and the maximum permissible unit pressure drop. The value of the permissible unit pressure drop is determined so that in the path to the receiver the total pressure drop will not exceed the value determined for the particular connection type.

Once the check box is ticked, the lower calculation table is filled. Calculations will be carried out starting from the selected receiver and ending at the main box. The software calculates the line losses and local losses in the design sections and provides the total pressure loss in the path to the gas receiver. The following values are listed under the table:

- Sum of pressure losses [Pa] – the total of all the pressure losses in the calculation path,
- pressure recovery/loss – pressure change resulting from the difference in gas and air density and the height of the gas receiver installed. In case of a gas that is lighter than air pressure is recovered, whereas in case of a gas heavier than air there is a pressure loss and the value is negative.
- total pressure loss – pressure drop accounting for the recovery or loss
- minimum and maximum gas pressure upstream from the gas device.

Calculations and result interpretation

Calculations

Paths

Messages

	Path	Total pipeline...	Max. unit pre...	Report		Description
<input checked="" type="checkbox"/>	Q SZG1 - ODB2	34.42	3.35	<input checked="" type="checkbox"/>		
<input type="checkbox"/>	Q SZG1 - ODB3	31.00	3.72	<input type="checkbox"/>		
<input type="checkbox"/>	Q SZG1 - ODB5	30.98	3.72	<input type="checkbox"/>		
<input type="checkbox"/>	Q SZG1 - ODB3	29.15	3.96	<input type="checkbox"/>		
<input type="checkbox"/>	Q SZG1 - ODB4	28.32	4.07	<input type="checkbox"/>		
<input type="checkbox"/>	Q SZG1 - ODB2	28.27	4.08	<input type="checkbox"/>		
<input type="checkbox"/>	Q SZG1 - ODB4	25.94	4.45	<input type="checkbox"/>		

Calculations

	Section name	Qr [m³/h]	f	Qobl [m³/h]	Dimension...	v [m/s]	Lzrr [m]	Lzkl [m]	Lztp [m]	Lzto [m]	Lzz [m]	Lo [m]	Lco [m]	Δha [Pa]	Δhj [Pa/...	Δh [Pa]
Q	ODB2 - g1.7	2.09	1.000	2.09	26.90 x 3.20	1.76	0.70	3.90	0.00	0.00	0.20	6.28	11.08	0.00	2.62	29.06
Q	g1.7 - g1.8	3.02	1.000	3.02	33.70 x 4.00	1.62	0.70	7.80	0.00	1.10	0.30	9.73	19.63	0.00	1.68	32.97
Q	g1.8 - g1.9	5.11	1.000	5.11	33.70 x 2.60	2.22	0.00	0.00	0.00	1.40	0.20	0.30	1.90	0.00	2.54	4.82
Q	g1.9 - g1.6	8.13	1.000	8.13	42.40 x 4.00	2.43	0.00	0.00	0.50	0.00	0.20	0.30	1.00	0.00	2.31	2.31
Q	g1.6 - g1.4	11.37	1.000	11.37	48.30 x 5.00	2.74	0.00	0.00	0.00	1.90	0.25	3.00	5.15	0.00	2.49	12.81
Q	g1.4 - g1.2	14.39	1.000	14.39	48.30 x 3.20	2.90	0.00	0.00	0.00	1.90	0.25	0.30	2.45	0.00	2.44	5.99
Q	g1.2 - g1	17.63	1.000	17.63	60.30 x 5.00	2.46	0.00	0.00	0.00	2.70	0.30	2.35	5.35	0.00	1.45	7.77
Q	g1 - SZG1	19.63	1.000	19.63	60.30 x 5.00	2.74	0.00	9.50	0.00	2.70	0.30	12.17	24.67	0.00	1.75	43.28

Permissible total pressure loss

150.00 Pa

Pressure loss sum

139.01 Pa

Permissible unit pressure loss

3.35 Pa/m

Pressure recovery/loss

39.33 Pa

Min. pressure at the path end

1.89 kPa

Measurement devices pressure loss

8.00 Pa

Max. pressure at the path end

2.39 kPa

Total pressure loss

107.68 Pa

Apply

Report

Close

Drawing 59. Calculation tables view

The table's columns include:

Column 1 – Design **section name** constituting the route between the gas source and the receiver. Design section marking. Beginning and ending design sections node numbers.

After selecting the design section and carrying out calculations, design section markings will appear in the projection and the extension. Changing the design route selection causes the design section markings for the new routes to be re-drawn.

Column 2 – Real gas flow

If the heat power M of a gas device is known and the fuel value determined in the gas box parameters window is also known, the following parameter is calculated:

Real gas flow $Q_r = (M/H_i) \times 3.6$ [m³/h],

where:

M - receiver power in kilowatts [kW]

H_i – gas fuel value [kW/m³].

If the design section supplies gas to n receivers, information about the total power of the supplied receivers is assigned to it.

Real gas flow – $Q_r = (\Sigma M/H_i) \times 3.6$ [m³/h]

Column 3 – Simultaneity factor

A simultaneity factor value is assigned to the design section. The value is calculated using R.Zajda's formula $f = 1/n^{0.52}$, where n is the number of simultaneity groups.

Column 4 – Design gas flow

The design flow is the product of the real flow and the simultaneity factor.

$Q_{obl} = Q_r \times f$,

Calculations and result interpretation

where f is the simultaneity factor.

If the design section supplies gas to m gas receivers (m – number of receivers) divided into n simultaneity groups (n – number of simultaneity groups) and for k gas receivers not included in a simultaneity group, then the design section gas flow calculation formula for the i -section will be:

$$Q_{obl, i} = (Q_1 \times f_n + Q_2 \times f_n + Q_3 \times f_n + \dots + Q_m \times f_n) + Q_a + Q_b + Q_c + \dots + Q_k$$

$Q_1 \dots Q_m$ – real gas consumption for receivers included in n simultaneity groups

$Q_a \dots Q_k$ – real gas consumption for k receivers not included in simultaneity groups

Column 5 - Dimensions

Diameters from the drawing are included in column 5, or if the user selects automatic diameter value selection, these will be automatically adjusted. Further calculations will be based on the pipe inside diameter.

Column 6 – Calculated velocity

Column 6 presents the calculated velocity value for a given design section.

Columns 7-11 – Substitute lengths of local resistances

Shut-off fittings (valves) and moulds, which will automatically assume the diameter of the pipelines, may be installed in a particular section.

Each element of the fittings and a mould causes local pressure loss. Local losses are converted into the so called **substitute lengths L_z** for the particular diameter. Substitute lengths of the elements in a design section will be summarized and their total will then be added to the length of a particular design section. In other words, the real design section length will be increased by the total of the substitute lengths.

Tab. 6. The substitute lengths for fittings and moulds in meters of the pipeline with a particular diameter

Fitting types	Nominal diameters [mm]								
	10	15	20	25	32	40	50	65	80
Ball valve	0.10	0.15	0.30	0.30	0.30	0.40	0.50	0.60	0.90
Angle valve	0.30	0.40	0.70	0.70	0.80	1.10	1.70	2.10	3.00
Elbow	0.40	0.55	1.30	1.30	1.50	1.80	1.90	2.10	2.90
Reducer	0.10	0.10	0.10	0.15	0.20	0.25	0.30	0.50	0.70
T-straight flow	0.10	0.15	0.40	0.40	0.50	0.70	1.00	1.30	1.80
T-turning flow	0.25	0.40	0.90	1.10	1.40	1.90	2.70	3.20	4.50

*Main gas stream at 90°

Column 12 - Section length

Calculations and result interpretation

The real design section length, or in other words the distance between the nodal points, is imported from the drawing into this column.

Column 13 - Total section length

The total section length is the sum of the real length and substitute lengths in the particular section.

$L_{co} = \Sigma L_z + L_o$ [m], where:

ΣL_z – substitute lengths total

L_o – section length

Column 14 - Unit pressure loss

Calculating the unit pressure loss (per 1 m of the pipeline)

The unit pressure drop is calculated using the formula:

$$\Delta h_j = H_{min.i} \cdot \left(1 - \sqrt{1 - 1.25 \cdot 10^8 \cdot \lambda \cdot \rho_g \cdot \frac{Q_{obl}^2}{d^5 \cdot H_{min.i}}} \right)$$

where:

Δh_j – unit pressure drop (Pa/m),

H_{min} – minimum installation input pressure [Pa],

λ – pipeline wall friction factor,

d – pipeline inside diameter (mm),

Q_{obl} – design flow [m³/h].

Calculating the friction factor

$$\lambda = \left[-2 \lg \left(\frac{2.51}{\frac{w_{rzobl} \cdot d \cdot 0.001}{\nu} \cdot \sqrt{\frac{0.3164}{\left(\frac{w_{rzobl} \cdot d \cdot 0.001}{\nu} \right)^{0.25}}} + \frac{k}{3.71 \cdot d}} \right) \right]^{-2}$$

where:

ν – gas kinematic viscosity (for group E natural gas the kinematic viscosity shall be assumed at 14.3×10^{-6} m²/s),

k – roughness factor (0.045mm for steel pipes and 0.0015mm for copper pipes),

w_{rzobl} – real design velocity:

$$w_{rzobl} = \frac{Q_{obl}}{3600 \cdot A} \text{ [m/s]},$$

where:

A – the internal pipe cross-section area is calculated using the formula:

Calculations and result interpretation

$$A = \pi \frac{(d \cdot 0.001)^2}{4} [m^2]$$

While selecting the automatic diameter selection function, the pressure loss value in a particular section per 1 m of the pipeline should not exceed $\Delta h_{\max} = \Delta h_d / 1.3 L_c$ [Pa/m].

Column 15 – Pressure loss

The pressure loss Δh on the design section is calculated in this column.

$$\Delta h = L_{co} \times \Delta h_j [\text{Pa}]$$

Total pressure loss control

The value of the section slopes listed in column 15 will be summed up, giving the sum of pressure losses in the design route $\Sigma \Delta h$

Pressure recovery/loss calculation control

Pressure loss due to the difference of heights between the source of gas (pipeline end next to the main gas box) and the highest gas receiver in a particular route occurs in gas installations. This is the so-called pressure recovery or pressure loss

If the specific density of the gas fuel is lower than air density under the same pressure and temperature conditions, then pressure recovery will occur (positive value).

If the gas density is higher than that of air, a pressure loss will occur (negative value) .

$$\Delta h_{od} = (\rho_p - \rho_g) \times (W_o - W_s) \times 9.81 [\text{Pa}]$$

where:

W_s – height of the lowest point at the gas box [m],

W_o – height of the highest installation point at the gas receiver [m],

ρ_p – air density (1.293 kg/m³ under normal conditions),

ρ_g – gas density under the same pressure and temperature conditions as for air.

Total pressure loss control

The total pressure loss is calculated as the difference between the sum of pressure losses and the value of recovered pressure

$$\Delta H = \Sigma \Delta h - \Delta h_{od} [\text{Pa}]$$

Minimum gas pressure upstream from the gas receiver is calculated using the formula:

$$P_{\min} = P_{p\min} - (\Delta H \times 1000) [\text{kPa}]$$

Maximum gas pressure upstream from the gas receiver is calculated using the formula:

Calculations and result interpretation

$$P_{\max} = P_{p\max} - (\Delta H \times 1000) \text{ [kPa]}$$

Designed installation diameters validity assessment criteria

The diameters assumed for the particular design paths must meet the conditions for comparison with the permissible values.

Permissible pressure loss on a critical path

$\Sigma \Delta h \leq \Delta h_d$ – the total of section pressure losses should be lower or equal to the permissible pressure loss in the critical path from the least favorably located receiver to the gas box.

Minimum pressure criterion upstream from the gas receiver – in each design path

$$P_{\min} \geq P_{d\min}$$

Minimum pressure criterion upstream from the gas receiver – in each design path

$$P_{\max} \leq P_{d\max}$$

If in a particular design path the designer does not obtain values that meet the criterion or better diameter optimization is possible, it is possible to change the diameters of the pipeline set constituting a particular design section.

7.3 CALCULATION DIAGRAMS AND REPORTS

Once a drawing is created and verified for validity, the designer may generate a calculation diagram in the form of an extension and axonometry.

7.3.1 Gas installation extension

Entire installation extension

Click the icon:

ArCADia software:

- Gas ribbon \Rightarrow Gas installations logical group \Rightarrow 

AutoCAD or INTERsoft-INTELLICAD software:

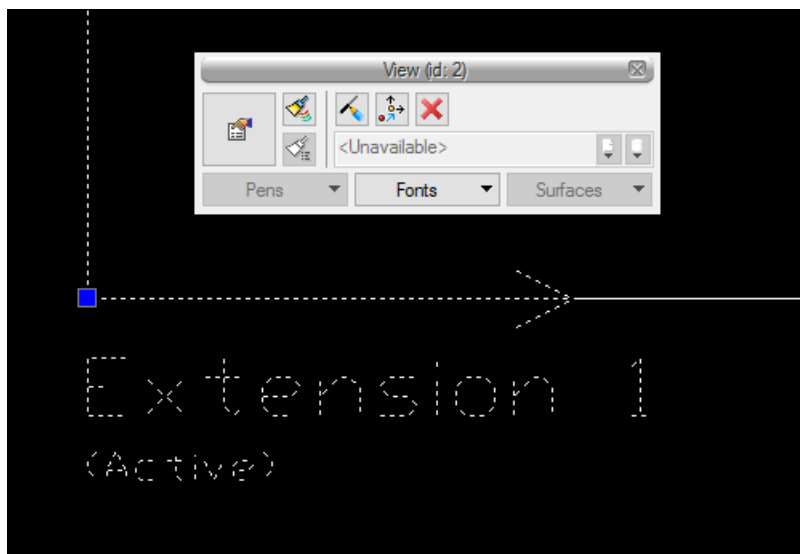
- Gas installations toolbar \Rightarrow 

or write

Calculations and result interpretation

- IGAS_AMPLVA.

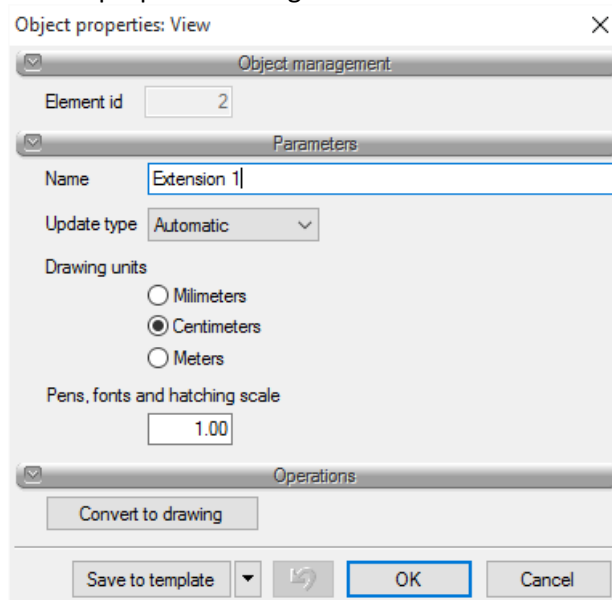
After clicking the **Insert extension** icon, locate the view handle of the extension area on the drawing.



Drawing 60. Extension handle view

A modification window becomes available after selecting the handle.

The extension drawing can be copied, if manual refreshing option is turned on . The handle location against view may be changed from this window by clicking the icon , and then clicking on the new position. The view can be deleted by clicking the delete icon . The user may also click the properties icon and the view properties dialog box will become available.



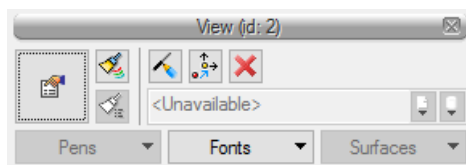
Drawing 61. Axonometry view properties window

In the properties window is possible to select whether the extension view should be refreshed manually or automatically. Automatic refreshing may slow down the software slightly when working with large installations, as the extension drawing is copied each time an element is added or


Calculations and result interpretation


removed from the projection. In such a case manual refreshing allows the user to make several changes and refresh the drawing afterwards.


After clicking on the frame of the inserted extension, an extension modification window appears.

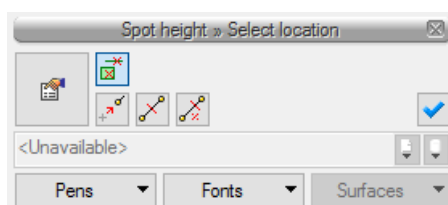


Drawing 62. Extension modification window

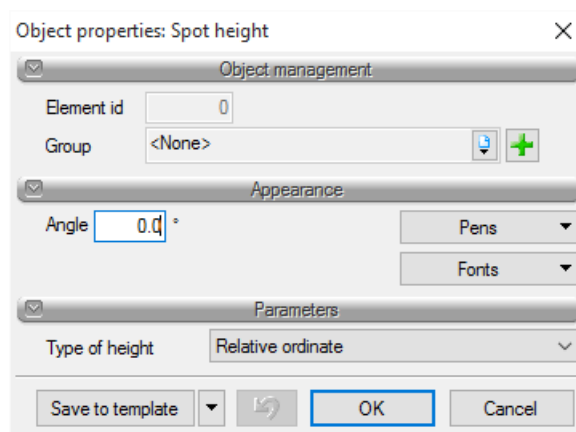
The  icon refreshes the view when working in the manual refreshing mode.

After clicking the icon , the user may insert a spot height for selected pipelines by clicking on them. A spot height will be inserted automatically.


Extension marking, inserted in the extension view, can be turned off and on by clicking the  icon.



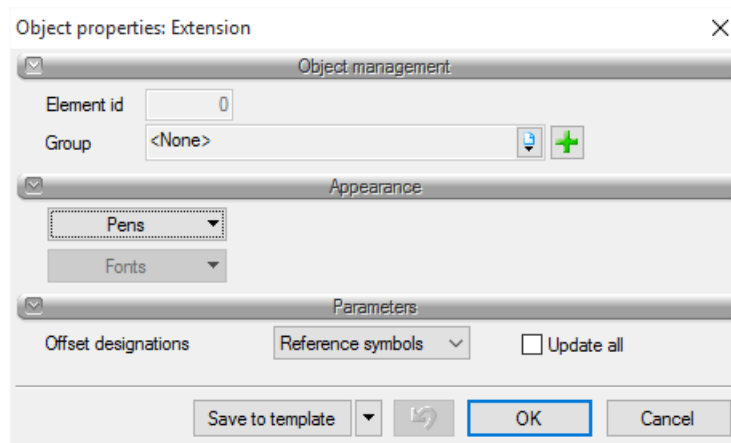
Drawing 63. Spot height modification window view



Drawing 64. Spot height properties window

Extension view properties may be displayed by clicking the  icon – in such a case the **Object properties: Extension** window will become available (Drawing 65).

Calculations and result interpretation

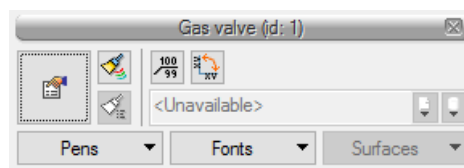


Drawing 65. Extension properties window

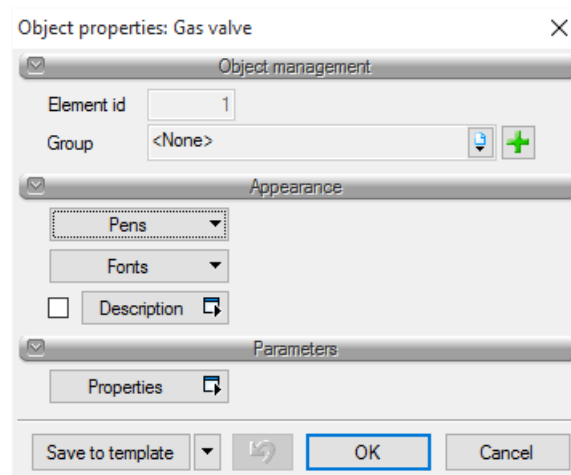
Offset designations may be changed in this window: symbols or lines and after selecting **Update all** the changes will be applied to all offsets.

After selecting an element in the extension, a modification window will become available.

1. Items



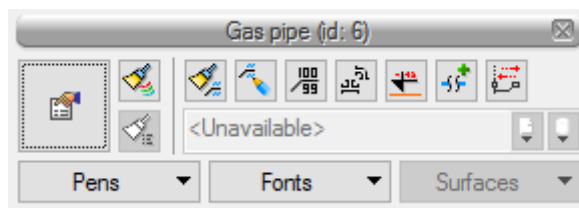
Drawing 66. Extension item modification window




Drawing 67. Extension item properties window

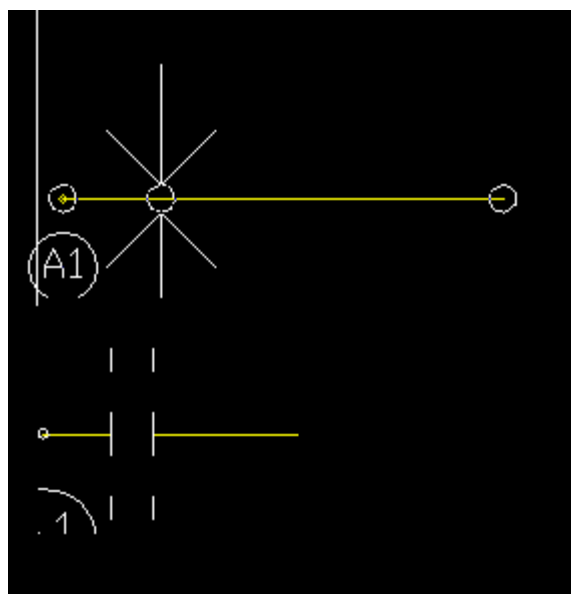
2. Pipelines

Calculations and result interpretation




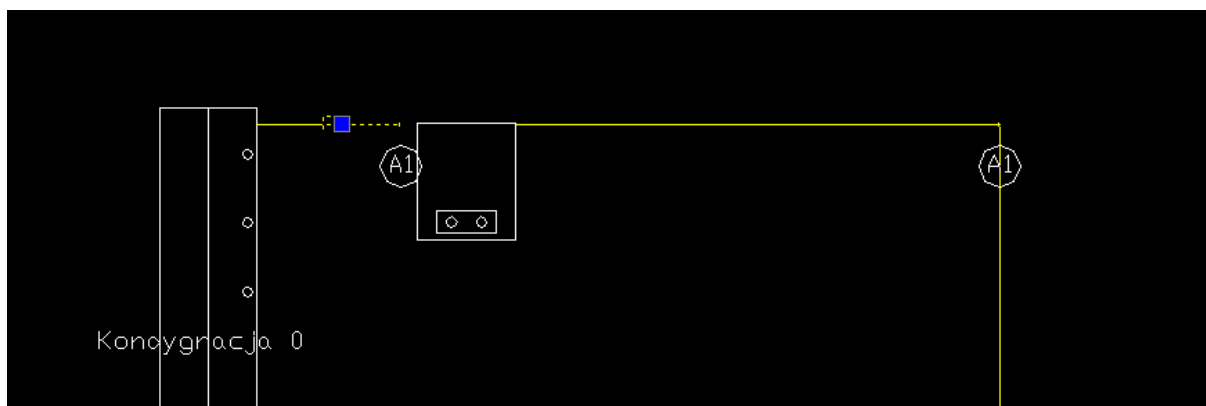
Drawing 68. Extension pipeline modification window

 **Enable/Disable apparent shortening** – by clicking on this icon the user may determine two points on the selected pipeline, which will delimit the section where the pipeline is to be “apparently cut out” so that pipe is apparently shortened.




Drawing 69. Selecting the element section for shortening and view after apparent shortening.

 – **Change extension direction** – the software automatically generates extensions, also from vertical pipelines. The user may change the direction of the extension by marking a distant pipeline which is a direct extension of a vertical pipe (Drawing 70).



Drawing 70. Selected pipeline view

 – deleting and re-adding automatically created offsets.

Installation section extension

Click the icon:

ArCADia software:

- **Gas ribbon** ⇒ **Gas installations** logical group ⇒



AutoCAD or INTERsoft-INTELLICAD software:

- **Gas installations** toolbar ⇒

or write

- IGAS_AMPLVB.

After clicking the installation section extension icon, the user defines which part of the installation shall be visible on the extension. An extension will be created from the selected pipe to the receivers located on a given branch.

7.3.2 Gas installation axonometry***Entire installation axonometry***

Click the icon:

ArCADia software:

- **Gas ribbon** ⇒ **Gas installations** logical group ⇒



AutoCAD or INTERsoft-INTELLICAD software:

- **Gas installations** toolbar ⇒

or write

- IGAS_AXVA.

Inserting and editing the axonometry view itself is analogous to inserting an extension view.

Installation section axonometry

Click the icon:

ArCADia software:

- **Gas ribbon** ⇒ **Gas installations** logical group ⇒



AutoCAD or INTERsoft-INTELLICAD software:

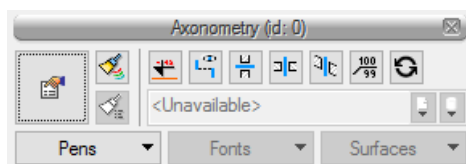
- **Gas installations** toolbar ⇒




or write

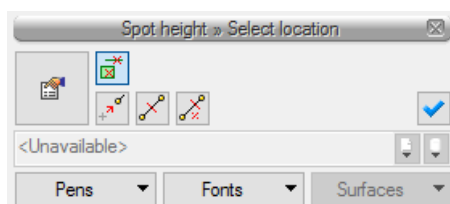
- GAS_AXVB.

Inserting and editing the installation section axonometry view is analogous to inserting an extension view.

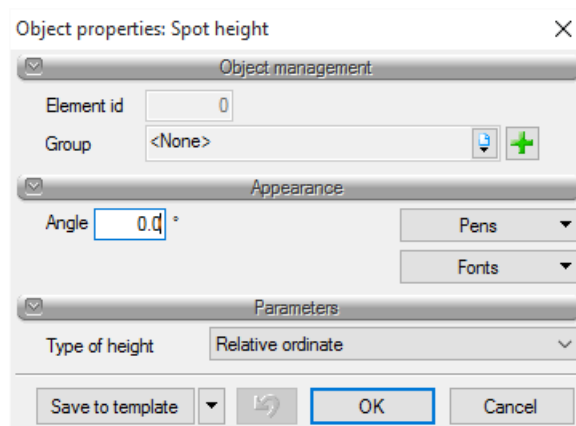


Drawing 71. Axonometry modification window

After clicking the  icon, the user may insert a spot height for the selected pipelines by clicking on them. A spot height will be inserted automatically.





Drawing 72. Spot height modification window view

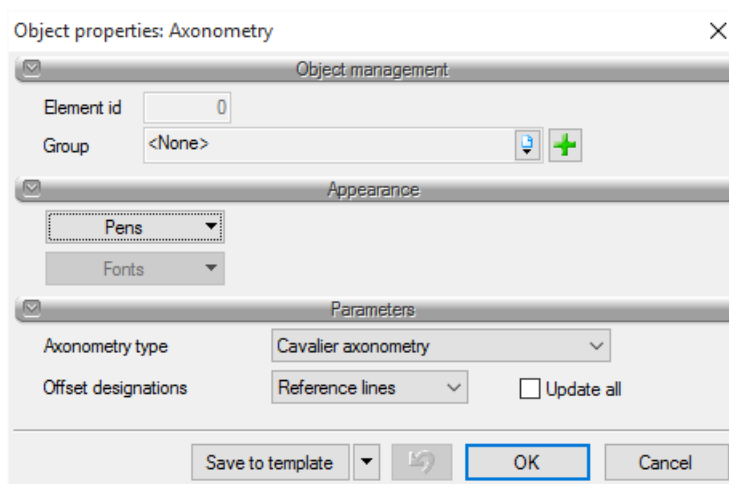


Calculations and result interpretation

Drawing 73. Spot height properties window

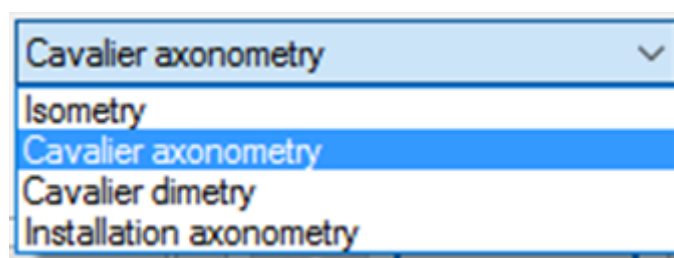
After clicking the  icon, extension marking inserted in the extension view can be enabled or disabled.

The user may also click the go axonometry view properties icon  – in such a case the Axonometry element properties window will become available.



Drawing 74. Axonometry properties window

Axonometry type – the user can select four types of axonometry from a drop-down list. Installation axonometry is also available apart from the standard types such as Isometry, Cavalier axonometry and Cavalier diameter. The former maintains the lengths from the projections in the axonometric view and is recommended when drawing a view of the entire system, rather than a branch of the installation and in the case of an installation that runs with parallel pipelines without slope.



Offset designations – the user selects one of the two offset insertion possibilities for the axonometry: these can be reference lines or reference symbols and an **Update all** checkbox. Once the checkbox is ticked, all the offsets introduced into the axonometry will change their reference markings and the subsequently introduced ones will already be those selected from the list.

7.3.3 Lists and material lists

To insert a **Material list**, click on the icon:

ArCADia software:

Calculations and result interpretation

- **Gas ribbon** ⇒ **Gas installations** logical group ⇒



AutoCAD or INTERsoft-INTELLICAD software:

- **Gas installations** toolbar ⇒



or write

- IGAS_SLI

To insert a **Gas installation items list**, click on the icon:

ArCADia software:

- **Gas ribbon** ⇒ **Gas installations** logical group ⇒





AutoCAD or INTERsoft-INTELLICAD software:

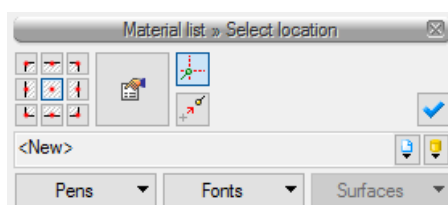
- **Gas installations** tool bar ⇒



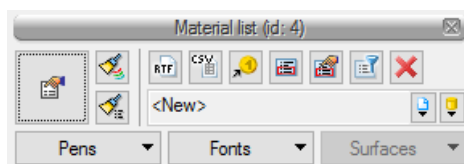
or write

- IGAS_IL.


Clicking table lines or going to Properties allows the user to edit the table content. After clicking the  button you can also generate RTF reports. After clicking the  button you can export the data from a material list to Ceninwest.



Drawing 75. Gas installation element list insertion window



Drawing 76. Gas installation material list modification window

A material list or an item list may be selected after inserting. In such a case a modifications window, with an icon for marking the selected elements on the projection , becomes available. After clicking on a given icon the user may define the position in the list using the mouse. The highlighted table row can be clicked and all the elements from this row will be selected on the projection. All

Calculations and result interpretation

selected items can have their parameters changed e.g. **Type parameters** (diameter, manufacturer, connection type or other parameters).

Gas Installation material list			
Item..	Name	Unit	Q
Ungrouped			
1	Four-burner cooker with roaster, 9.0 kW, DN15	pcs	1.0
2	Gas boiler, 30.0 kW, DN20	pcs	1.0
3	Gas box,	pcs	1.0
4	Gas pipe on plaster surface-laid, Seamless steel, DN15	m	8.0
5	Gas pipe on plaster surface-laid, Seamless steel, DN20	m	4.0
6	Gas pipe on plaster surface-laid, Seamless steel, DN25	m	12.0
7	Gas valve, DN15	pcs	1.0

Drawing 77. Settings view with selected elements