Amarant

Tutorial

Version 07.2018

Index

1. Introduction.

Pressure Vessel Transformer (PVT) is compatible with Windows 7 or newer Windows versions. The PVT, in combination with the CAD Autodesk Inventor (AI) 2015 or newer. The PVT may be operated both as a stand-alone program and as a CAD controlling module.

The PVT makes it possible to create and edit solid models of vessel, its parts and units, as well as drawings of the various vessel views.

The design documentation development using the PVT includes:

1. Generation of vessel design.
2. Automatic generation of a solid model in AI.
3. Configuration of drawings and specifications.
4. Automatic generation of drawings and specifications.

The PVT project file extension is «.pvt».

The AI allows the user to edit the solid models and drawings without interfering the PVT operation.

Important:

Number decimal separator must be «.».

Settings are in: Start → Control Panel → Region and Language → Advanced settings → Decimal symbol, set «.».

To work, you need to connect to the Internet with open ports 8000 and 8005.

2. Main Interface.

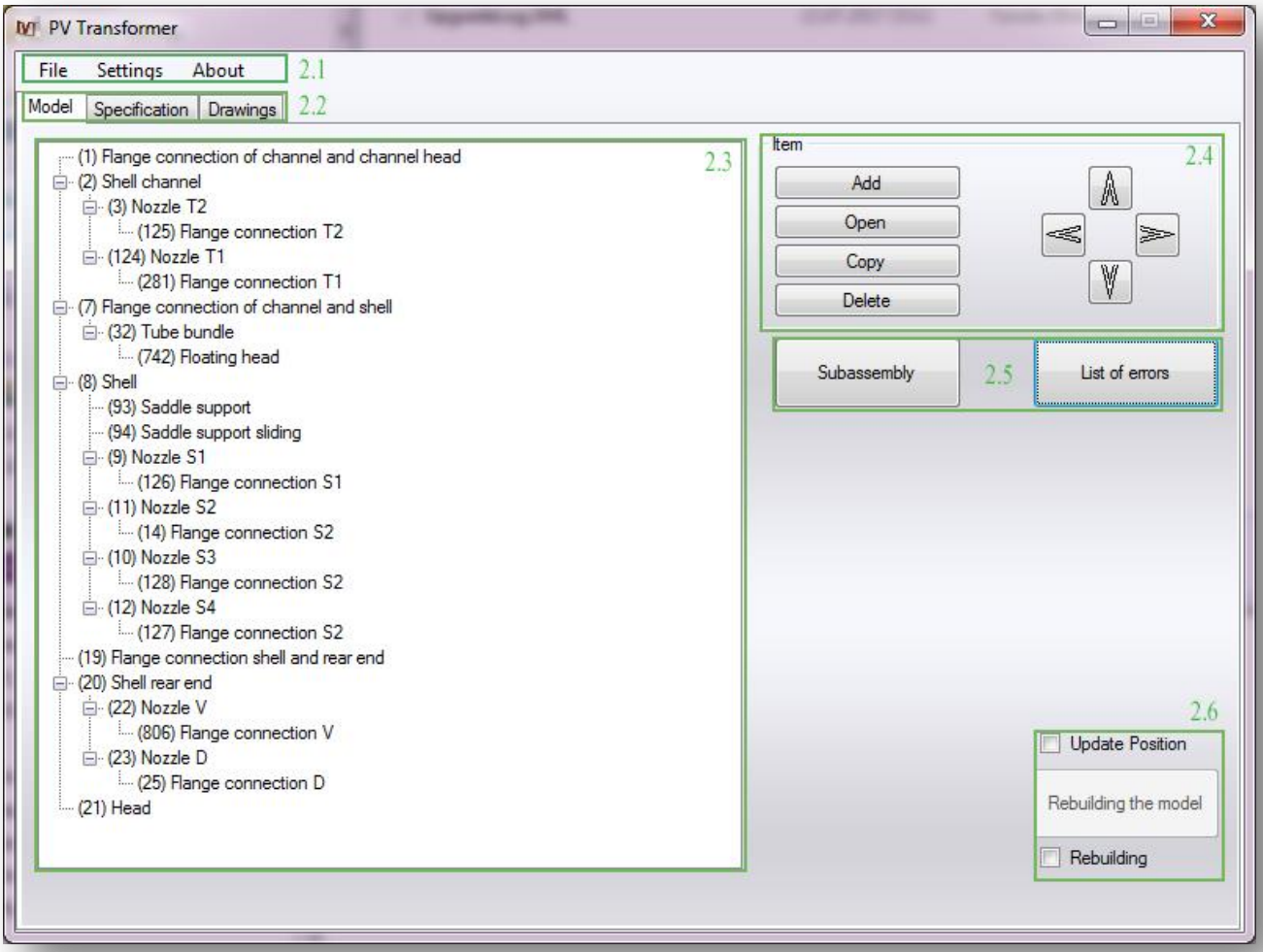


Fig. 2. Main window

The main window consists of:

2.1. Top menu: File, Settings, About.
2.2. Tabs for switching between the solid model, specification and drawings.
2.3. Vessel model tree.
2.4. Units management buttons.
2.5. Generation sub-assemblies of solid model and a list of errors.
2.6. Model generation control.

Enable the check box "Rebuild" and click "Rebuilding the model" to generate a solid model. After rebuilding, the checkbox will be unchecked automatically. This is made in order to prevent accidental clicks on the button, as the rebuilding procedure takes significant time and system resources.

3. Settings. About.

3.1. Settings.

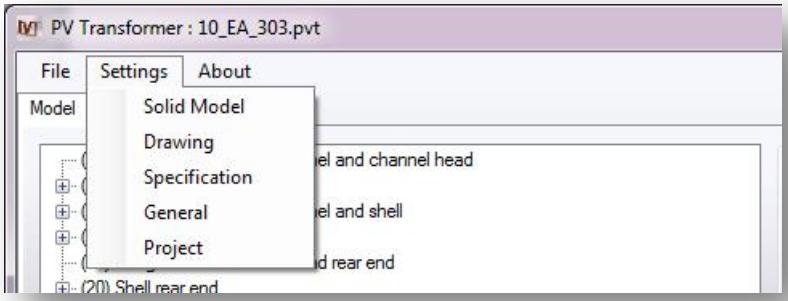


Fig. 3.1. Settings

3.1.1. Solid model settings.

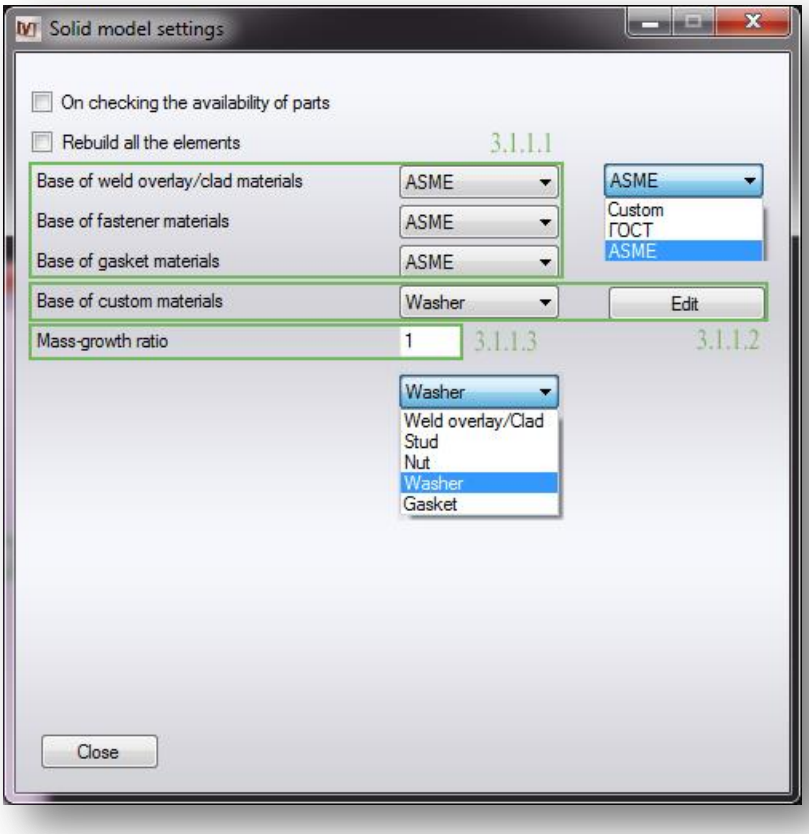


Fig. 3.1.1. Solid model settings

3.1.1.1. Materials database selection.

The drop-down lists allow to select the materials bases for overlays/clads, fasteners and gaskets. The selected bases will be indicated in the solid model nodes interface. In addition to standardized it is possible for each option to specify the user base.

3.1.1.2. Custom database editor.

Select a database from the drop down list and click «Edit» to open the editing window for the selected base.

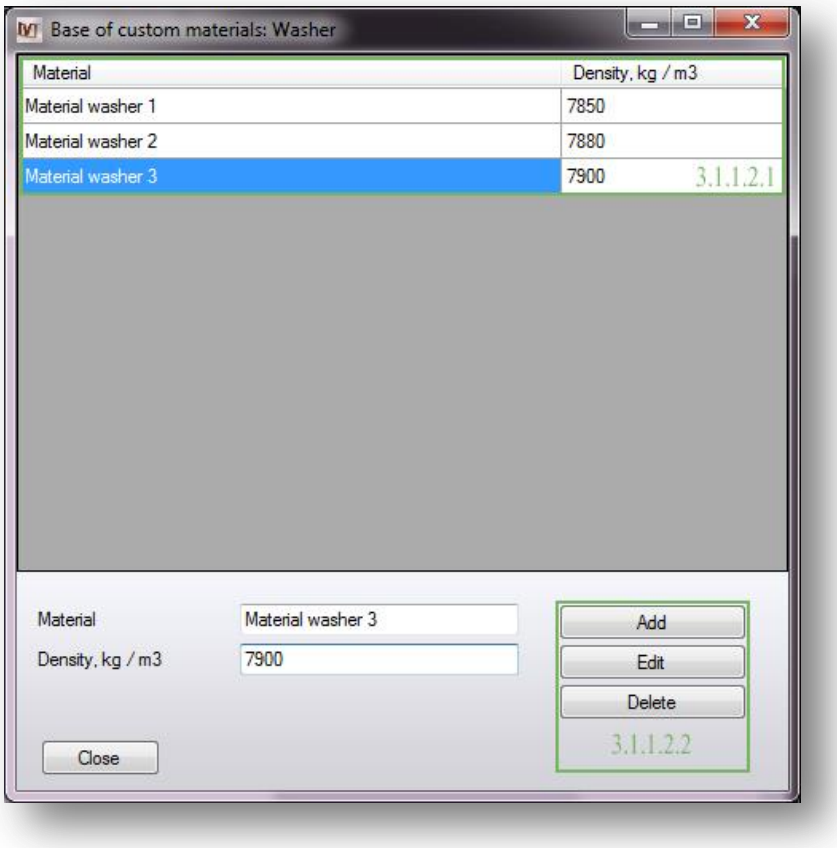


Рис. 3.1.1.2. Custom materials editor for washers

3.1.1.2.1. List of materials including the materials name and density.
3.1.1.2.2. List management buttons.

3.1.1.3. Mass-growth ratio – a parameter determining the material density relative to the density specified by the user in the solid model parts interface. 1 ratio is a density corresponding to the actual material density, and 1.5 ratio is a material density increased by 50%.

3.1.2. Drawing settings.

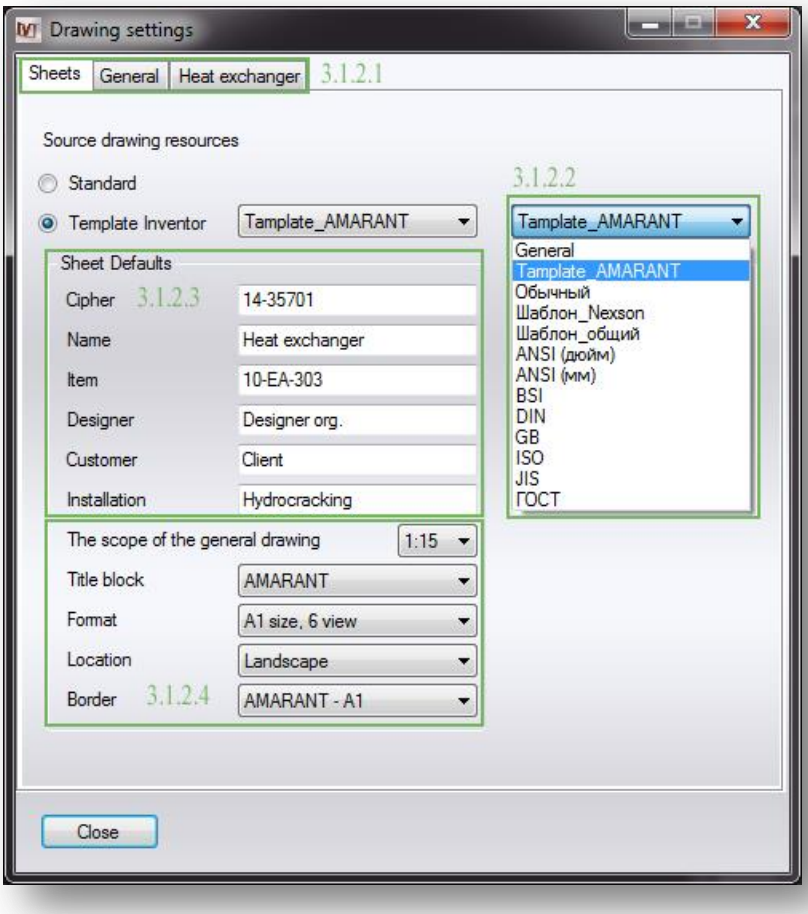


Fig. 3.1.2. Drawing settings

3.1.2.1. The tabs switch between the sheet parameters, general drawing parameters and the parameters of a particular type of vessel which is selected in the Project Settings window shown in Figure 3.1.5.

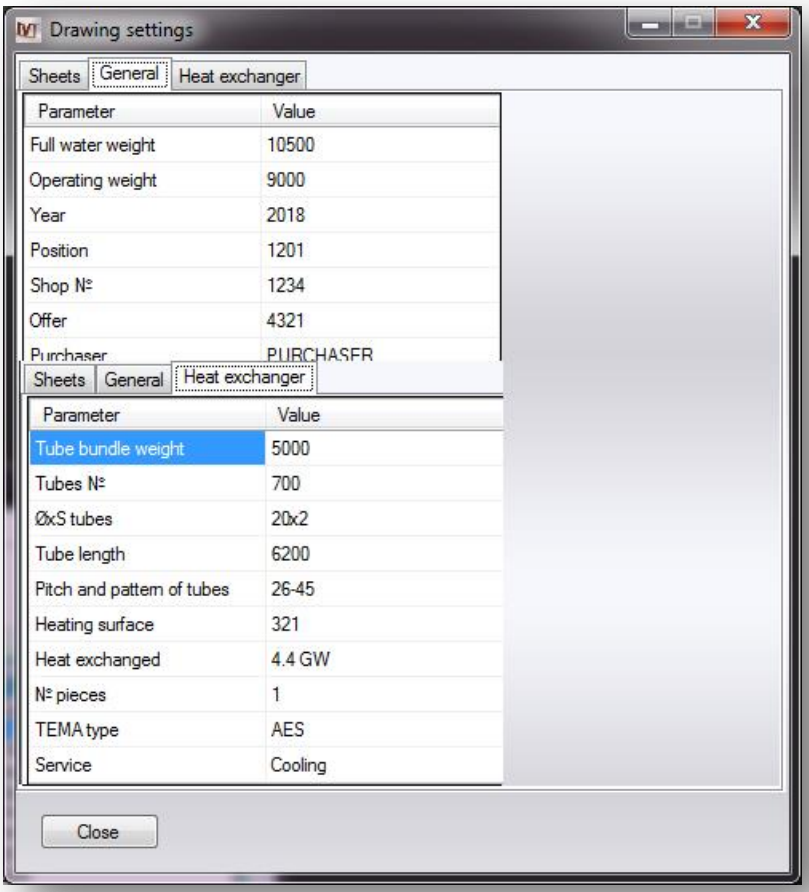


Fig. 3.1.2.1. General drawing settings and the parameters of a particular type of vessel

In this window, the user fills the information about the vessel which will be indicated in the title blocks, specification, tables and other standard drawing fields. The procedure for creation, deletion and editing of parameters is described in paragraph 3.1.5.2.

3.1.2.2. Drawing template.

When you select a Standard radio button shown in Figure 3.1.2, the drawing will be created based on the template set by default in AI. When selecting "Template Inventor», the drop down list to the right will allow to select on of the drawing templates stored at C:\Users\Public\Documents\Autodesk\Inventor “version”\Templates.

To create your own template, you must create an AI drawing with .idw extension with a set of title blocks, formats, frames and other elements of the drawing, and place it in this directory.

3.1.2.3. Sheet information.

Basic vessel data - code, name, position and other information that will be specified in the title or in the vessel specification table.

3.1.2.4. Sheet parameters.

Basic drawing parameters - scale, title block, sheet size, position and frame specified above in the selected AI template drawing.

3.1.3. Specification settings.

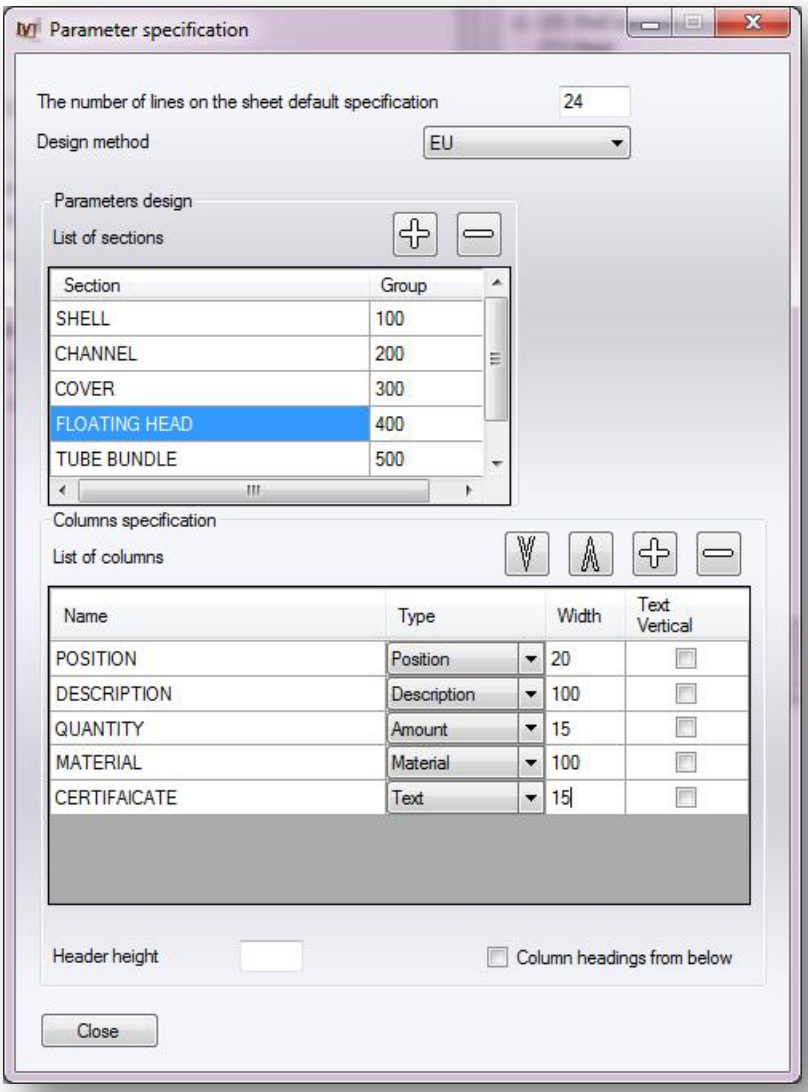


Fig. 3.1.3. Specification settings

The interface is under development.

3.1.4. General settings.

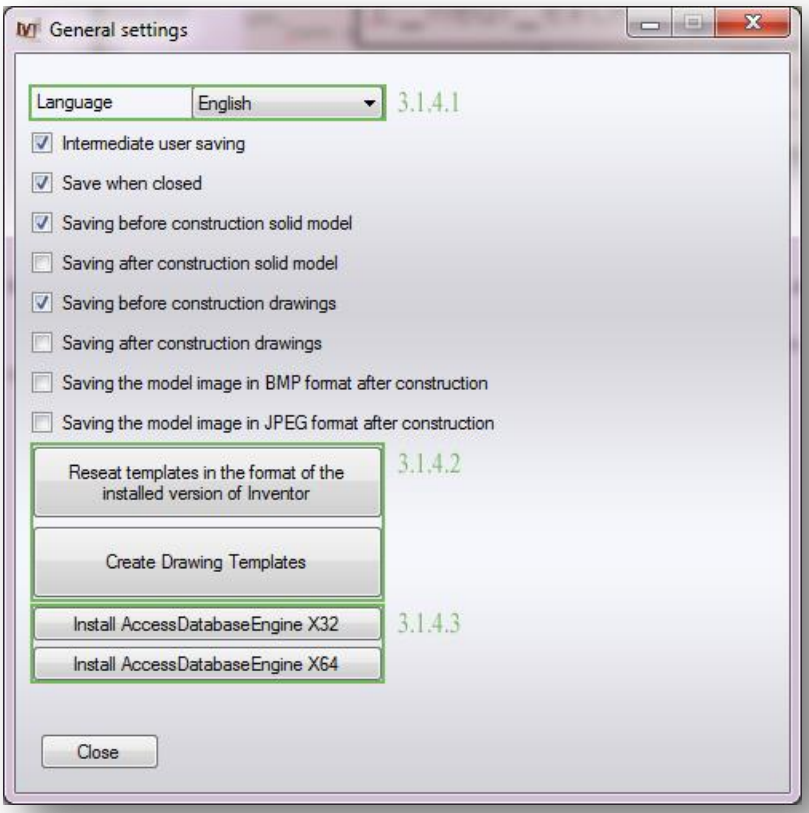


Fig. 3.1.4. General settings

3.1.4.1. Choosing the PVT interface language.
3.1.4.2. Button "Resave templates .in.." saves the parts files .ipt and assemblies files .iam of AI in the version installed on the PC. This feature is necessary if you have incompatible versions of PVT and AI. The PVT version must be earlier than the version of AI installed on your computer, for example, PVT 2015 and AI 2018. "Create Drawing Templates" must be used after the first installation of PVT to copy the standard AI templates .idw in the directory C:\Users\Public\Documents\Autodesk\Inventor “version”\Templates, as described in para. 3.1.2.2.
3.1.4.3. If the user has no Microsoft Access on its PC, the PVT may not work properly. The user can open this window and click the corresponding button to install Microsoft Access. After installation, restart PVT.

3.1.5. Project Settings.

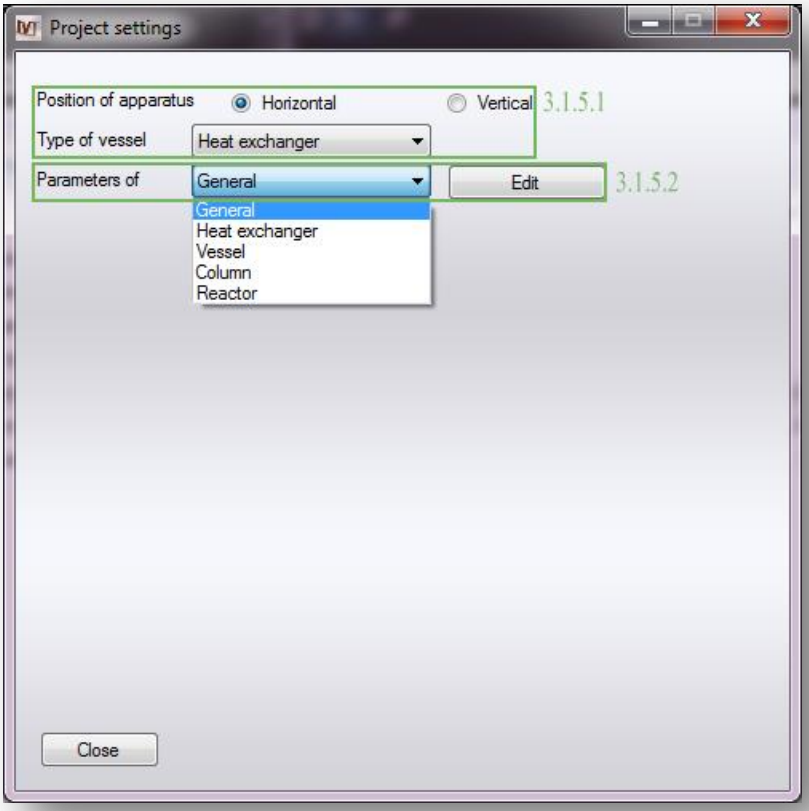


Fig. 3.1.5. Project settings

3.1.5.1. Selection of the vessel location and type.

After selecting the type of vessel in drawings setting window displayed in Figure 3.1.2, the tab with the parameters list is displayed (Figure 3.1.2.1).

3.1.5.2. Editing drawings parameters.

The user selects the main parameters or the parameters for a particular type of vessel. Clicking the Edit button opens the editing window. The interface is similar to the interface described in para. 3.1.1.2.

To add a parameter, the user must add the parameter code by entering the vessel type code + "_":

M_ - general information on the vessel displayed in the General tab, figure 3.1.2.1

C_ - column parameter

E_ - heat exchanger parameter displayed in the Heat exchanger tab, figure 3.1.2.1

V_ - vessel parameter

R_ - reactor parameter

In this example, the E_heat_exchanged code is added for «Heat exchanged» parameter related to a heat exchanger.

To enter the parameter value to the drawing, open the AI template drawing (para. 3.1.2.2.), find the desired table or title block in the Sketch Symbols (in this example - E_TABLE DID AMARANT) and start editing (Figure 3.1.5.2.1). The name of the basic parameters table must contain the vessel code (E) + "_" (similar to the parameters above) + "TABLE DID" + "*any set of words (AMARANT)*»" Each type of vessel needs a separate table to be created.

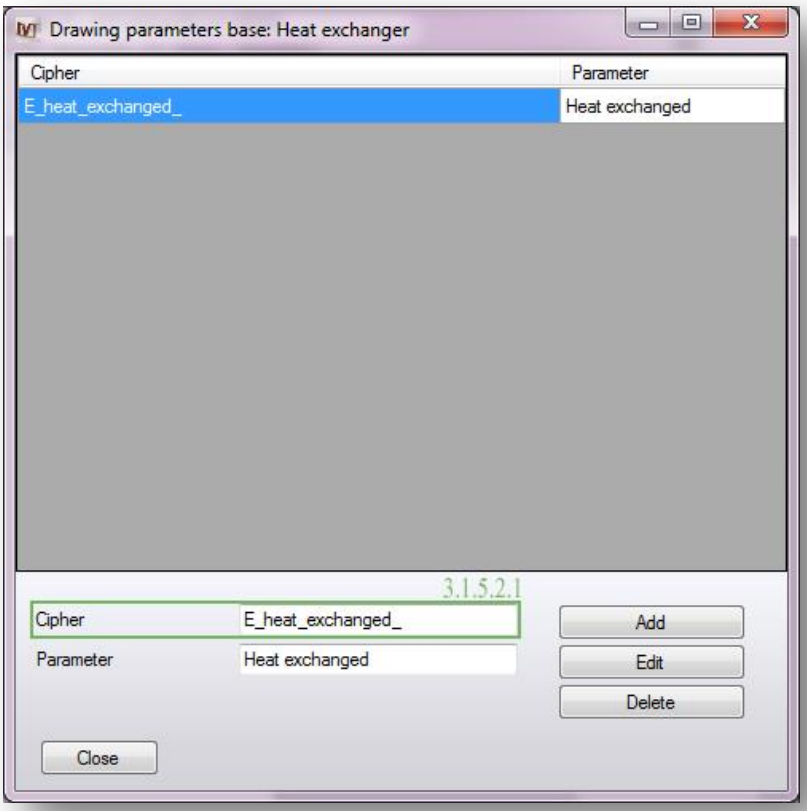


Fig. 3.1.5.2. Drawing parameters editing window

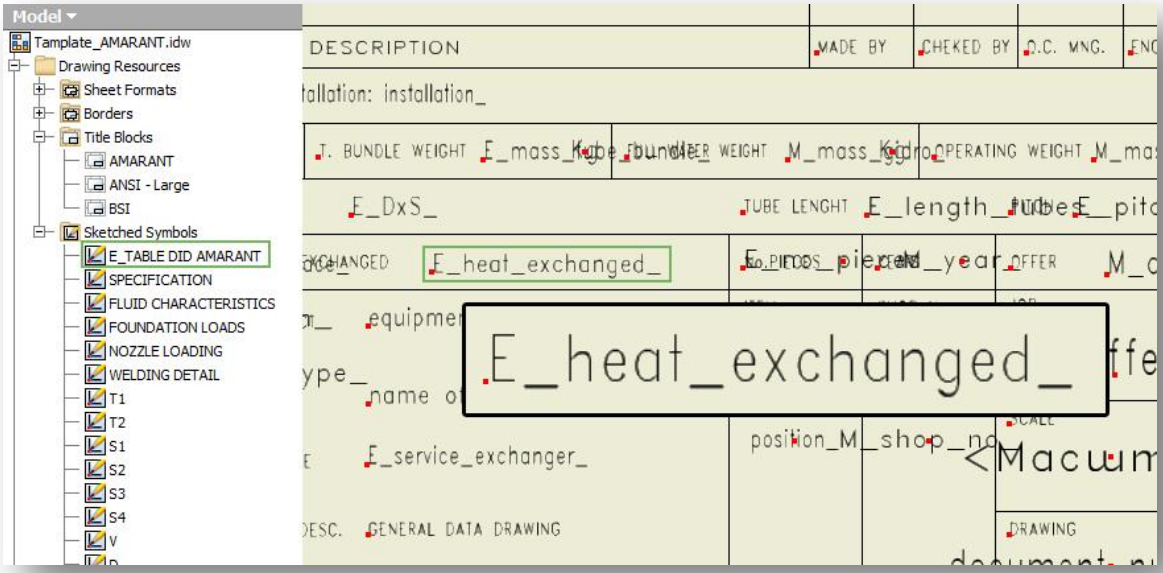


Fig. 3.1.5.2.1. Tables editing in AI

Next, create a text field in the table named the same as the parameter code in Figure 3.1.5.2. When specified in the drawing settings window in Figure 3.1.2.1, the parameter value will be assigned to the appropriate text box in the AI template.

3.2. About the software.

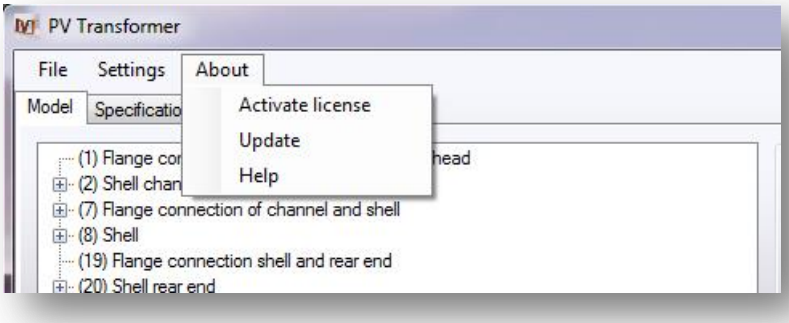


Fig. 3.2. About the software

3.2.1. License Activation.

Click this button to open the license key activation window.

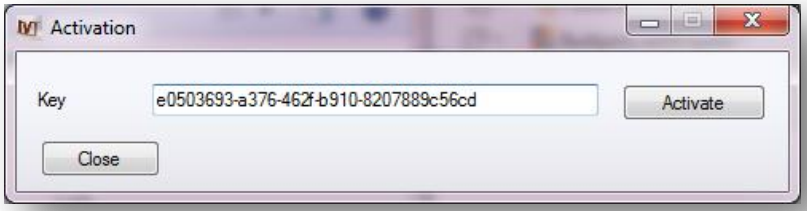


Fig. 3.2.1. License activation window

License Activation is done after the first installation of PVT and is not required even after the reinstalling. To a computer attached license key and it cannot be activated on the other.

Important:

The files on the C: \ drive of your computer can be protected from editing by third-party applications. In case of unsuccessful activation, you must open the file C:\Users\USER\Amarant\PVT\bin\Release\license.key, enter the key given to you and save the file.

3.2.2. Update.

The interface is under development.

3.2.3. Help.

Click Help to open the online help at www.amarant1.com

4. Solid model.

4.1. Model tree.

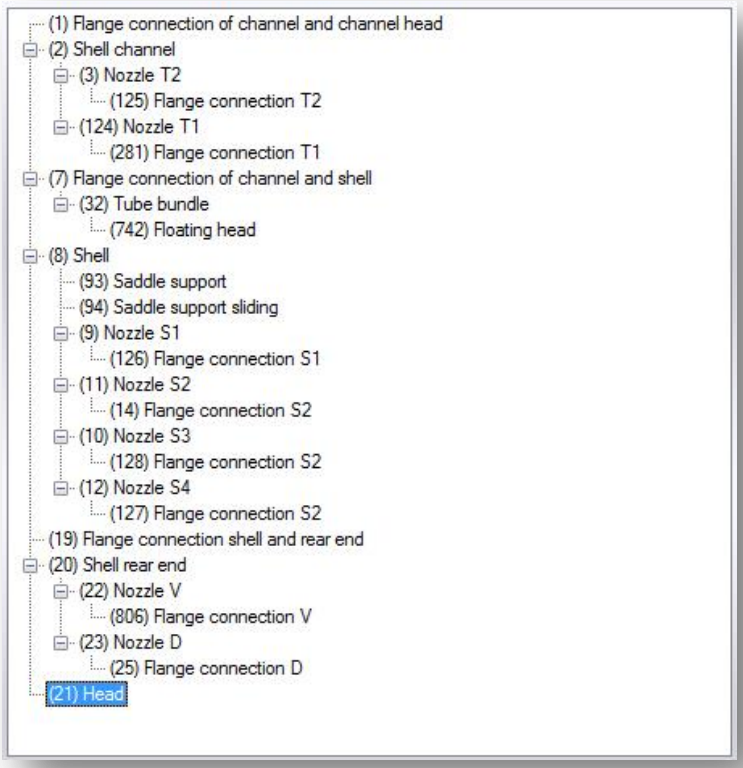


Fig. 4.1.1. Model tree

The tree consists of units arranged under the parent unit sequentially.

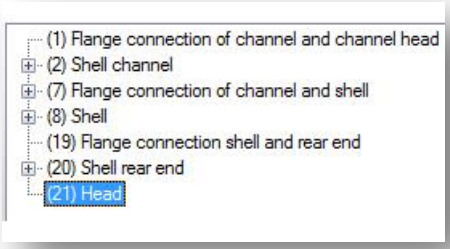


Fig. 4.1.2. Successive units

The figure 4.1.2. shown units 1, 2, 7, 8, 19, 20 and 21 arranged in the first column.

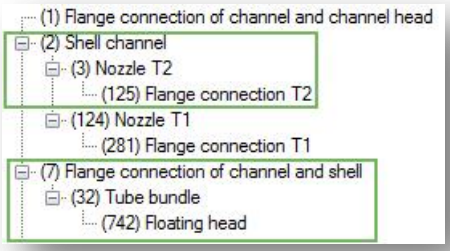


Fig. 4.1.3. Units located under the parent unit

In Figure 4.1.3., Flanged connection T2 No. 125 is located under the parent unit 3 Nozzle T2, which is located under Chamber Shell unit No. 2. The same applies to units 742 Floating Head → unit 32 Tube Bundle → units 7 Flange connection between the chamber and shell. Also, the unit 742 is a child for the unit 32, and the unit 32 is child for unit 7. The number in brackets before the name of the unit is a unique number that is assigned when you add a unit to the tree.

Thus, the vessel tree combination is limited by child units arranged successively within and sequentially after the parent units.

Adding, opening, copying, deleting, and moving between the tree order and levels is made by clicking buttons in the area 2.4 in Figure 2.

When you click "Add" button, a window appears with a list of units forming the vessel structure.да.

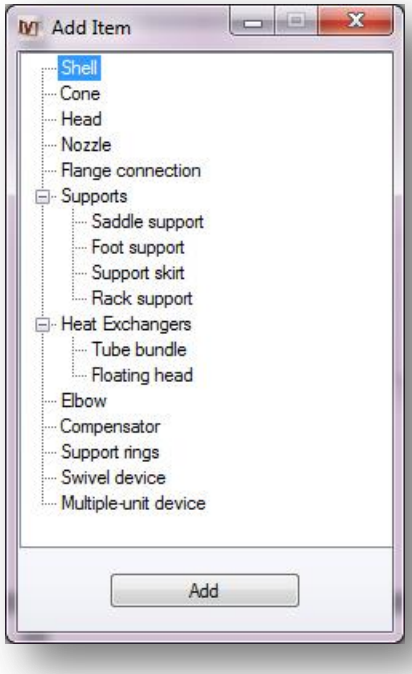


Fig. 4.1.4. List of units

The example of a vessel tree in Figure 4.1.1 shown a chain of units looks 1 → 2 → 7 → 8 → 19 → 20 → 21. Units 93, 94, 9, 11, 10 and 12 are arranged one after the other, but a saddle support can not join the saddle support, the nozzle can not join the saddle support and nozzle, so these units are arranged as child units for the unit 8.

Child units and equal units arrangement is shown in Tables 4.1.5 and 4.1.6.

Previous unit	Next unit														
	Shell	Head	Cone	Nozzle	Flange connection	Tube bundle	Floating head	Foot support	Saddle support	Skirt support	Rack support	Elbow	Compensator	Support rings	Swivel device
Shell	+	+	+	-	+	+	-	-	-	-	-	+	+	-	-
Head	+	+	+	-	+	-	-	-	-	-	+	+	+	-	-
Cone	+	+	+	-	+	-	-	-	-	-	-	+	+	-	-
Nozzle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flange connection	+	+	+	-	+	+	-	-	-	-	-	+	+	-	-
Tube bundle	+	-	-	-	+	-	+	-	-	-	-	-	-	-	-
Floating head	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foot support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saddle support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Skirt support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rack support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elbow	+	+	+	-	+	-	-	-	-	-	-	+	+	-	-
Compensator	+	+	+	-	+	-	-	-	-	-	-	+	+	-	-
Support rings	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Swivel device	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4.1.5. Sequential units location

Parent unit	Child unit														
	Shell	Head	Cone	Nozzle	Flange connection	Tube bundle	Floating head	Foot support	Saddle support	Skirt support	Rack support	Elbow	Compensator	Support rings	Swivel device
Shell	-	-	-	+	-	-	-	+	+	+	+	-	-	+	-
Head	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-
Cone	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-
Nozzle	+	+	+	-	+	-	-	-	-	-	-	+	+	-	-
Flange connection	-	-	-	+	-	+	-	-	-	-	-	-	-	-	+
Tube bundle	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Floating head	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Foot support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saddle support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Skirt support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rack support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elbow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compensator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support rings	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Swivel device	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4.1.6. Parent and child units arrangement

4.2. General units interface.

The units can be divided into consisting of standardized and non-standardized parts. Standardized parts are part which geometry is completely defined by the standard.

The units consisting of non-standardized parts include: shell, cone, nozzle, tube bundle, floating head. All the other units consist of standardized parts. Similarly, we can define two types of units interfaces.

Non-standardized units can include a small number of standardized parts, such as tube bundle which geometry is unique, but the interface allows selection of a standardized nut in the bundle structure. The interface of the standardized unit by the example of flange connection is shown below.

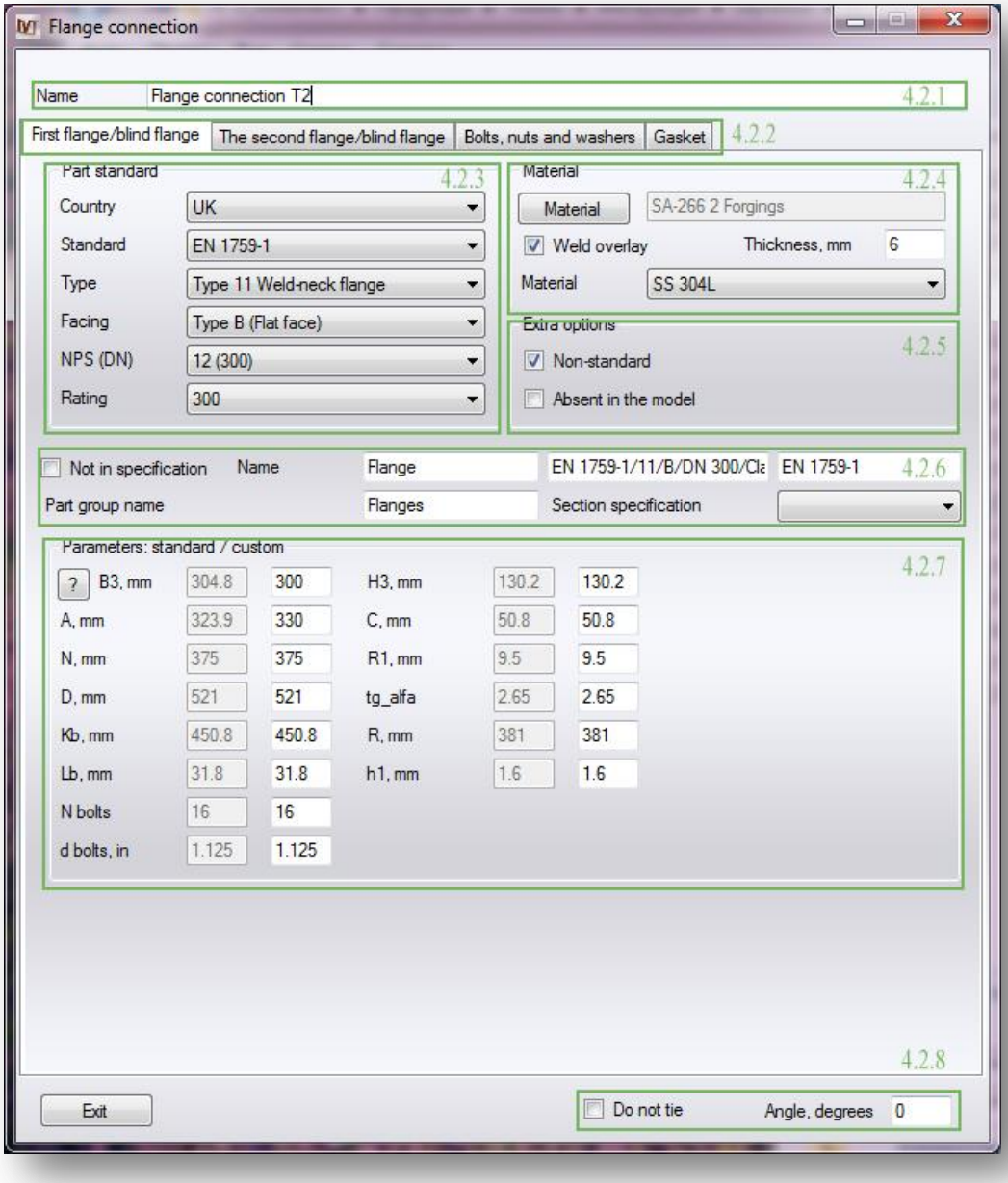


Fig. 4.2. First flange tab in the flange connection interface

4.2.1. The unit name appears in the vessel tree and in the AI solid model browser.

4.2.2. The tabs switch between First flange, Second flange, Fasteners and Gasket.

4.2.3. Group of drop-down lists for the selection of standardized part.

Here, there are 6 drop-down lists, 2 of which (country and standard) are constant, (exceptions will be described below) the remaining amount depends on the choice of first two drop down lists.

After the detail is selected in the drop-down group 4.2.3 shows standard and custom parameters in the group 4.2.7. To change the geometry of the standard parts, check "non-standard" in the group 4.2.5. After that, the custom parameters in 4.2.7 will be available for editing, and the standard parameters will be disabled for comparison. The group 4.2.6 fields will become enable as they are required for specification. To return to the standard geometry, uncheck the box "non-standard" in the group 4.2.5.

It is important to remember that you must uncheck the "non-standard" when making other choices in the 4.2.3 group, otherwise the user settings will remain unchanged.

4.2.4. Material.

Click "Material" button to open the window with options for the source selection (ASME/GOST/...).

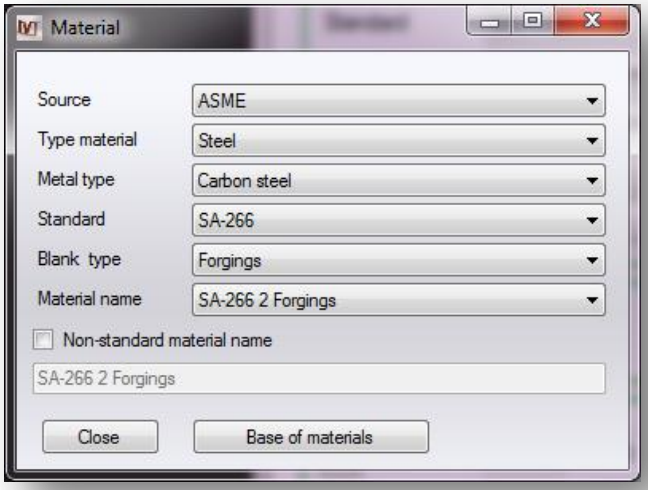


Fig. 4.2.4.1. Material selection

Click “Base materials" to open a window with a list of materials, their properties and parameters according to the source selected when choosing the material. In this window, you can add/delete/edit materials and their properties.

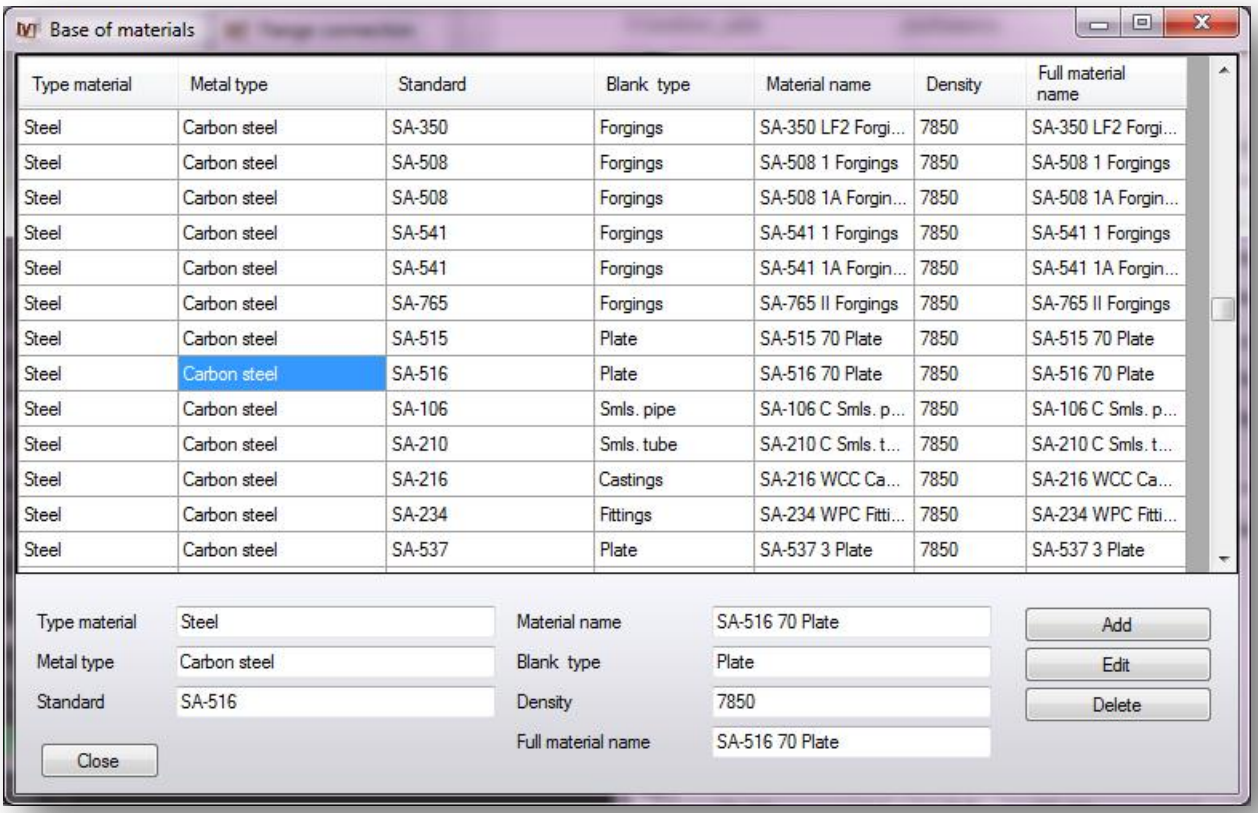


Fig. 4.2.4.2. Base of materials

In group 4.2.4. check “Weld overlay" to enable the "thickness" field and the "Material" dropdown list. Remember that the base material of the second metal layer is selected in the model settings, para. 3.1.1.

4.2.5. Extra options.

Check “Absent in the model" to make this part disabled for building. This is useful, for example, for flange connection fasteners. The "Non-standard" checkbox function is described above in para. 4.2.3.

4.2.6. Described above in para. 4.2.3.

4.2.7. Standard and custom parameters.

When you press the button marked with "?", a window with explanatory drawings with dimensioning relating to a particular selected part appears. If there are several explanatory drawings, you can switch them by clicking "Next picture". The functions of the 4.2.7. group is described above in para. 4.2.3.

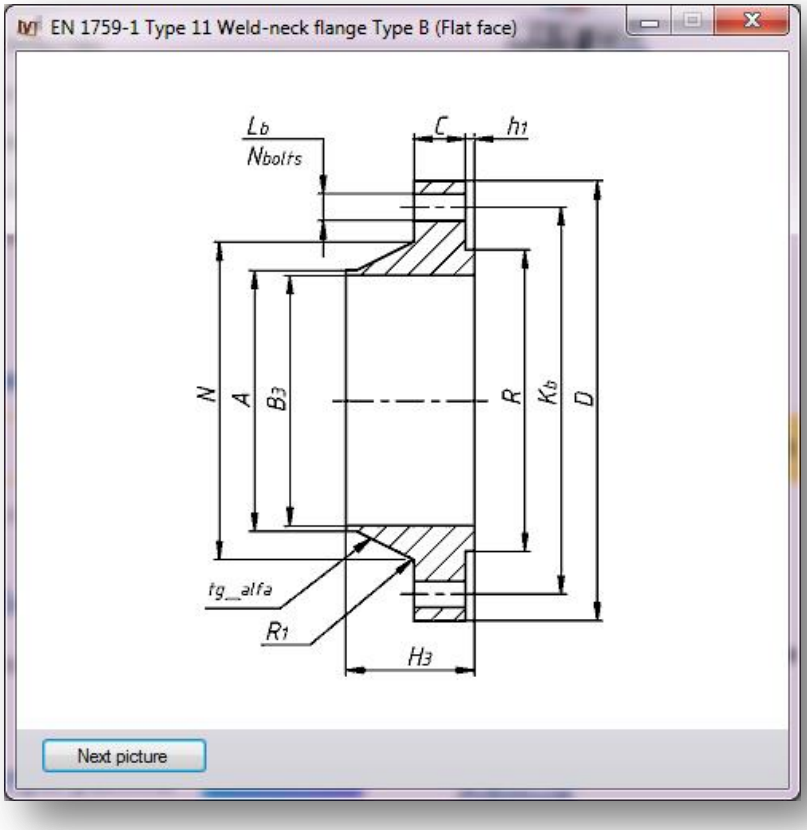


Рис. 4.2.7. Пояснительный рисунок.

4.2.8. Checkbox "Do not tie".

Check to disable a particular part/unit attachment to the previous unit. This is useful for non-standard designs. In this case, attachments in the solid model can be made using AI. The units located in the tree after this part will be attached to this part/unit. The "Angle" field rotates the unit clockwise around the axis of symmetry with respect to the previous one.

4.3. Shell.

Non-standard unit. It consists of a single window.
Sequential arrangement after units: shell, head, cone, flange connection, tubes bundle (examples will be described in para. 4.8.), elbow, compensator.
Child location inside the units: nozzle.
The unit includes a single part.

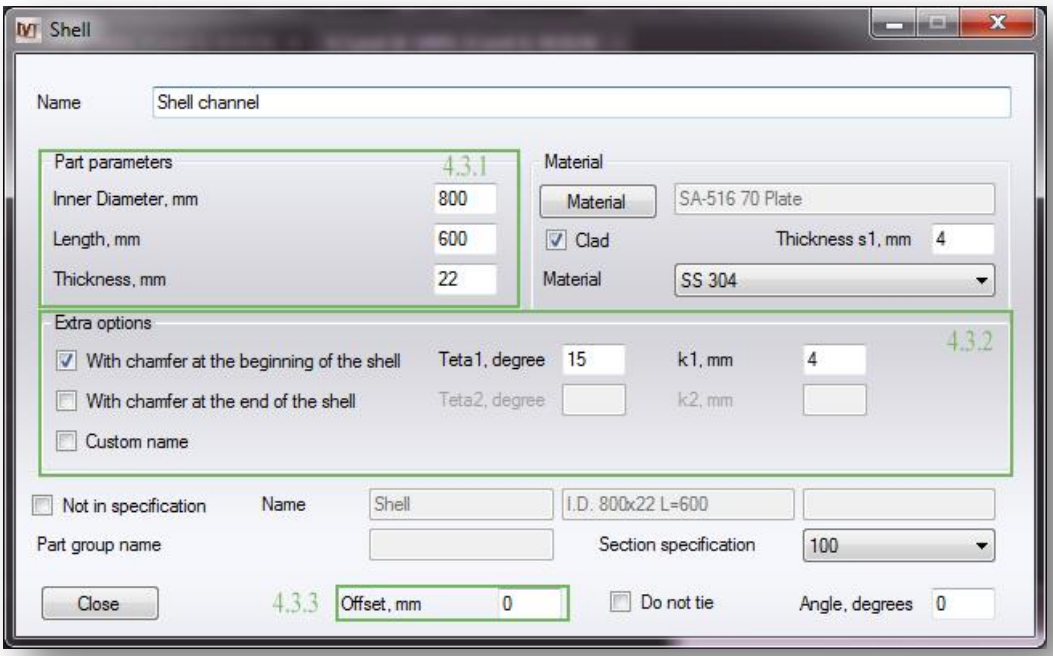


Fig. 4.3. Shell

4.3.1. Part parameters - the shell geometry.

4.3.2. Extra options.

It is possible to make chamfer at both ends of the outer surface of the shell. When the "Custom name" is checked, the fields necessary for specification become accessible (similar effect when the "non-standard" flag in group 4.2.5 is checked, and 4.2.6 group enables as described in para. 4.2.3)

4.3.3. Offset.

The offset along the axis of symmetry from the shell to the previous unit, may have positive or negative value.

No differences from the general interface described in para. 4.2.

4.4. Head.

Standardized unit, consists of a single window.
Sequential location after units: shell, head, cone, flange connection, elbow, compensator.
Child location inside the units: nozzle.
The unit includes one and more parts, depending on the selected type.

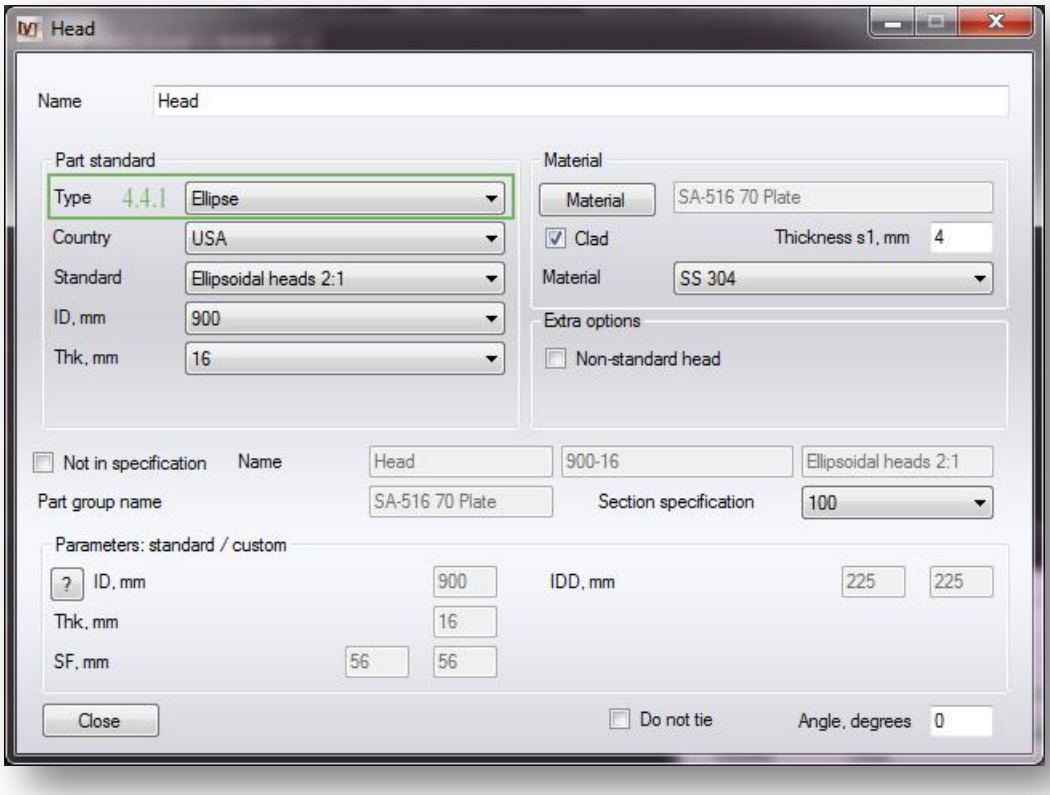


Рис. 4.4. Head

4.4.1. The difference from the group 4.2.3. described above is the presence of the "Type" drop-down list.

4.5. Cone.

Non-standardized unit, consists of a single window.
Sequential location after units: shell, head, cone, flange connection, elbow, compensator.
Child location inside the units: nozzle.
The unit includes one and more parts, depending on the selected type.

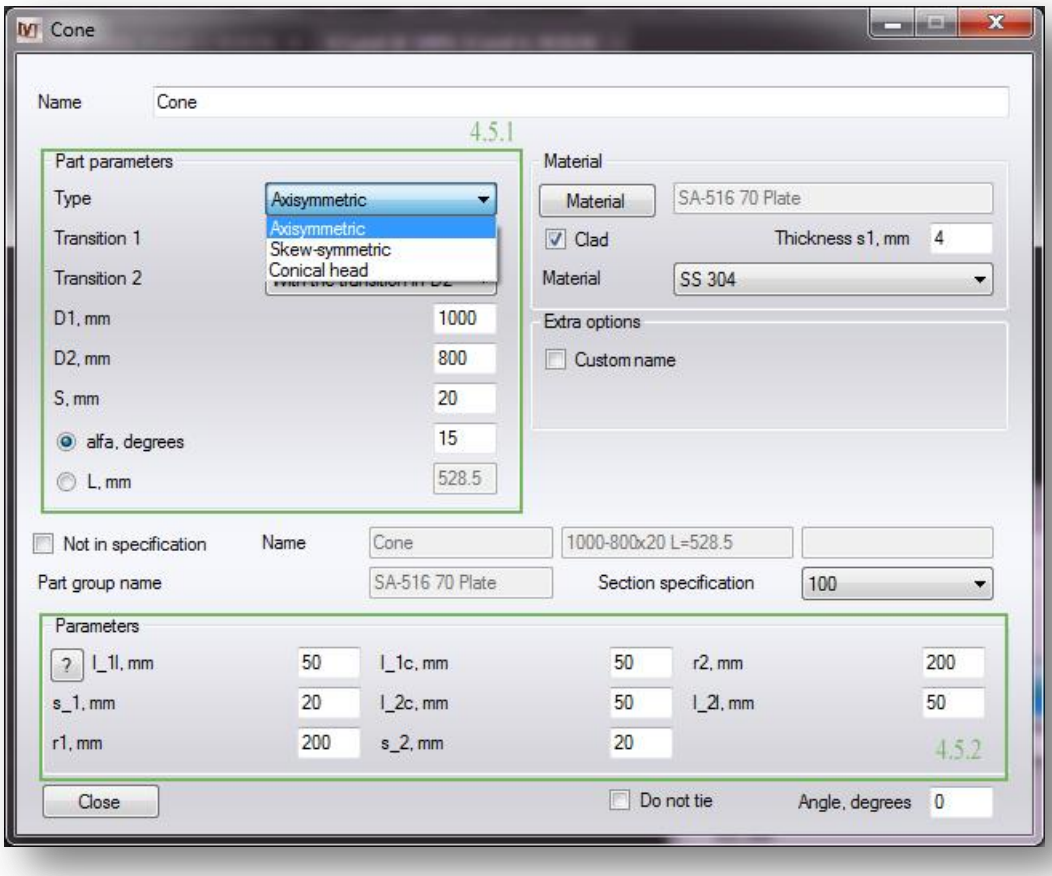


Рис. 4.5. Cone

4.5.1. Part parameters.

Depending on the part type (axially symmetric or antisymmetric cone, conical head), the corresponding drop-down lists and fields become available, as well as the parameters in the group 4.5.2.

4.6. Nozzle.

Non-standardized unit, consists of a single window.
Sequential location after units is impossible.
Child location inside the units: shell, head, cone, flange connection, compensator.
The unit includes one and more parts, depending on the selected type.

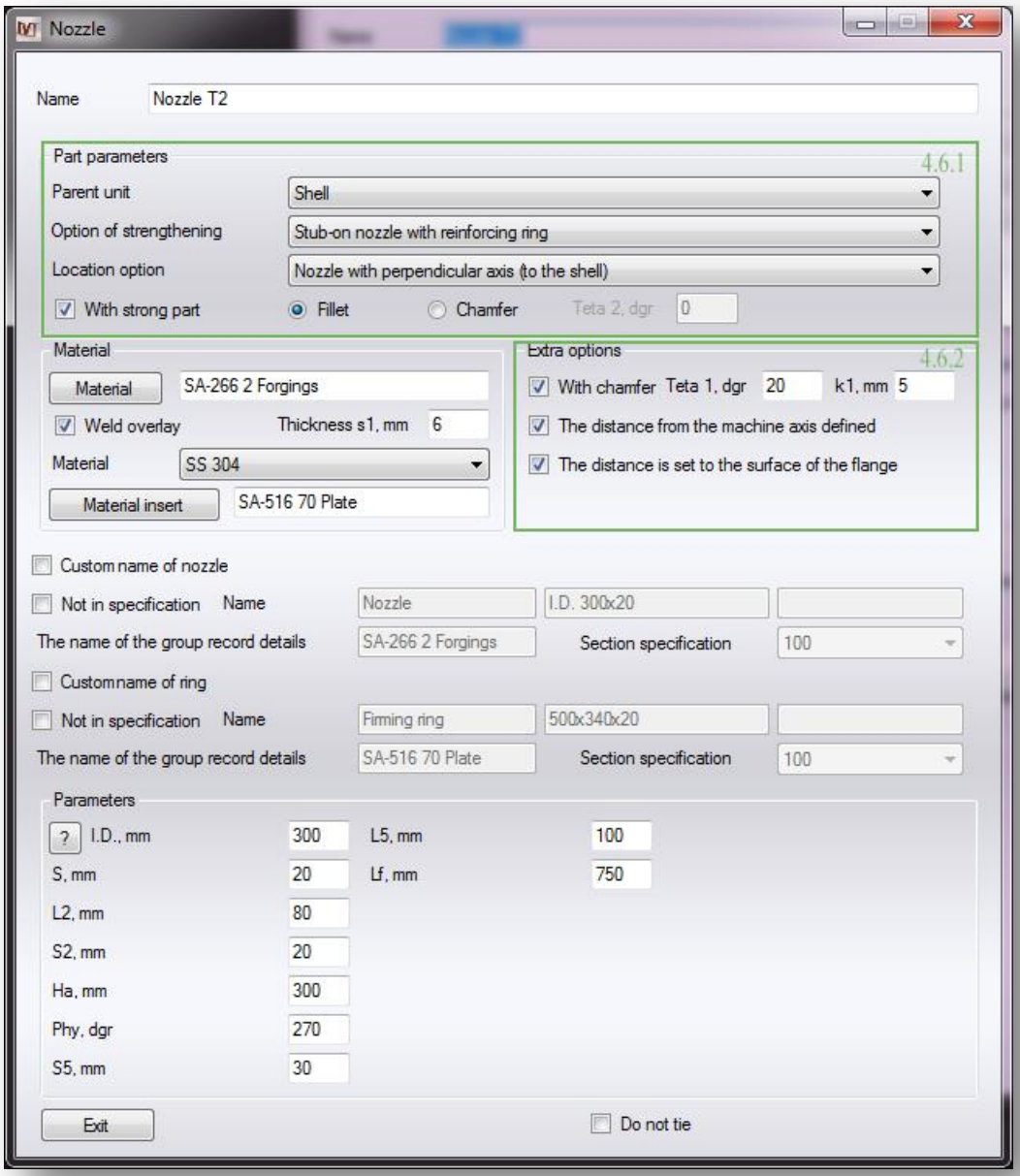


Рис. 4.6. Nozzle

4.6.1. Part parameters. Includes several drop-down lists:

4.6.1.1. Parent unit – shell, cone, head, blank flange.

4.6.1.2. Option of strengthening.

4.6.1.3. Location option.

The drop-down lists 4.6.1.2 and 4.6.1.3 items depend on the selected parent unit. The option below allows to set a thickened of nozzle part with a chamfer or fillet.

4.6.2. Extra options. Depending on the dropdown lists combination, the group includes various additional embodiments.

All combinations of the 4.6.1. group and extra functions are displayed in detail in the explanatory drawings opened by clicking "?" near the parameter group. Everything else is similar to a general interface as described in para. 4.2.

4.7. Flange connection.

Standardized unit. It consists of five tabs:

4.7.1. First flange/blank flange.

4.7.2. Second flange/blank flange.

4.7.3. Fasteners.

4.7.4. Gasket.

4.7.5. Clamped part.

Sequential location after units: shell, head, cone, flange connection, tube bundle (examples will be described in para. 4.8.), elbow, compensator.

Child location inside the units: nozzle.

The unit includes several parts.

The tab 4.7.1. is described in para. 4.2., the tab 4.7.2 is similar to 4.7.1.

4.7.3. Fasteners.

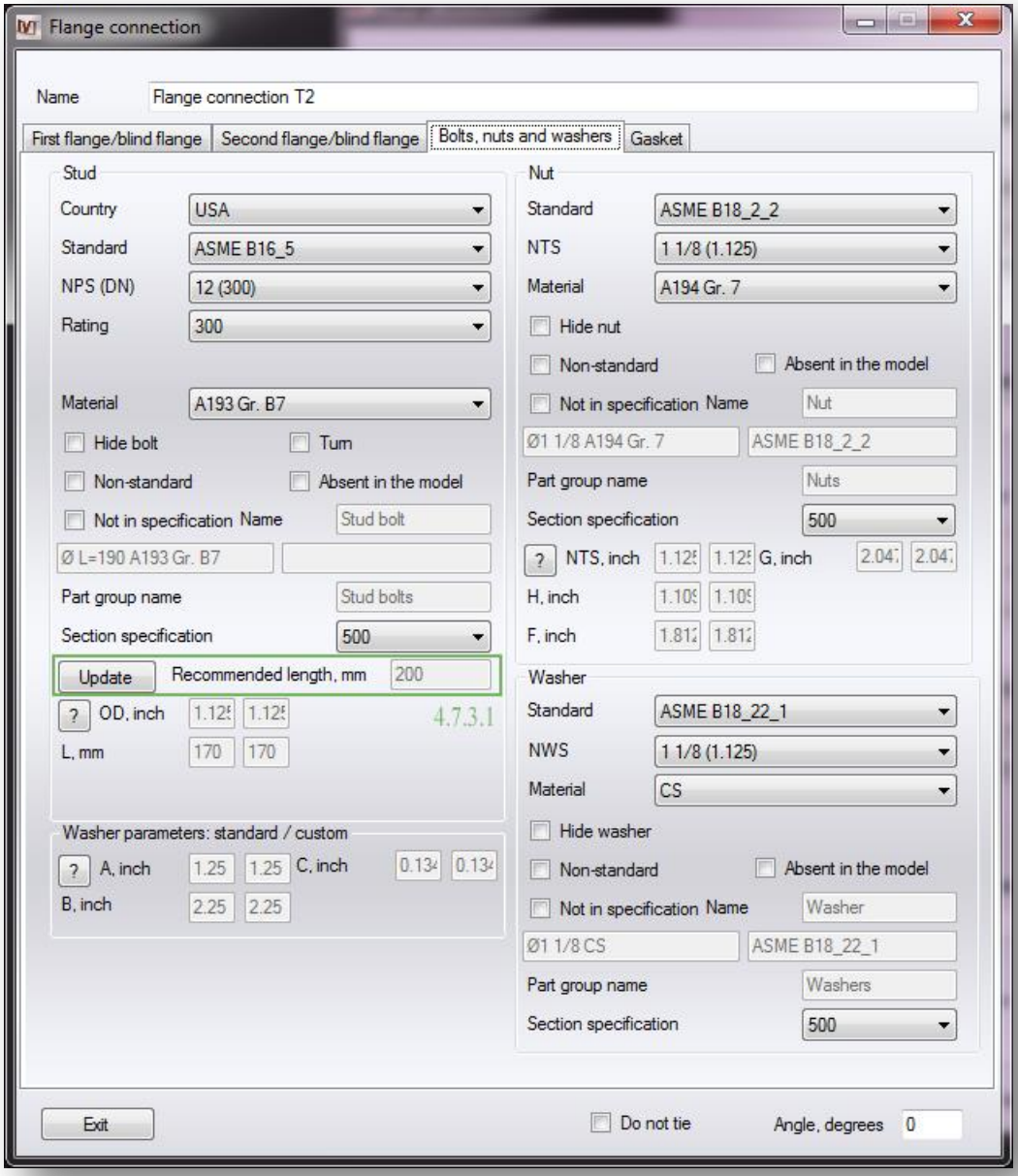


Fig. 4.7.3. Fasteners of flange connection

When you click the "Update" button 4.7.3.1., the recommended length of the stud/bolt appears. The user must choose the length from the drop-down list or edit the parameters according to recommendations. This action is advisable to carry out after the user fills all the required fields in all tabs, and a chain of connected parts is formed after filling.

4.7.4. Gasket.

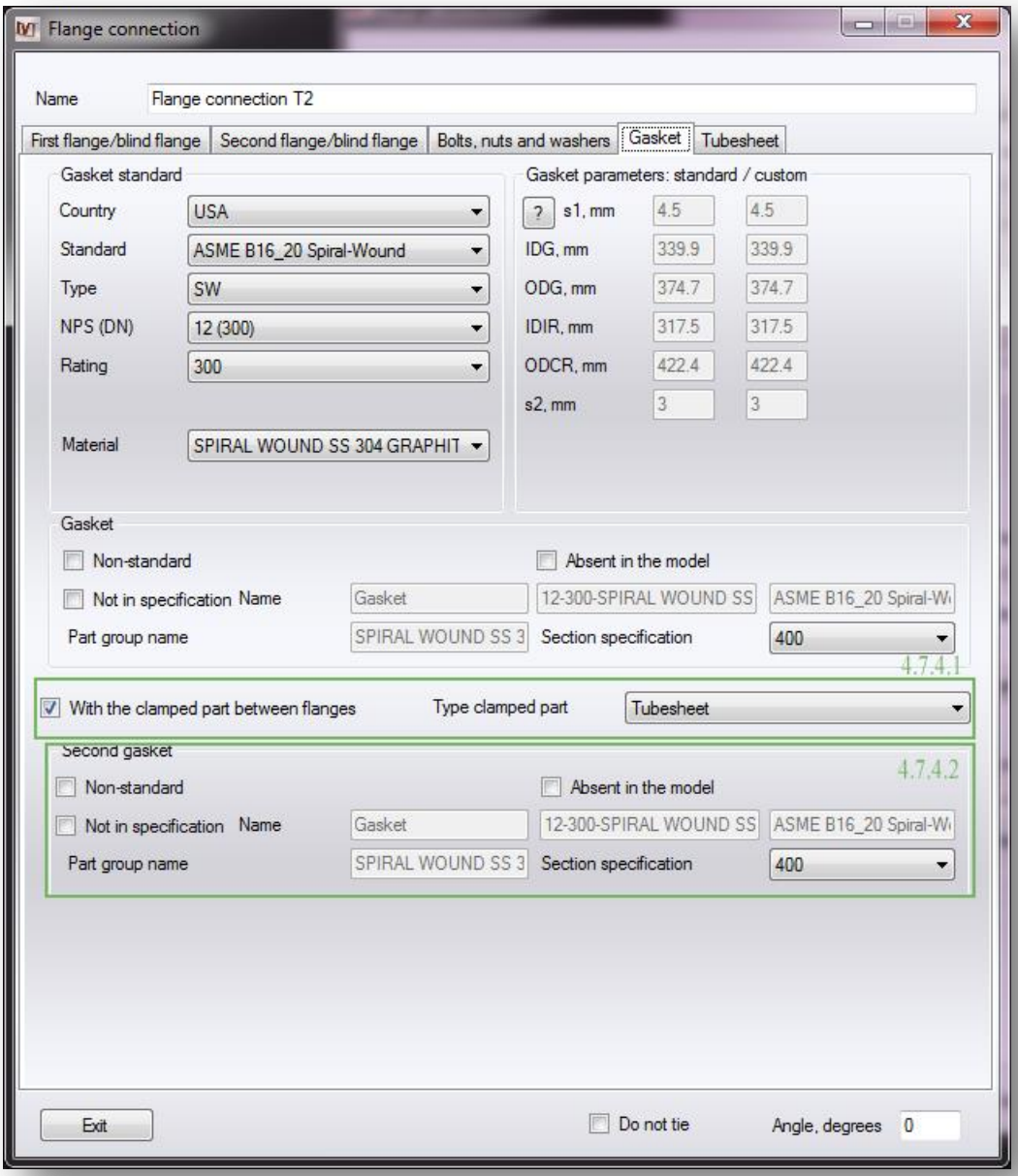


Fig. 4.7.4. Gasket of the flange connection

4.7.4.1. Check "With the clamped part" and select type from the dropdown list: tubesheet or swivel plug.
4.7.4.2. When choosing the clamped part type, a second gasket must be able in the flange connection. This group contains fields necessary for specification.

4.7.5. Clamped part.

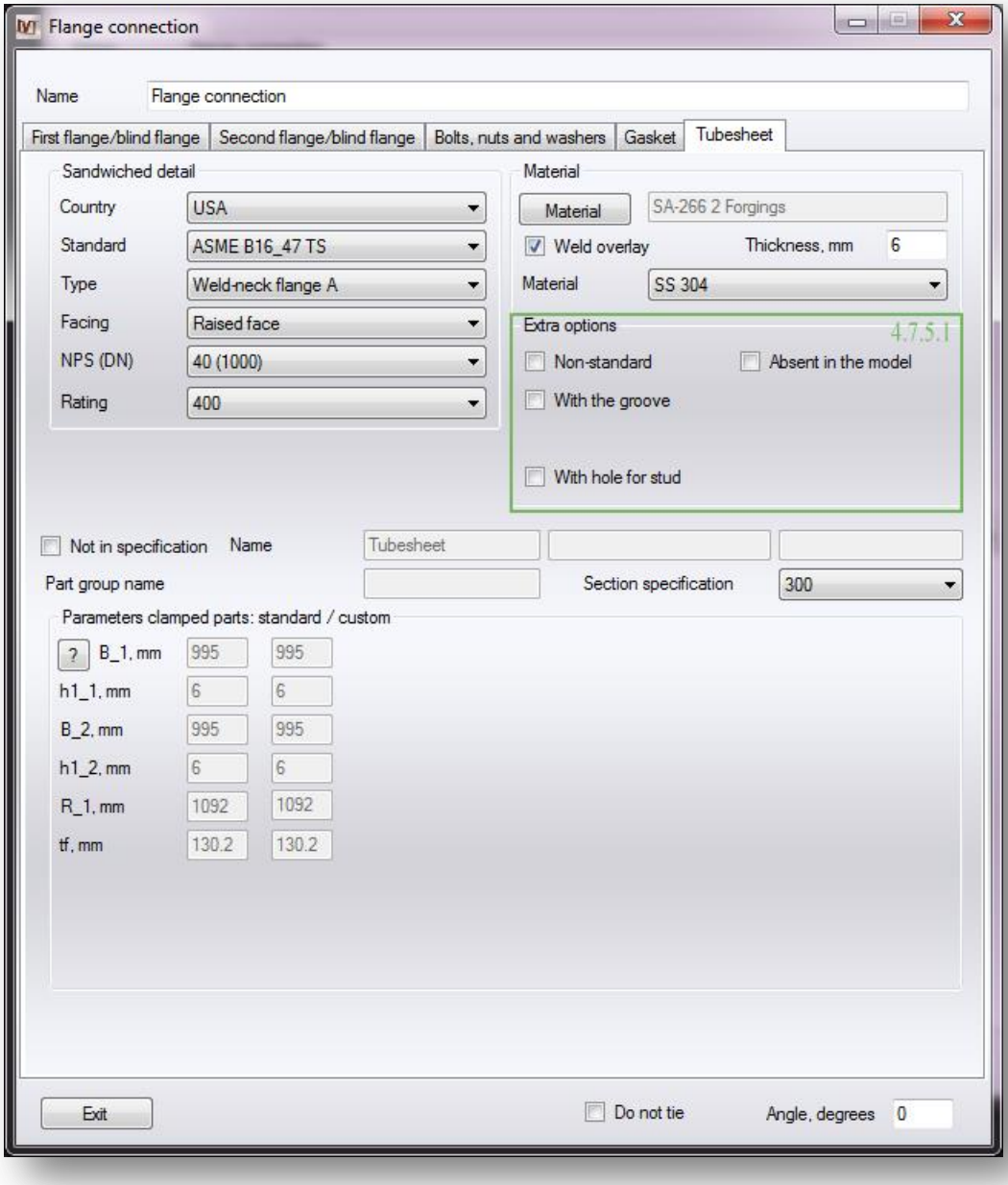


Fig. 4.7.5. Clamped part - flange connection tubesheet

4.7.5.1. Extra options.

The possibility of building a tubesheet with a groove or stud holes. All parameters are specified in the explanatory drawings.

4.8. Tube bundle.

Non-standardized unit. It consists of four tabs and one additional window:
4.8.1. General information.
4.8.2. Tubes and fasteners.
4.8.3. Baffles.
4.8.4. Bypass and support elements.
4.8.5. Tube layout.
Sequential location after units: shell, flange connection.
Child location inside the units: flange connection.
The unit includes several parts.

4.8.1. General information.

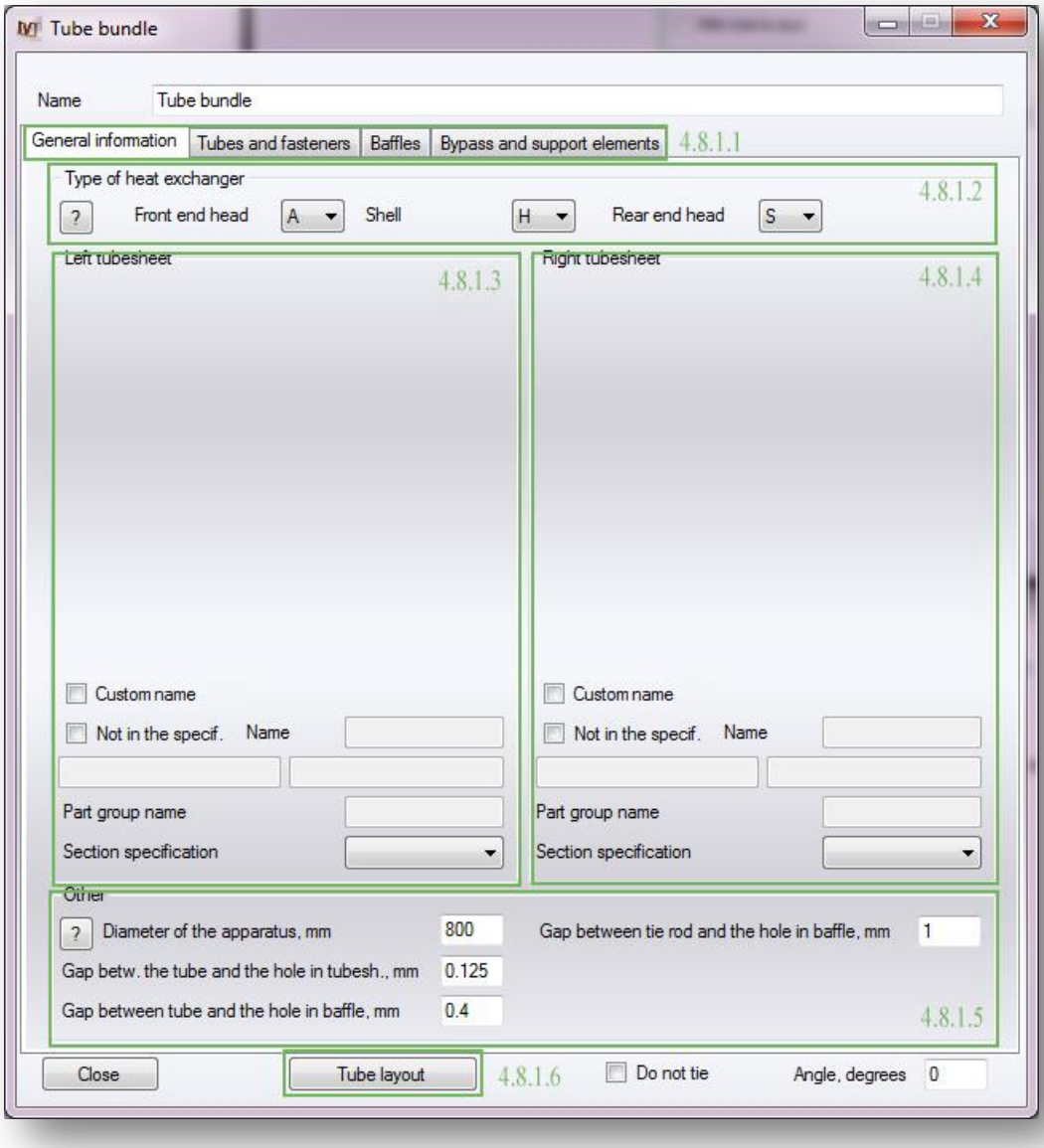


Fig. 4.8.1. Tube bundle general information

4.8.1.1. Switching between tabs 4.8.1.-4.8.5.
4.8.1.2. Heat exchanger type.

The type is specified according to the TEMA type (Tubular Exchanger Manufacturers Association).

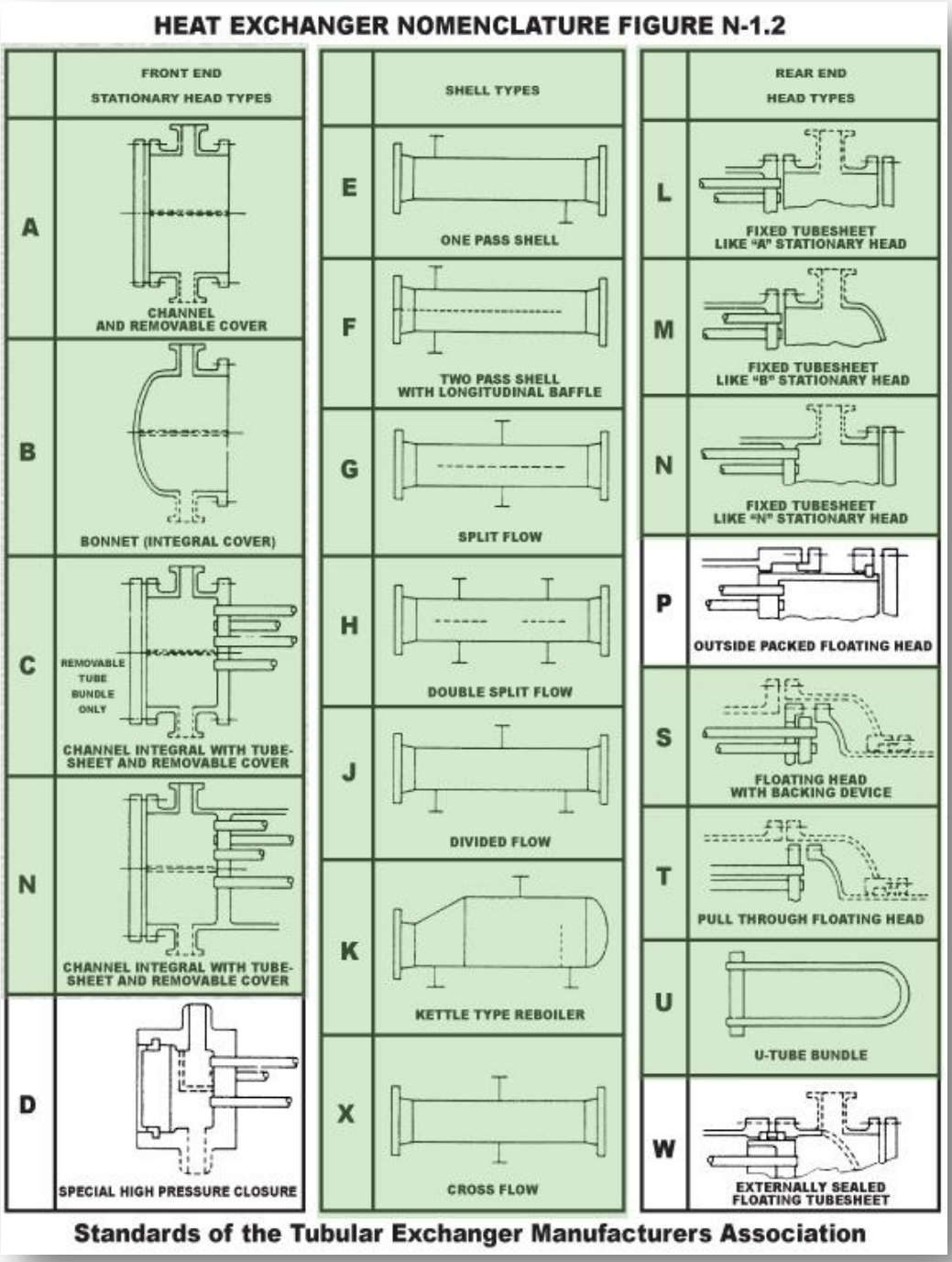


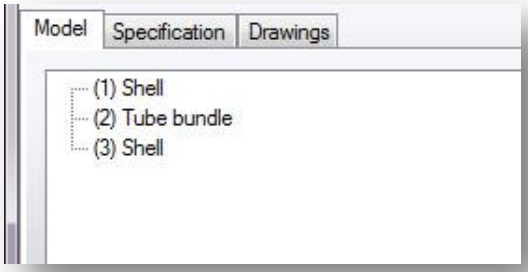
Fig. 4.8.1.2. Types of heat exchangers according to TEMA

The green color indicates the supported structures. The types in PVT are divided into 4 types:

1. N1/N2/N3 | Any shell | N1/N2/N3/U (N type is divided into 3 subtypes).
2. A/B | Any shell | L/M; A1/B1 | Any shell | U (A1/B1 are similar to the types of chambers A/B in a design with two fixed tubesheets).
3. C | Any shell | U.
4. A/B | Any shell | S/T/U.

Sketch drawing for the each type is shown in the explanatory drawings.

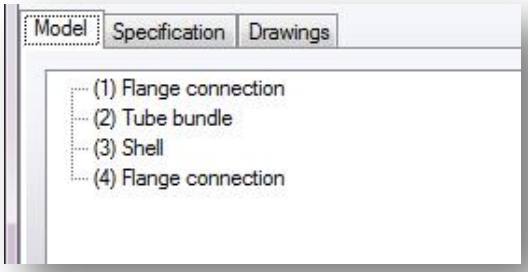
Depending on the design option, the sequence of units in the tree should be followed.



Location of parts:

1. Shell 1.
2. Left tubesheet 2.
   2.1. Elements of the tube bundle 2.
3. Shell 3.
4. Right tubesheet 2.

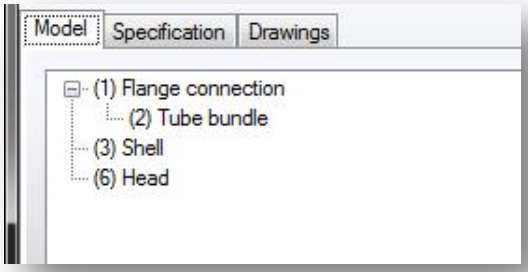
Fig. 4.8.1.2.1. An arrangement of units for type 1



Location of parts:

1. Flange 1.1.
2. Flange-tubesheet 1.2.
   2.1. Elements of the tube bundle 2.
3. Shell 3.
4. Flange-tubesheet 4.1.
5. Flange 4.2.

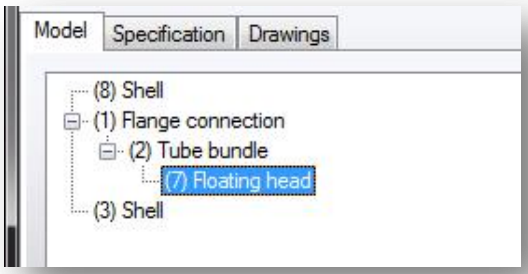
Fig. 4.8.1.2.2. An arrangement of units for type 2



Location of parts:

1. Flange-tubesheet 1.1.
   1.1. Elements of the tube bundle 2.
2. Flange 1.2.
3. Shell 3.
4. Head 6.

Fig. 4.8.1.2.3. An arrangement of units for type 3



Location of parts:

1. Shell 8.
2. Flange 1.1.
3. Tubesheet 2.
   3.1. Elements of the tube bundle 2.
      3.1.1. Floating head (S, T) 7.
4. Flange 1.2.
5. Shell 3.

Fig. 4.8.1.2.4. An arrangement of units for type 4

4.8.1.3. Parameter group of the left tubesheet.

The following input fields of parameters, specifications and materials for the tubesheet of a heat exchanger:

1. **N1/N2/N3** | Any shell | N1/N2/N3.
2. **A/B** | Any shell | L/M.
3. **A1/B1** | Any shell | U.
4. **C** | Any shell | U.

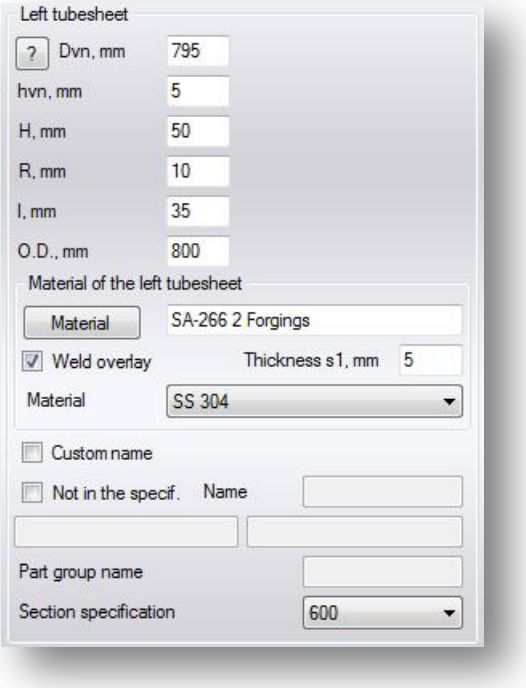


Fig. 4.8.1.3. Parameters group for the left tubesheet

4.8.1.4. Parameters group for the right tubesheet

The items described above in para. 4.8.1.3. become available for:

1. N1/N2/N3 | Any shell | **N1/N2/N3.**
2. A/B | Any shell | **L/M.**

4.8.1.5. Other parameters.

The user specifies the shell inner diameter, clearance between the tubes and tubesheet and baffle, and the clearance between the tie rods and the baffle.

4.8.2. Tubes and fasteners.

The user specifies by the geometry of heat exchanger tubes, tie rods, spacers and nuts, as well as materials and designations for the specification. When building a solid model the user can be specify the equivalent to the mass heat exchange tubes instead of the tubes, both for straight tubes and U-tubes: check the flag "Equivalent tubes mass» 4.8.2.1. This will save your time when building a model of the vessel and system resources when it is rendered. A one demo tube with zero mass will be build.

The tube bundle has a standardized nut, similar to 4.7.3 interface.

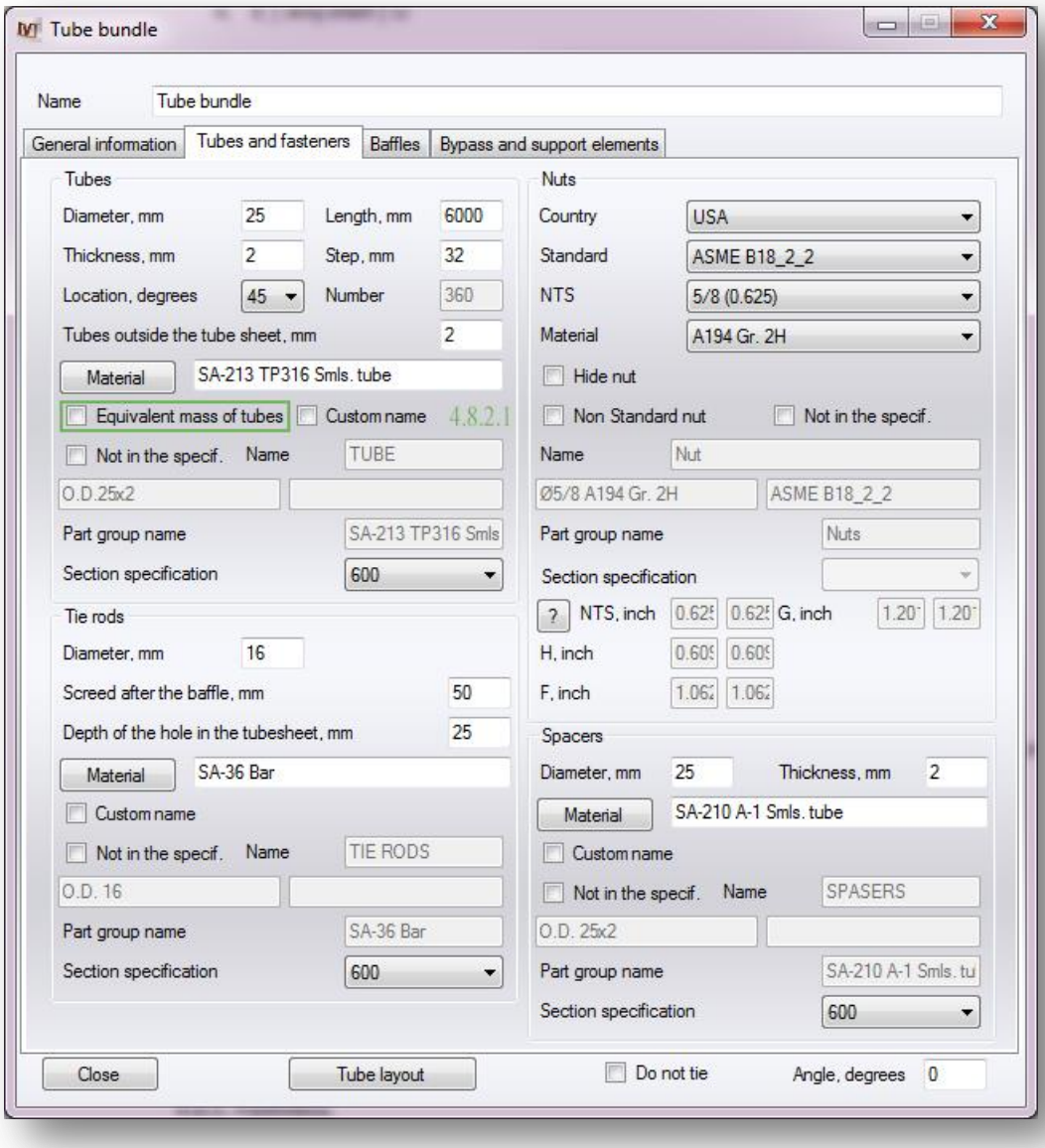


Fig. 4.8.2. Tubes and fasteners for the tube bundle

4.8.3. Baffles.

The user specifies the baffle type, section orientation, parameters, as well as material and designation for the specification. The maximum number of baffles group is 10.

4.8.3.1. Baffle type - transverse or longitudinal.

4.8.3.2. Drop-down lists of options:

4.8.3.2.1. Section type.

4.8.3.2.2. Orientation - Vertical | horizontal.

4.8.3.2.3. Orientation - Left/Top | right/bottom.

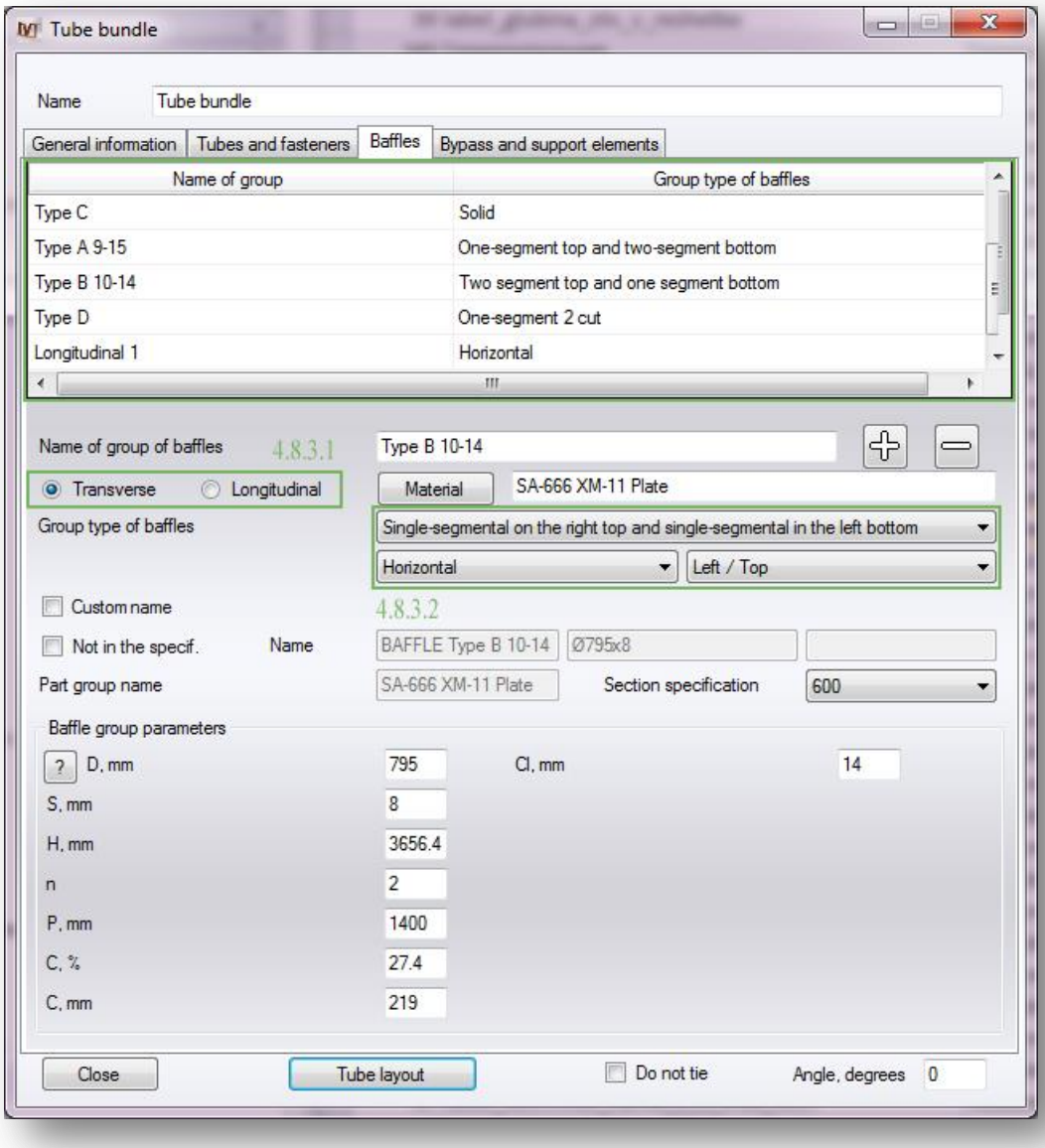


Fig. 4.8.3. Tube bundle buffles

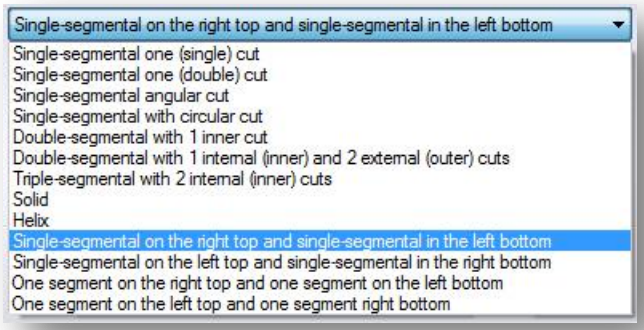


Fig. 4.8.3.2.1. Baffles cut types

4.8.4. Bypass and supporting elements.

The user specifies the geometry, material and tube bundle support elements designation – sliding bars or sliding tubes. The maximum number of support elements is 10.

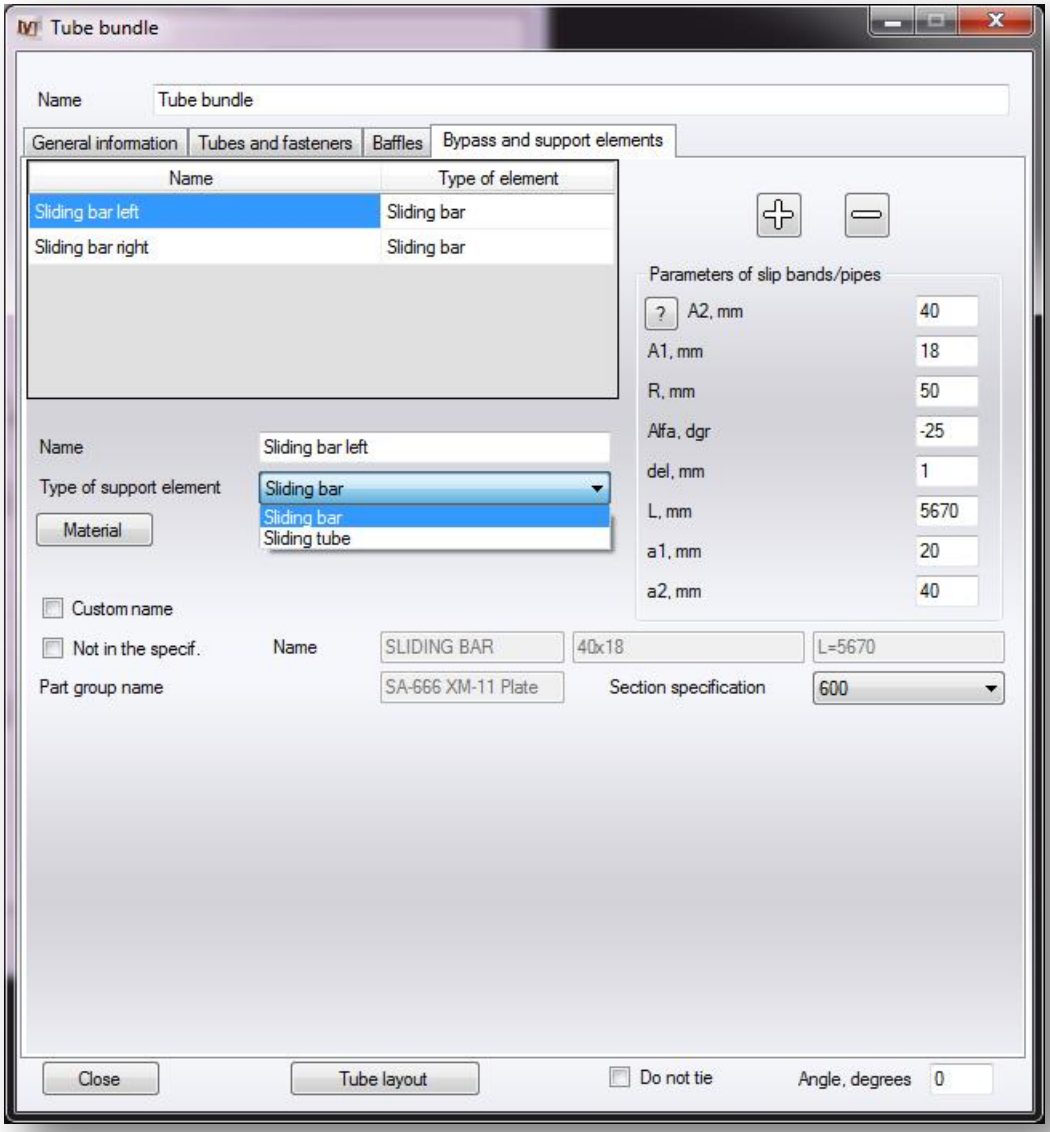


Fig. 4.8.4. Bypass and supporting elements of the tube bundle

4.8.5. Tube layout.

The window is opened by pressing the button 4.8.1.6. in Figure 4.8.1.

4.8.5.1. The limiting parameters of tube layout area.

The explanatory drawings contain the parameter «delta n,%» - the maximum difference of tubes number between passes in percent. This is an approximate parameter, its actual value is calculated after tube layout generation..

4.8.5.2. Location of tubes.

При включении флажка «Пользовательская delta y, mm» и введении определенного значения в поле ввода ближайший горизонтальный ряд труб к оси «Y» будет смещен на это значение. При снятии этого флажка и обновлении разбивки значение будет введено автоматически, исходя из расположения труб, в данном случае -22.5 мм. Варианты разбивки – линейный, смешанный и квадрант. Число ходов 1,2,4-…-20.

4.8.5.3. Entering coordinates.

When the flag "Custom delta y, mm" is checked and a specific value is entered in the input field, the closest tubes horizontal row to the «Y» axis will be shifted by this value. When unchecking this flag and updating the division, the value is entered automatically based on the location of the tubes, in this case -22.5 mm. The tube layout options are linear, mixed and quadrant. The number of passes is 1,2,4-…-20.

4.8.5.4. Restoration of tube layout.

Click this button to delete all tie rods and additional/deleted tubes. The layout will be generated limiting with the parameters 4.8.5.1. and 4.8.5.2.

4.8.5.5. Extra options.

It is possible to select the input and output nozzles of the shell side, the diameters of these nozzles will be displayed.

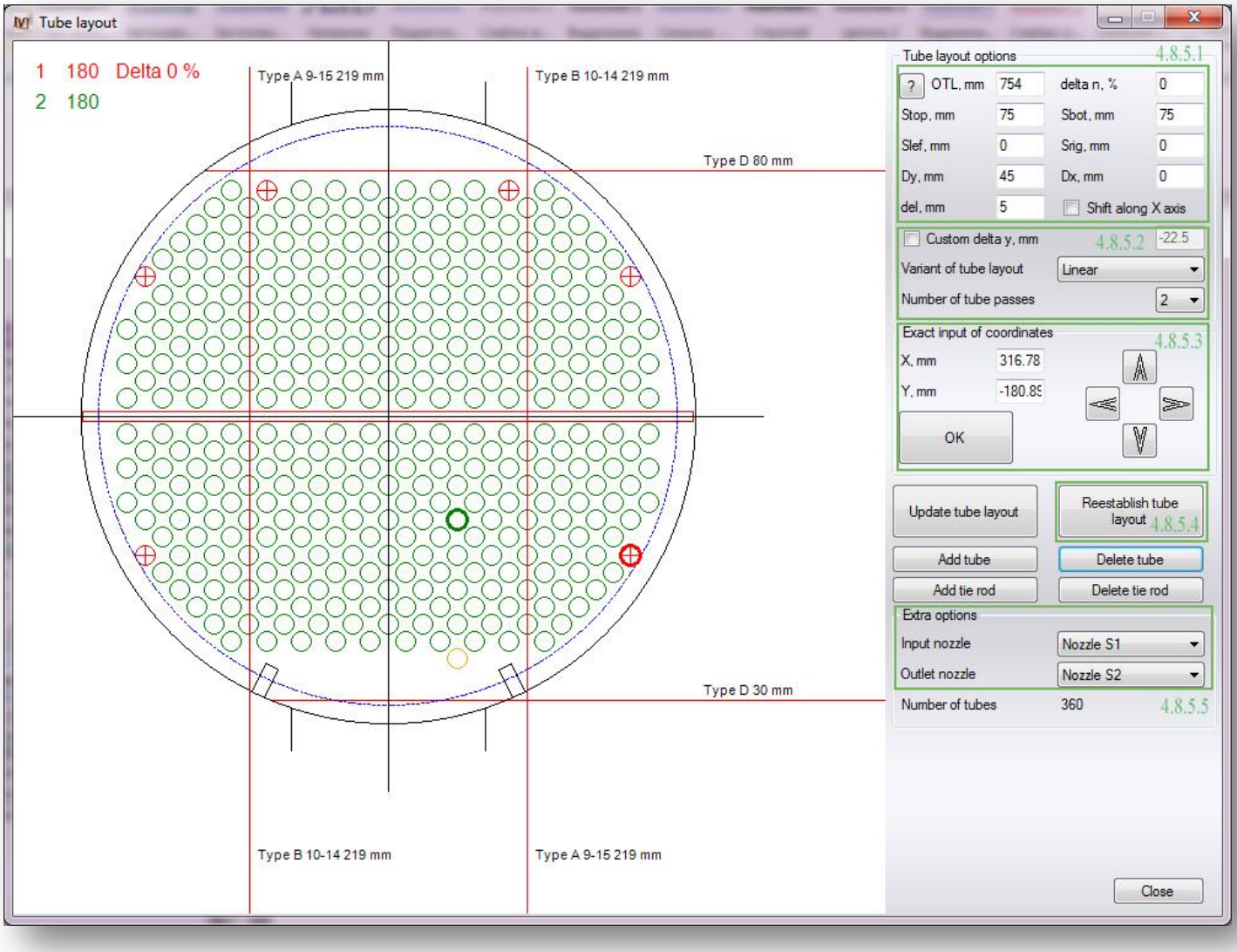


Fig. 4.8.5. The tube layout

4.9. Floating head.

Non-standardized unit. It consists of two tabs:
4.9.1. Tubesheet, flange, divided ring and joint.
4.9.1. Head, gasket and fasteners.
Sequential location after the units is impossible.
Child location inside the units: tube bundle.
The unit includes several parts.

4.9.1. Head, gasket and fasteners.

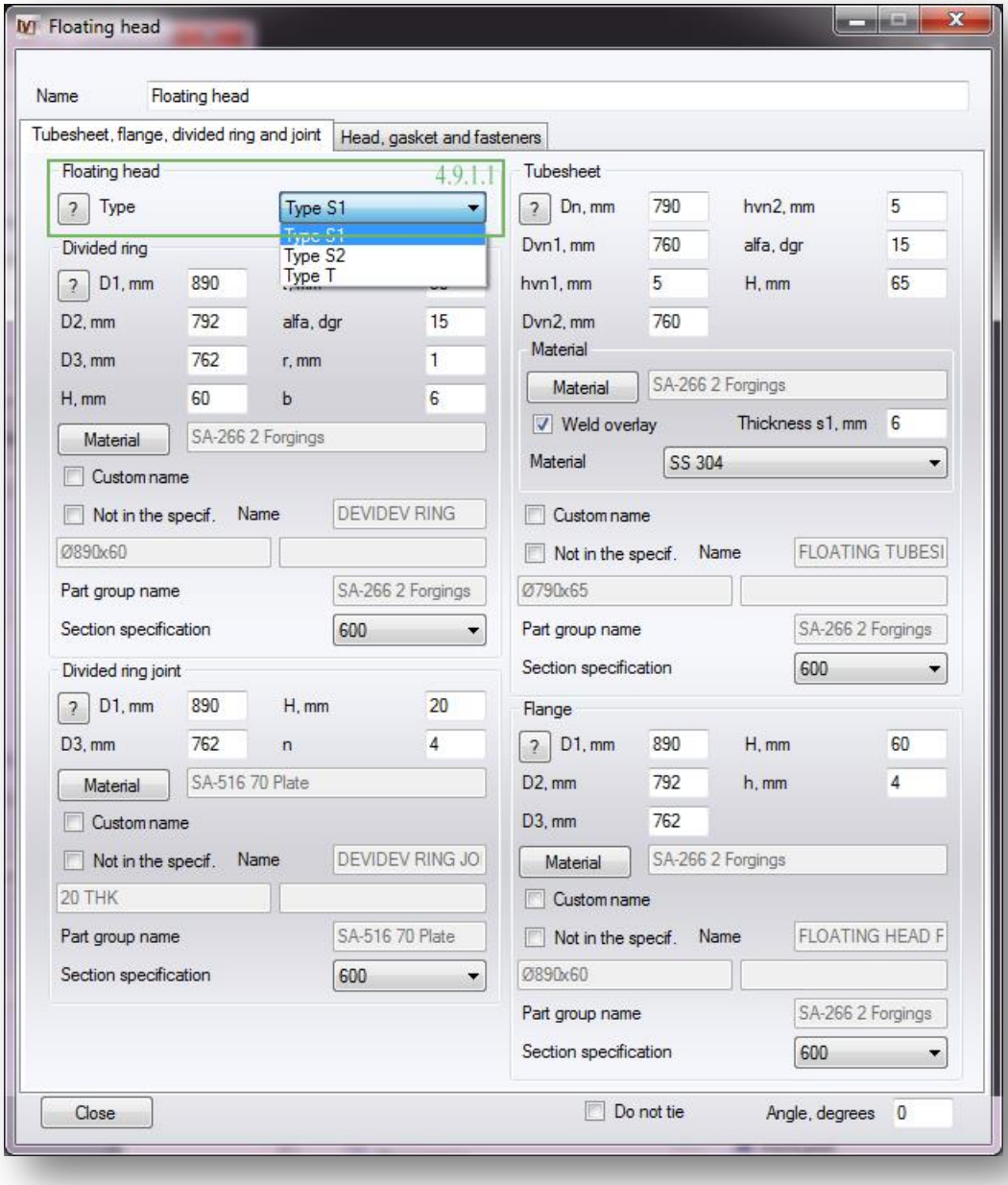


Fig. 4.9.1. Tubesheet, flange, divided ring and floating head joint

4.9.1.1. Selecting the design type.

Three options are available: S1, S2, and T (S type is divided into 2 subtypes), similar to TEMA types. Depending on the selected type, group of parameters and parts become available for the floating

head unit. The groups interfaces are similar to the interface of non-standardized parts in the tube bundle.

4.9.2. Head, gasket and fasteners.

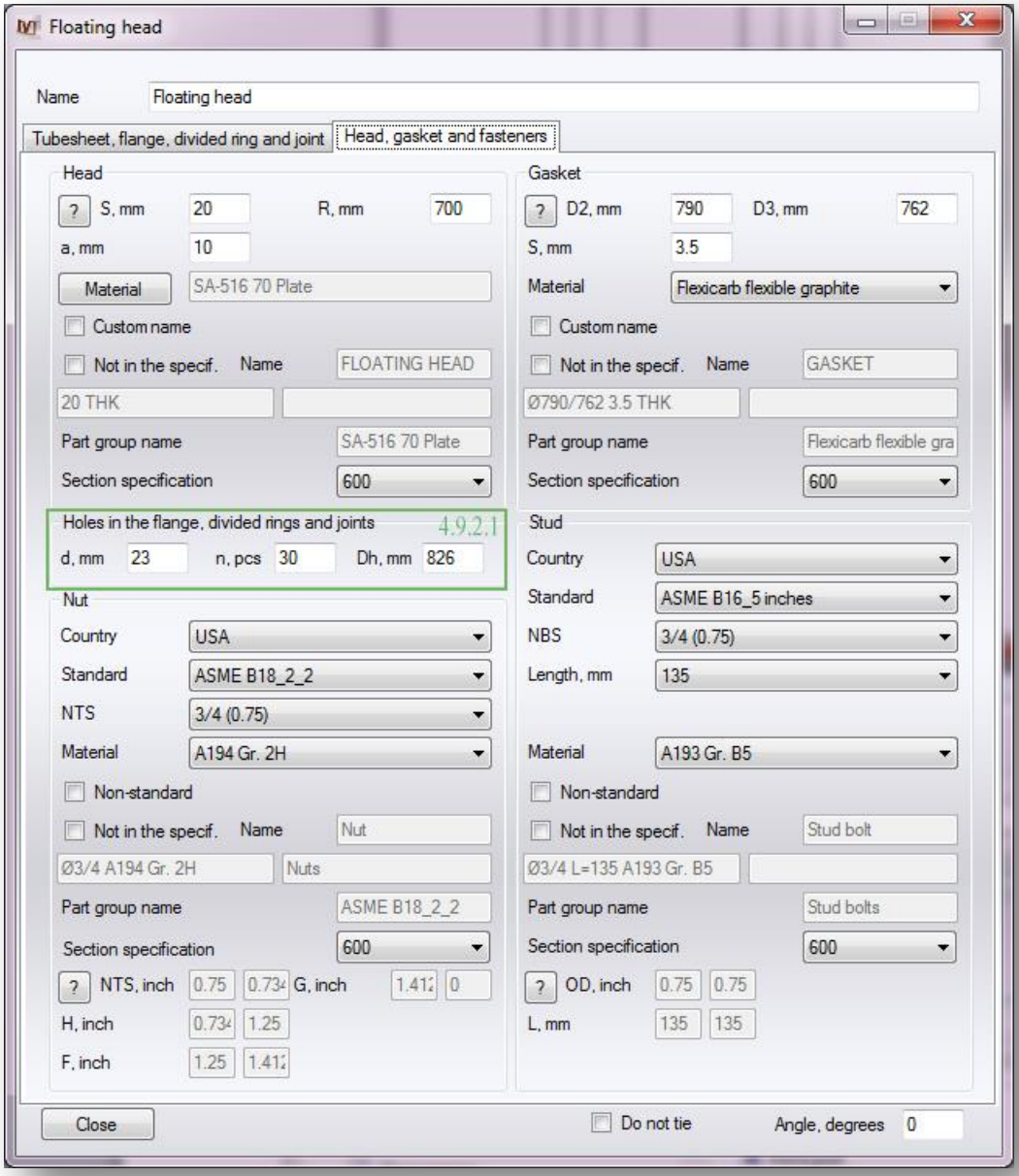


Fig. 4.9.2. Head, gaskets and fasteners of the floating head

The groups interfaces are similar to the fasteners interfaces in the flange connection and the interfaces of non-standardized parts of the tube bundle.

Design options 4.9.1.1, standardized geometry of the floating head unit parts are described in detail in the explanatory drawings.

4.10. Foot support.

Standardized unit. It consists of a single window.
Sequential location after the units is impossible.
Child location inside the units: shell.
The unit includes several parts.

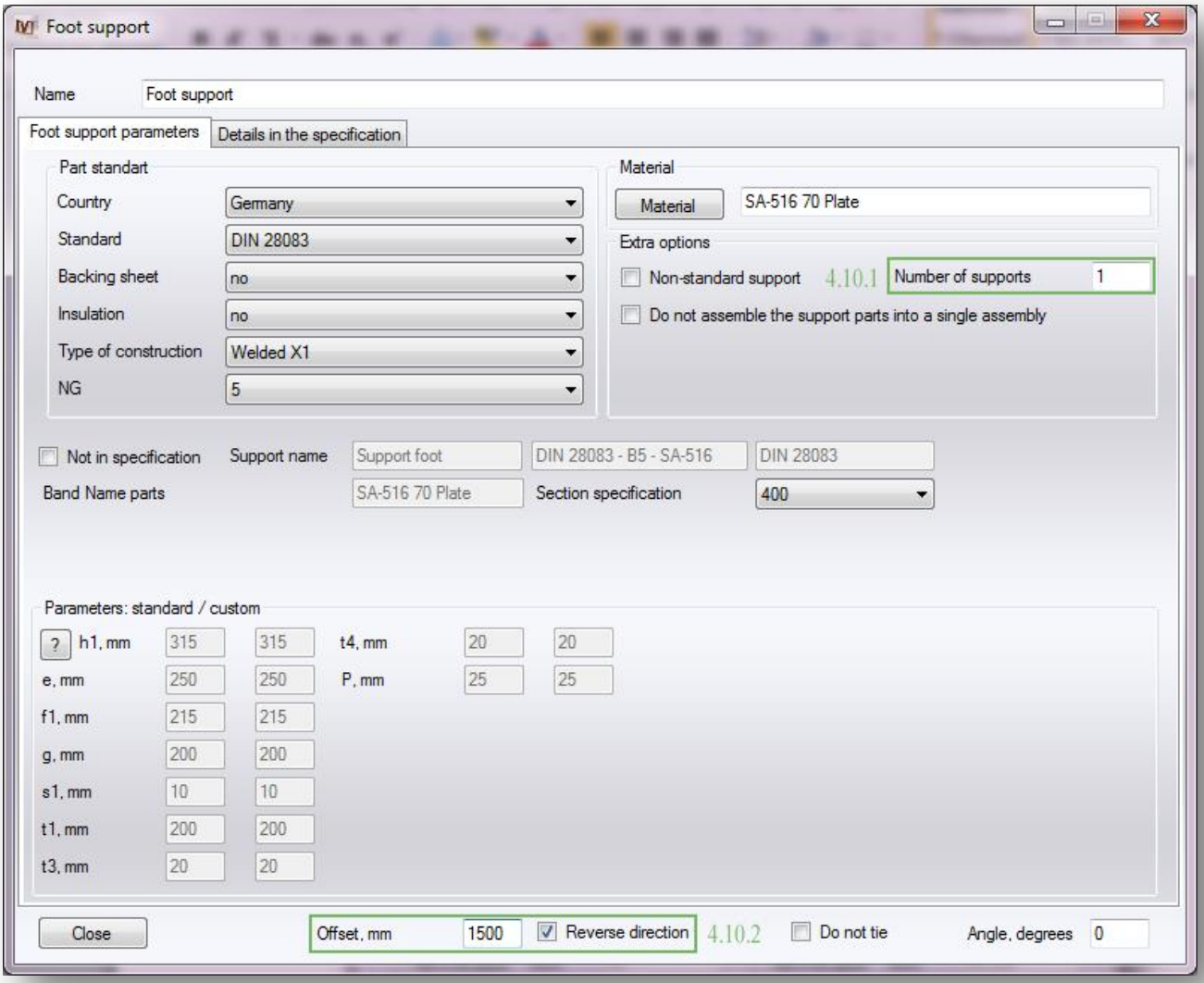


Fig. 4.10. Foot support.

4.10.1. The supports are arranged uniformly along 360 degrees around the shell axis.
4.10.2. The offset from the parent element is a shell. When the check box is checked, the support direction changes to the opposite direction along the shell axis.

The rest of the foot support interface is similar to the standardized units interface described above.

4.11. Saddle support.

Standardized unit. It consists of a single window.
Sequential location after the units is impossible.
Child location inside the units: shell.
The unit includes several parts.

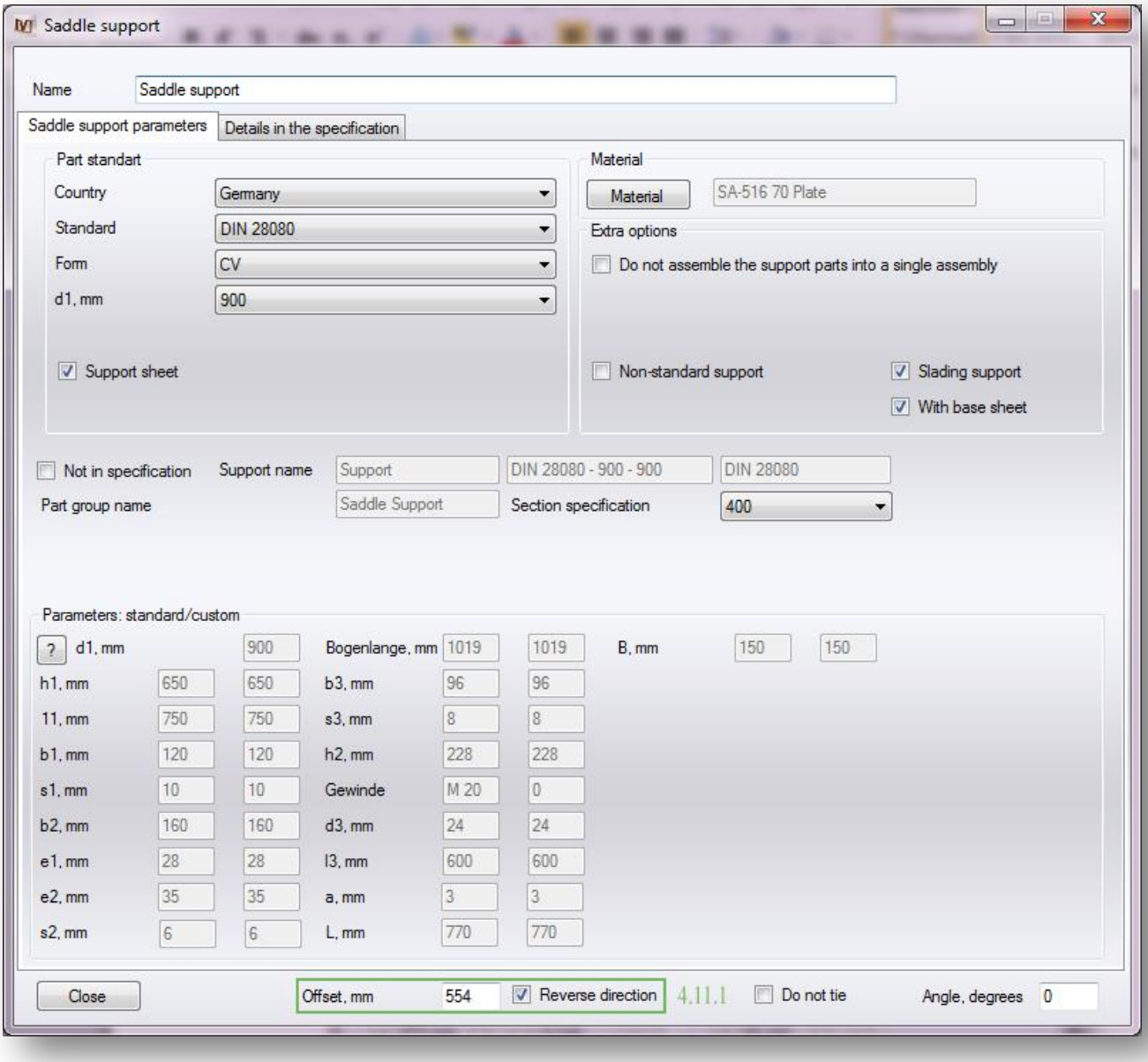


Fig. 4.11. Saddle support

4.11.1. Completely similar to para. 4.10.2.

The rest of the saddle support interface is similar to the standardized units interface described above.

4.12. Support skirt.

Standardized unit.
Sequential location after the units is impossible.
Child location inside the units: shell, head (depending on the standard and the support type).
The unit includes several parts.

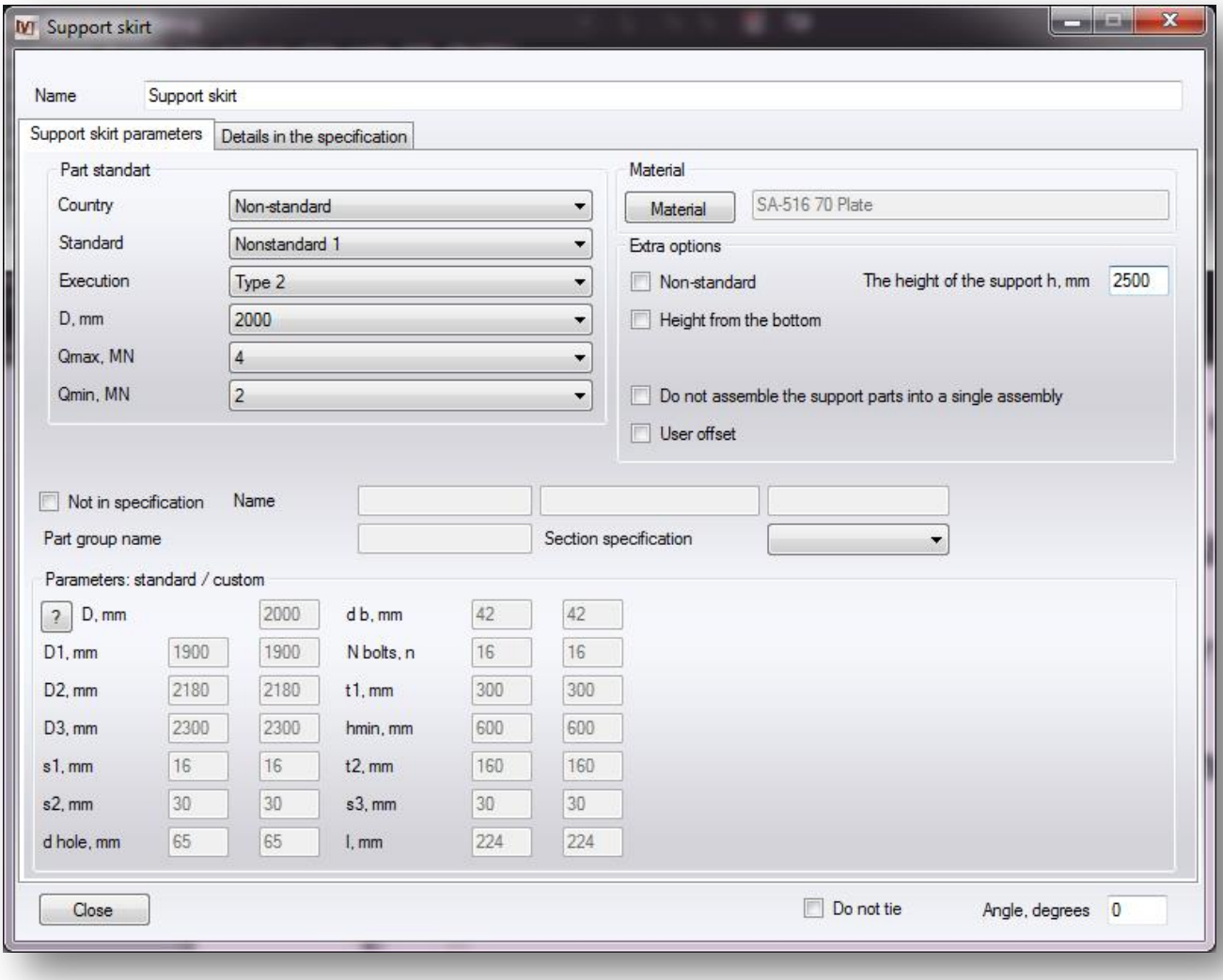


Fig. 4.12. Support skirt

The rest of the support skirt interface is similar to the standardized units interface described above.

4.13. Rack support.

Standardized unit.
Sequential location after the units: head (depending on the standard and the support type).
Child location inside the units: shell, cone (depending on the standard and the support type).
The unit includes several parts.

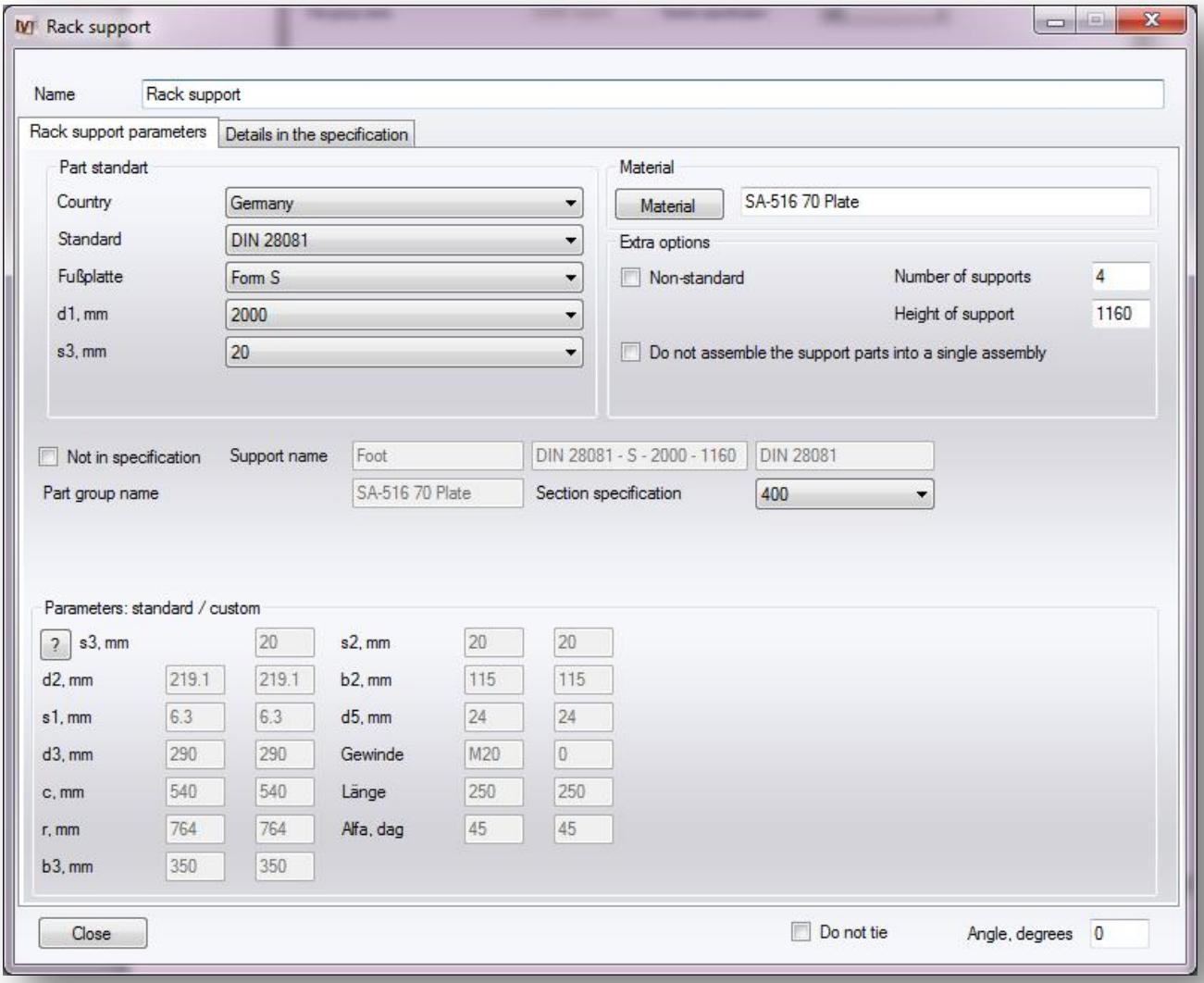


Fig. 4.13. Rack support

The rest of the rack support interface is similar to the standardized units interface described above.

4.14. Elbow.

Standardized unit. It consists of a single window.
Sequential location after units: shell, head, cone, flange connection, elbow, compensator.
Child location inside the units: nozzle.
The unit includes one part.

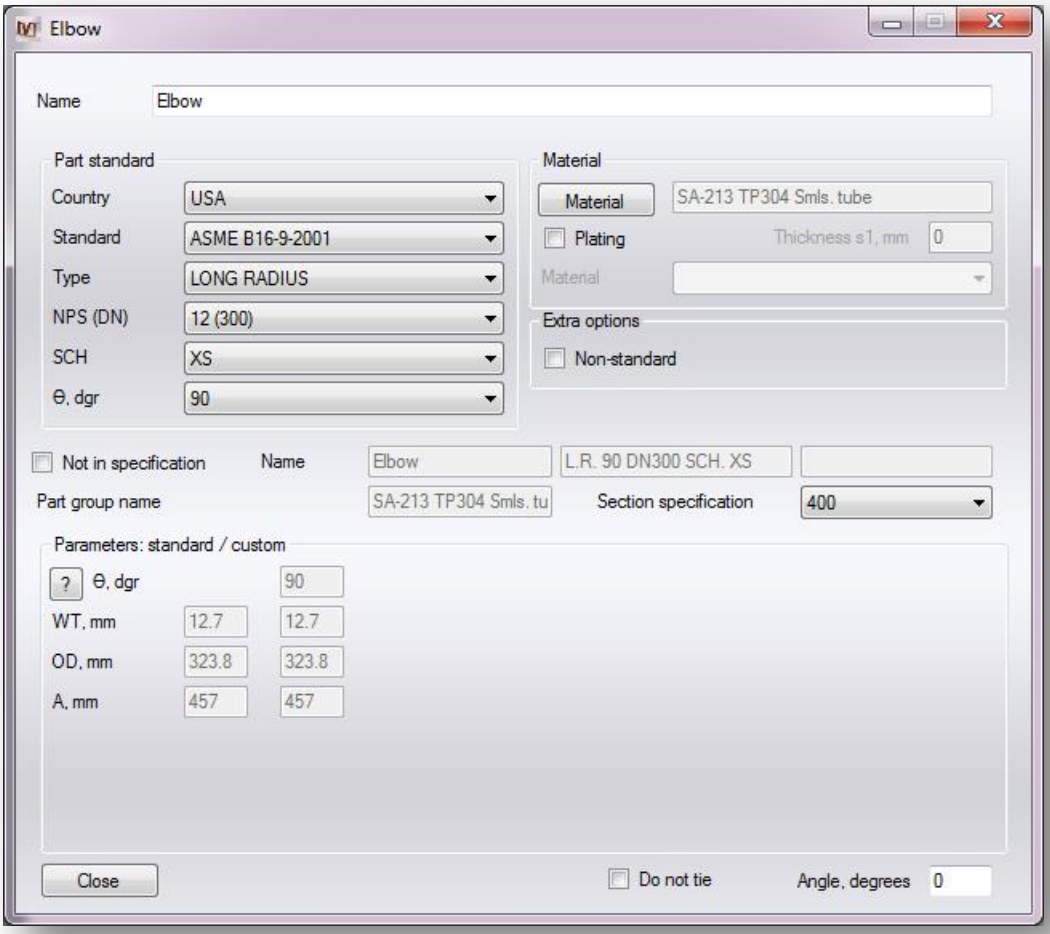


Fig. 4.14. Elbow

The rest of the elbow interface is similar to the interface of standardized units described above.

4.15. Compensator.

Standardized unit. It consists of a single window.
Sequential location after units: shell, head, cone, flange connection, elbow, compensator.
Child location inside the units: nozzle.
The unit includes several parts.

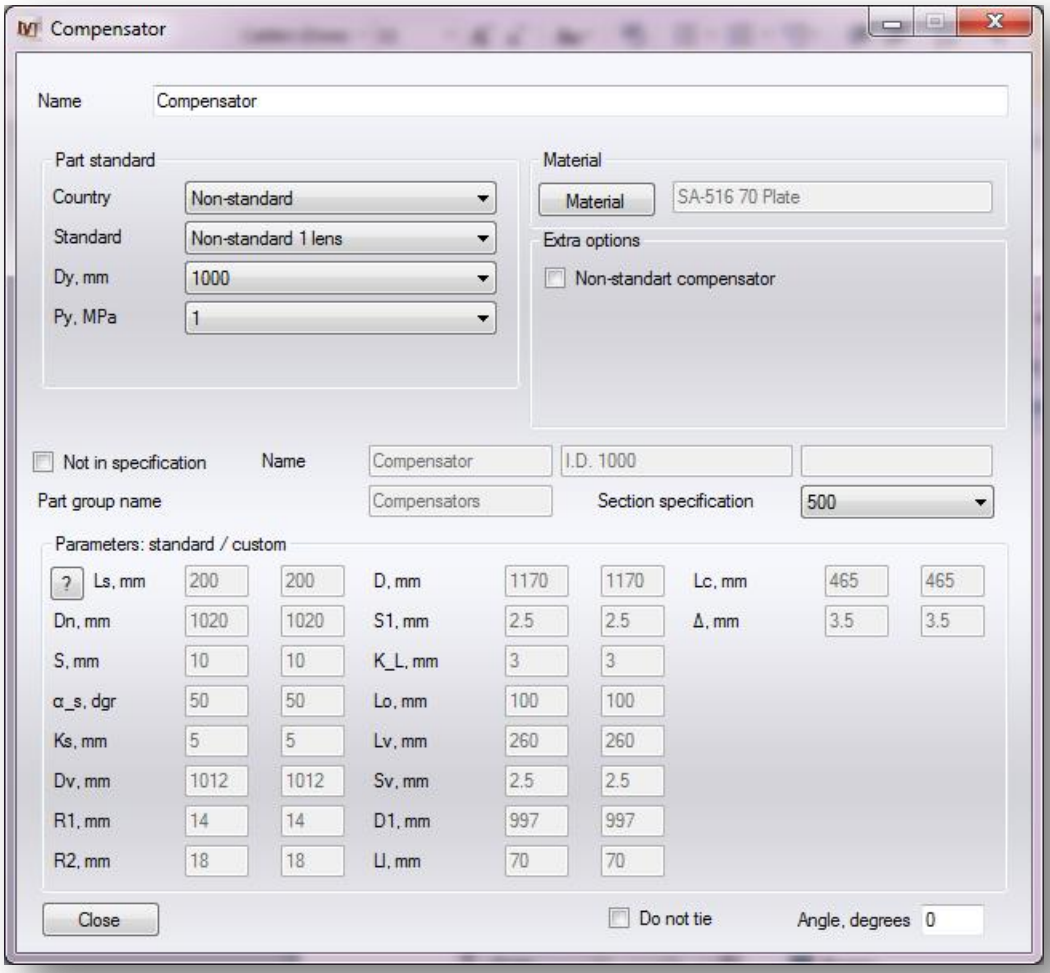


Fig. 4.15. Compensator

The rest of the compensator interface is similar to the interface of standardized units described above.

4.16. Support rings.

Standardized unit. It consists of a single window.
Sequential location after the units is impossible.
Child location inside the units: shell.
The unit includes several parts.

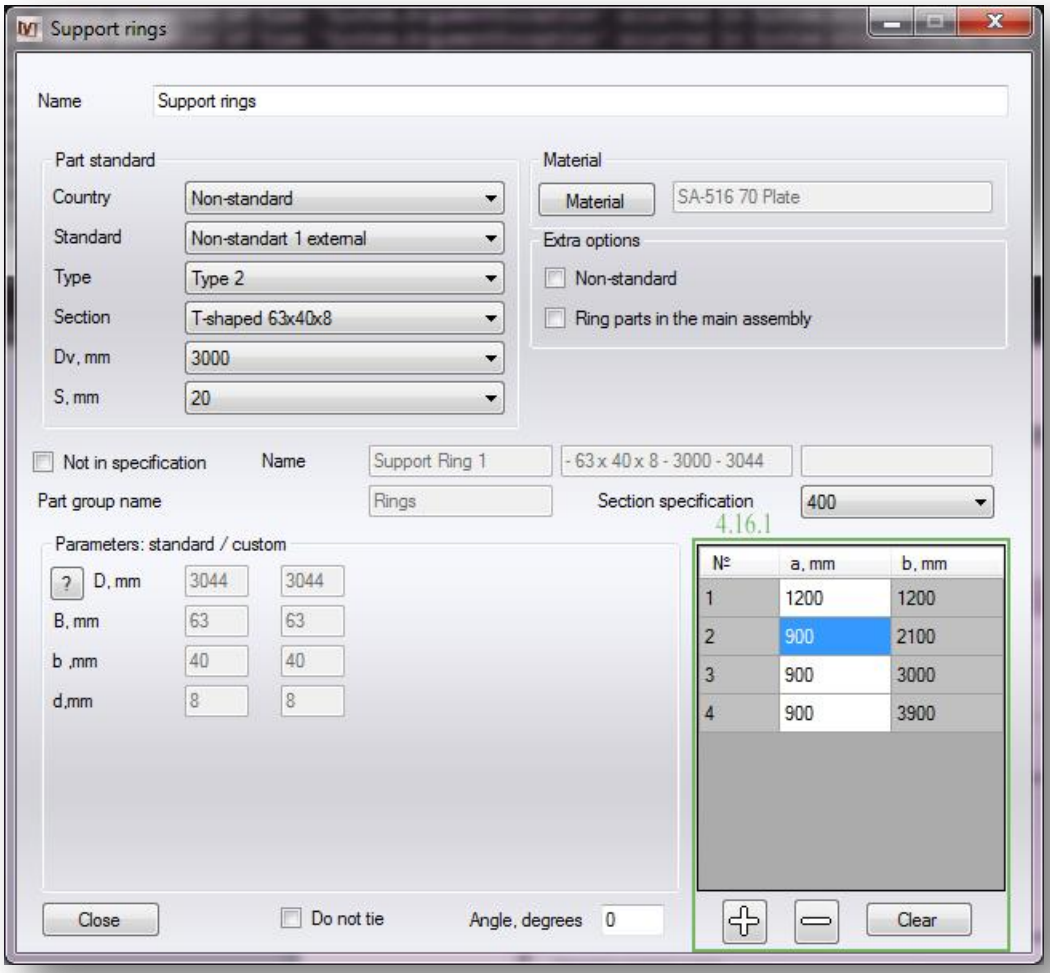


Fig. 4.16. Support rings

4.16.1. The user specifies the number and offset for each support ring “a, mm”, “b, mm” is a total distance from the each ring to the shell, the maximum number of rings is 30. The rest of the interface is similar to the standardized units interfaces described above.

4.17. Swivel device.

Standardized unit. It consists of four tabs:
4.17.1. Lifting device.
4.17.2. Extra options.
4.17.3. Earring, polt, handles.
4.17.4. Lever.
Sequential location after the units is impossible.
Child location within units: Flange connection.
The unit includes several parts.

4.17.1. Swivel device.

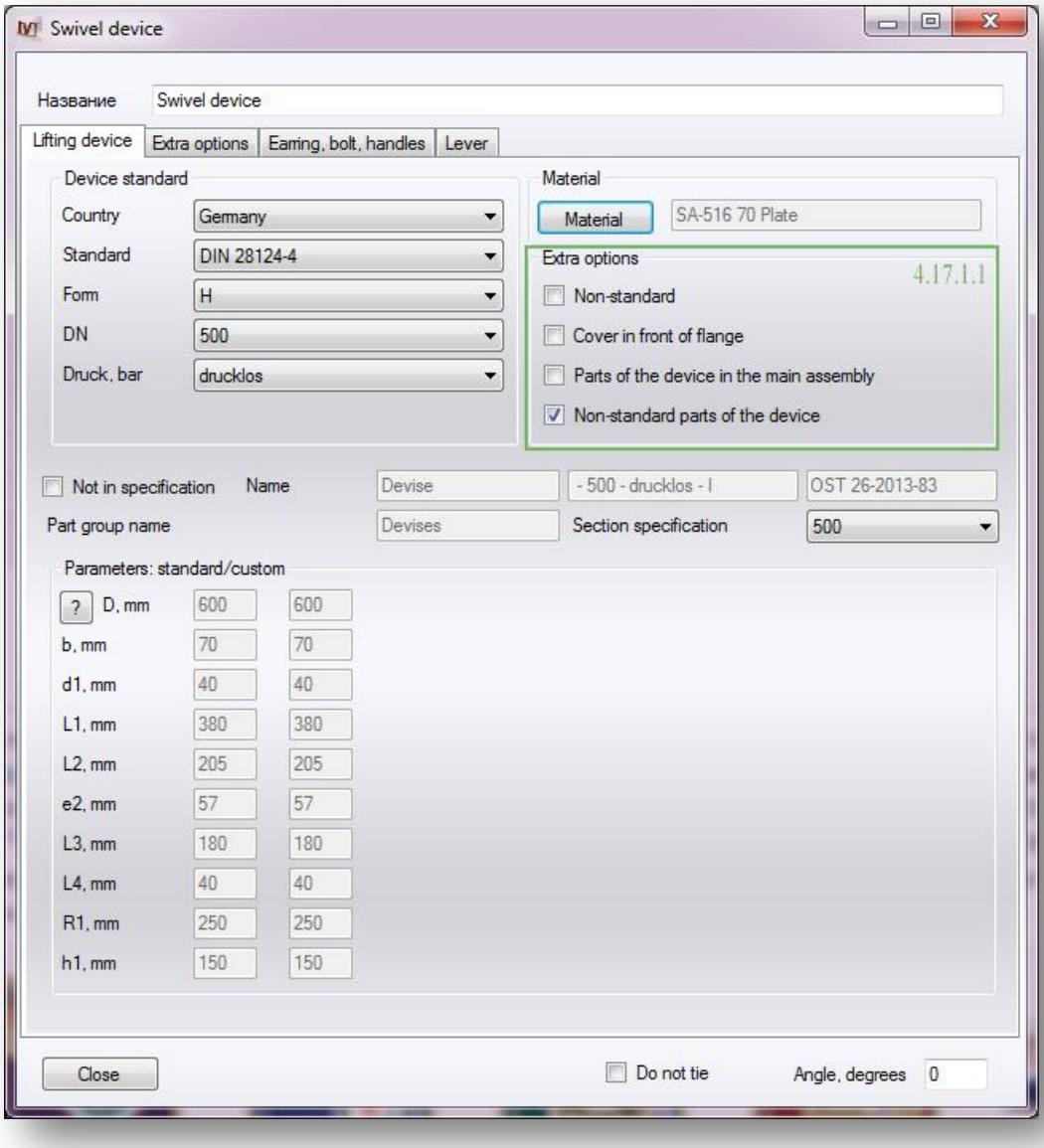


Fig. 4.17.1. Swivel device

Check the flag «Cover in front of flange» to make swivel device bound to the second flange, the default bound is to the first flange. Tabs 4.17.2- 4.17.4 Becomes available after checking flag "Non-

standard parts of the device". The rest of the interfaces similar to the standardized interfaces described above.

4.17.2. Extra options.

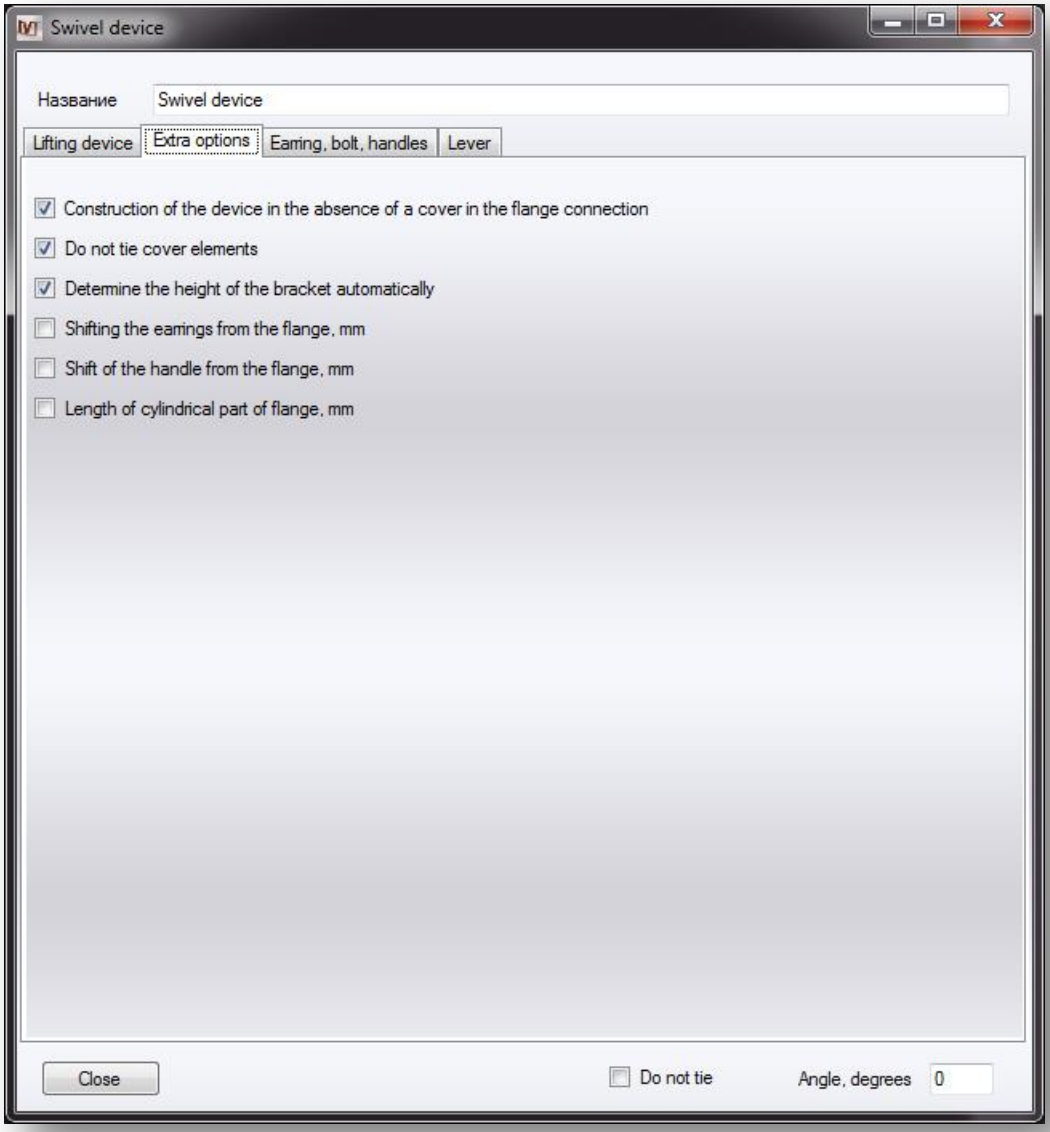


Fig. 4.17.2. Extra options

Check the flag "Construction of the device in the absence of a cover the flange connection" to make it possible to construct the swivel device with no blank flange or if the cover is installed instead of the flange (when the flag is checked, the construction will not run). The flags "Shift of the shackle from the flange" and "Shift of the handle from the flange" will become available.

Check "Determine the height of the bracket automatically" to enable automated calculation of the swivel device brackets height based on the parameters of the flange connection (the default height of the bracket is taken from the standard).

Check "Shift of the shackle from the flange" to specify the distance from the earring to the flange base surface.

Check "Shift of the handle from the flange" to specify the distance from the handles to the flange base surface.

Check "Diameter of cylindrical part of flange" to specify the flange base surface diameter or shell outer diameter.

4.17.3. Earring, bolt, handles.

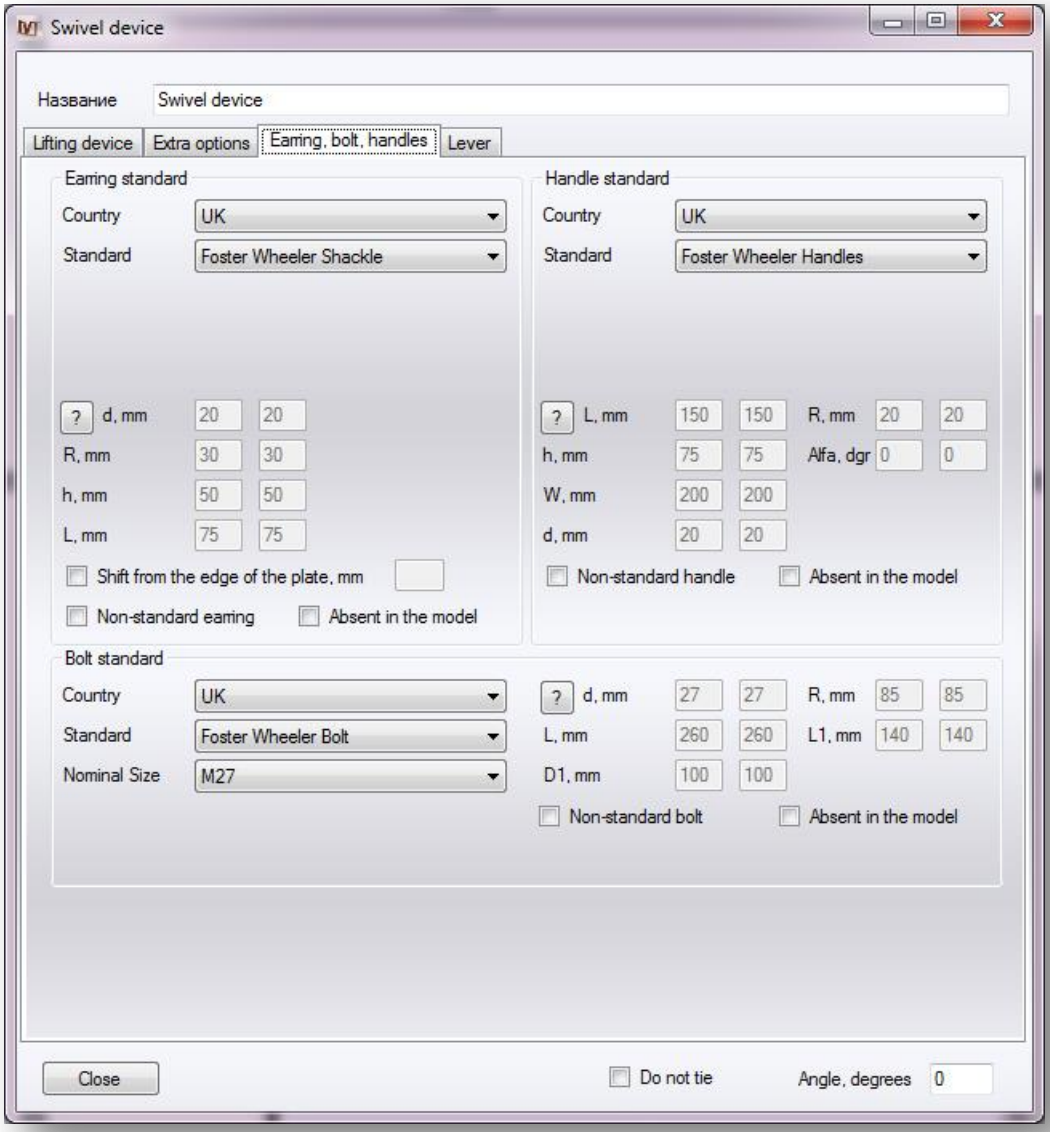


Fig. 4.17.3. Earring, bolt, handles

The interface is similar to the standardized units interfaces described above.

4.17.4. Handle.

The interface is similar to the standardized units interfaces described above.

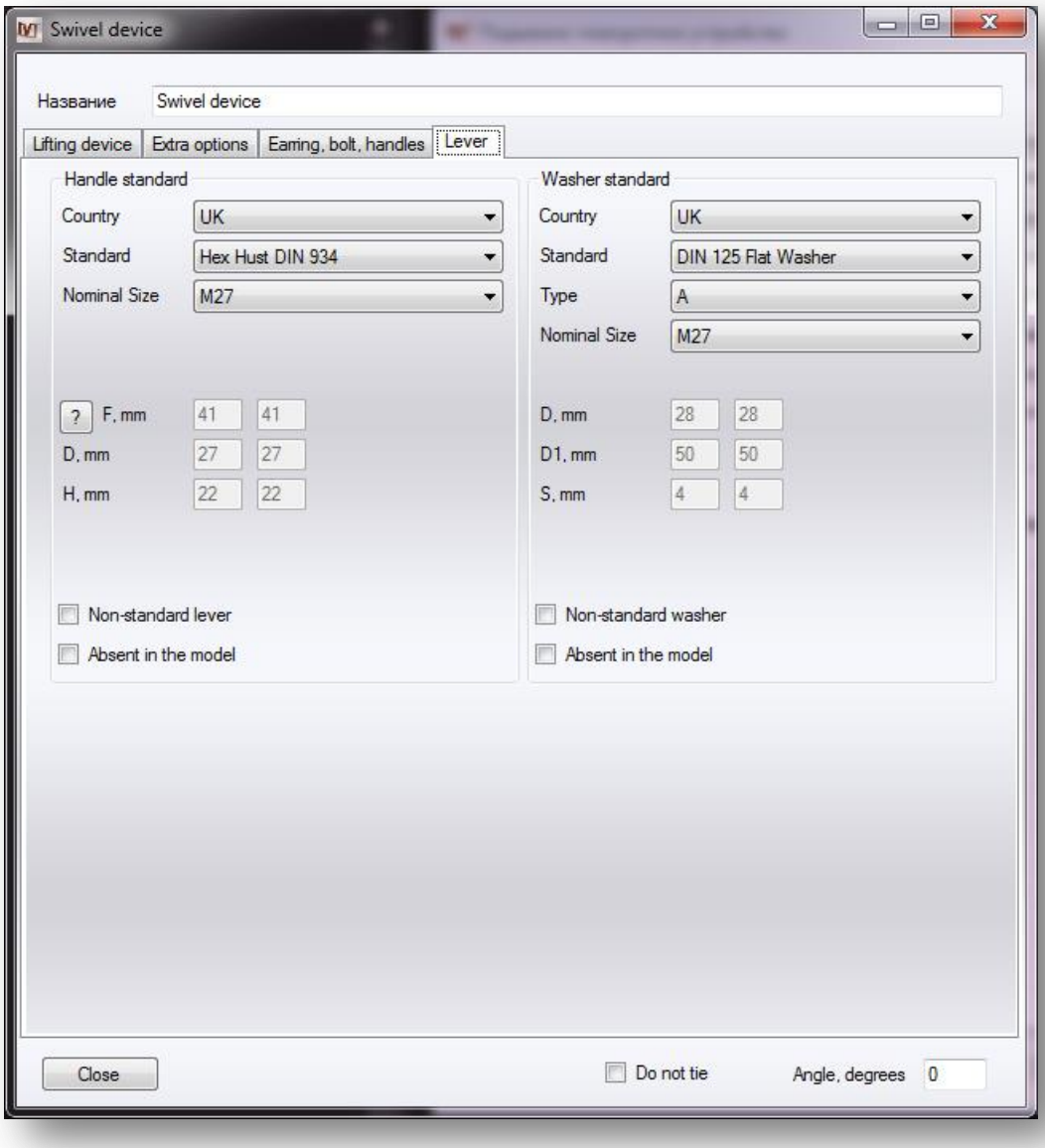


Fig. 4.17.4. Handle

4.18. Multi-level unit.

Conditional unit. It consists of a single window.
Sequential location after units: a multi-level unit.
Child location after the units is not possible.
The unit does not include any parts.

The unit is a conditional unit forming the individual shells devices, e.g. double or triple heat exchanger. To specify the shells offset you need to enter offset values on three axes - X, Y, Z. It is possible not to fix the device by checking "Do not fix by coordinates" in the group 4.18.1.1.

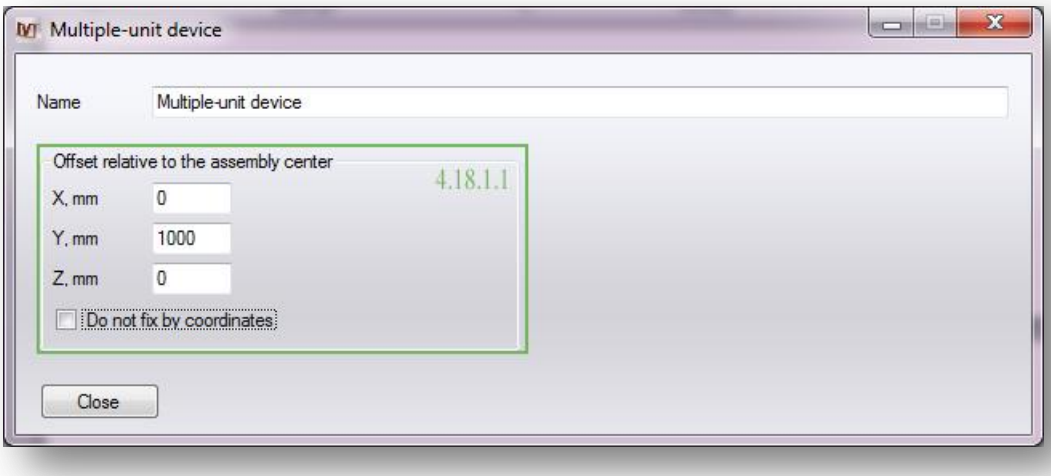


Fig. 4.18.1. Multi-level unit

To form a separate shells, make all vessel units child units of the "Multi-unit device" as shown in Figure 4.18.2.

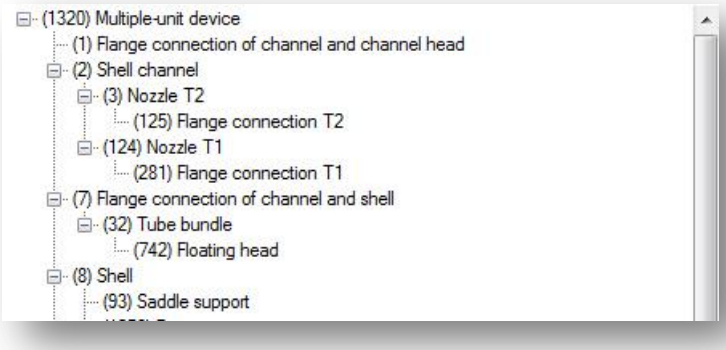


Fig. 4.18.2. Location of the Multi-unit device in the vessel tree

To form several shells, arrange units of the multi-unit device sequentially as shown in Figure 4.18.3.

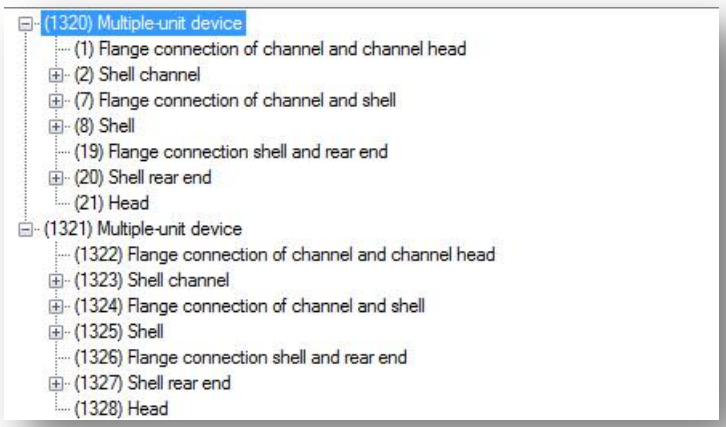


Fig. 4.18.3. Location of multi-unit device in the vessel tree

4.19. Subassemblies.

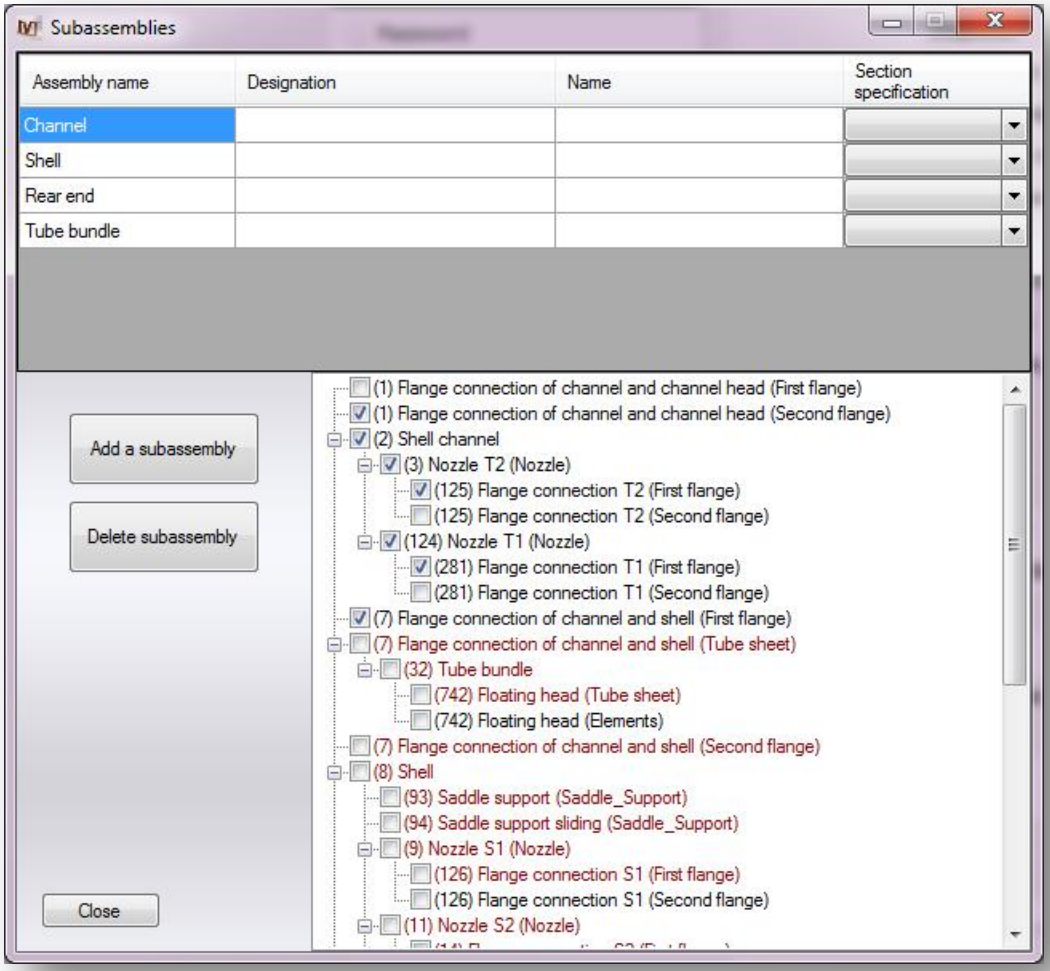


Fig. 4.19. Subassemblies

The subassemblies window is opened by clicking "Subassembly" in group 2.5 in Figure 2. This option has 4 subassemblies – chamber, shell, shell cover and tube bundle. To add a unit or part in the subassembly, check the box next to the required element. The subassembly units chain must be continuous, that is physically uniform. The user can not add two flanges and clamped part if any included in the flange connection. Red-colored are elements added to other subassemblies, and they can be added to the editable subassembly when performing the above-described conditions.

5. Specification.

PVT interface is not completed, the section will be filled soon.

6. Drawing.

6.1. Sheets list.

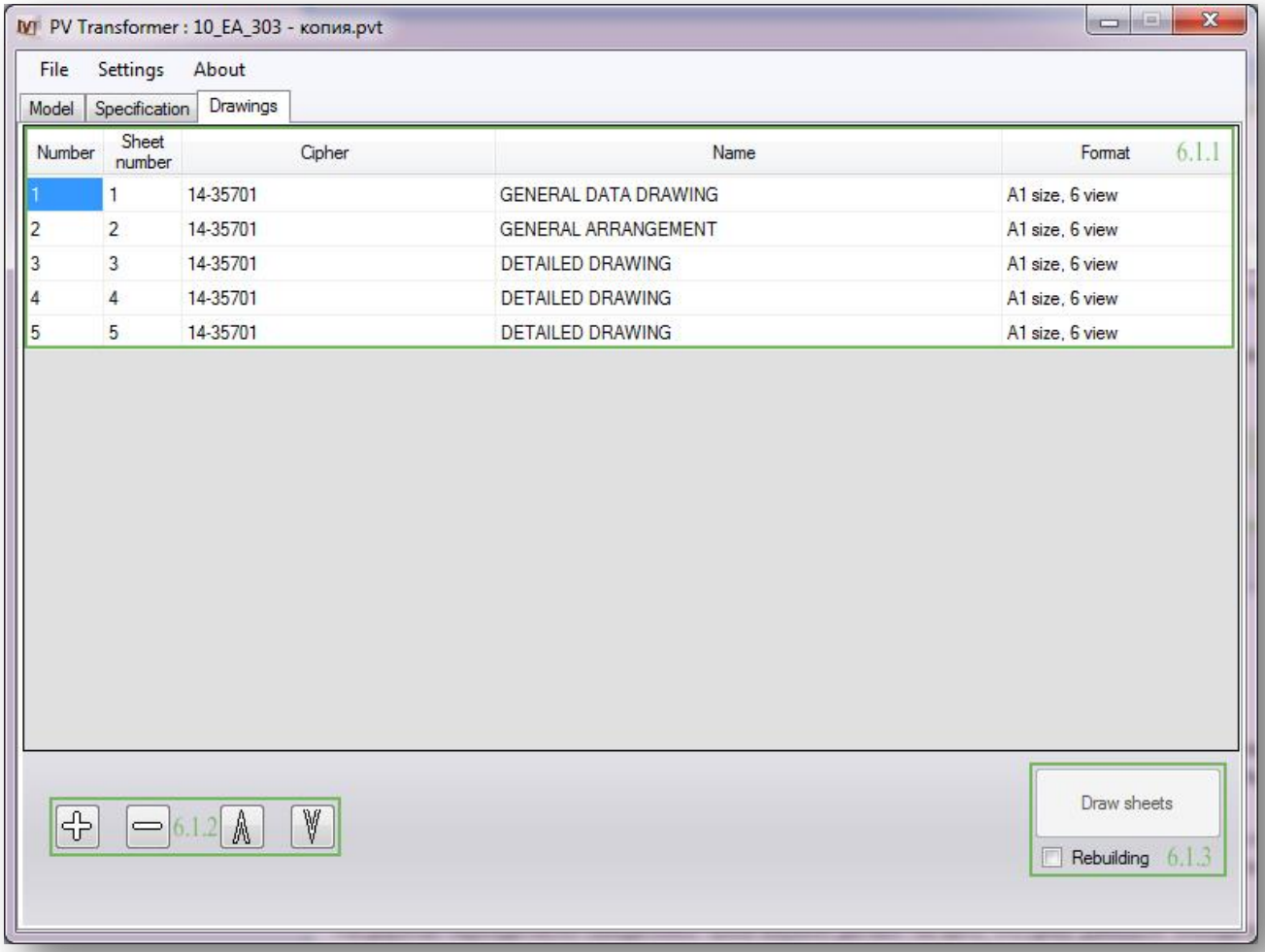


Fig. 6.1. Sheets list

6.1.1. Sheets list.

Fields "Code" and "Name" are editable from the sheets list interface. The number of sheets in the drawing is not limited.

6.1.2. Adding, deleting and moving the sheet up/down through the list.

6.1.3. Generating of sheets.

Generate sheets by checking "Rebuild" and click "Rebuild sheets". After rebuilding, the checkbox is unchecked automatically. This is done to prevent accidental button clicking, as rebuilding takes time and computer resources.

6.2. Sheet interface.

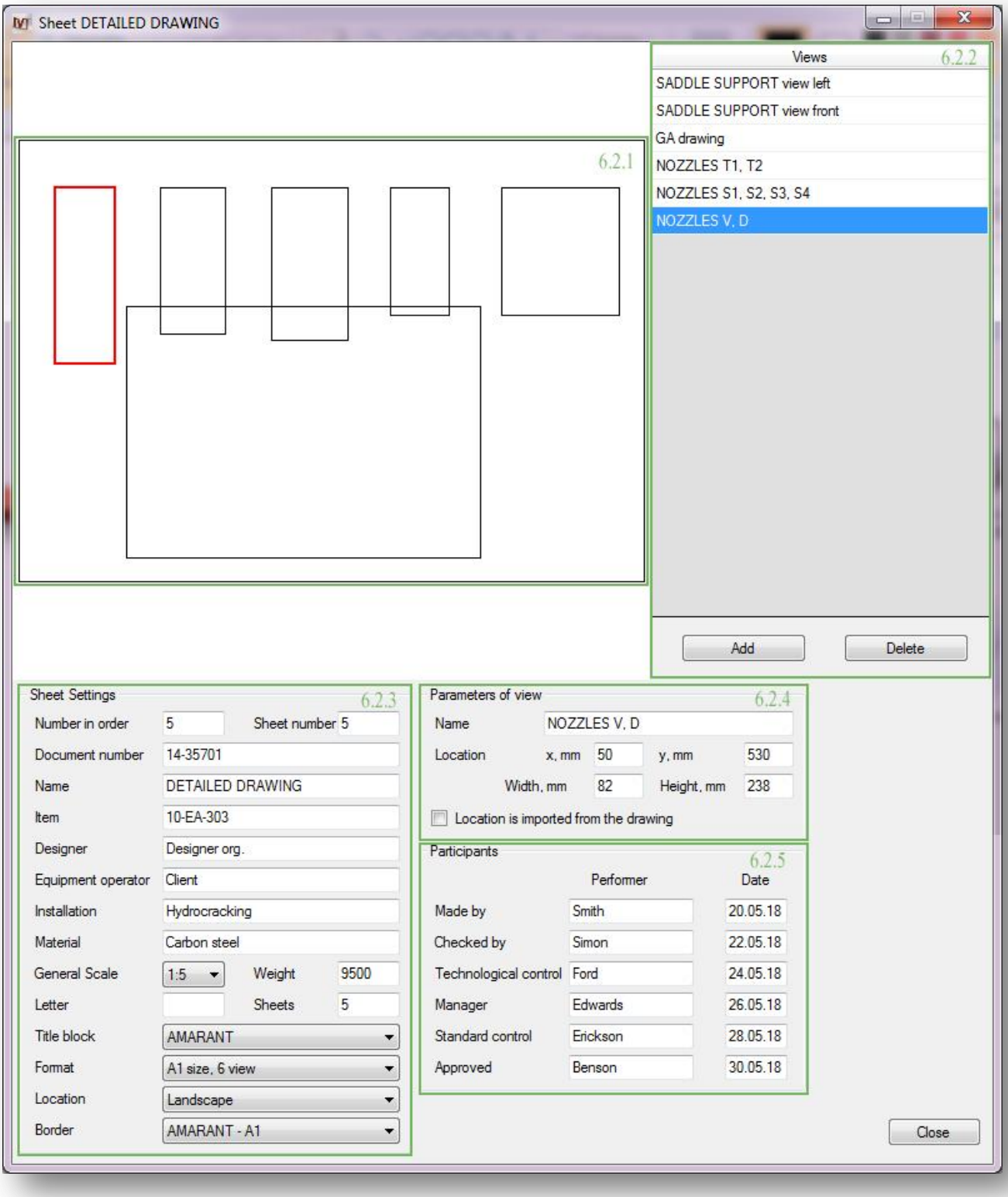


Fig. 6.2. Interface of sheet

6.2.1. Sketch of the sheet with views.

The sketch is formed based on the sheet size and orientation entered in 6.2.3, as well as the sizes and positions based on the views of sheet.

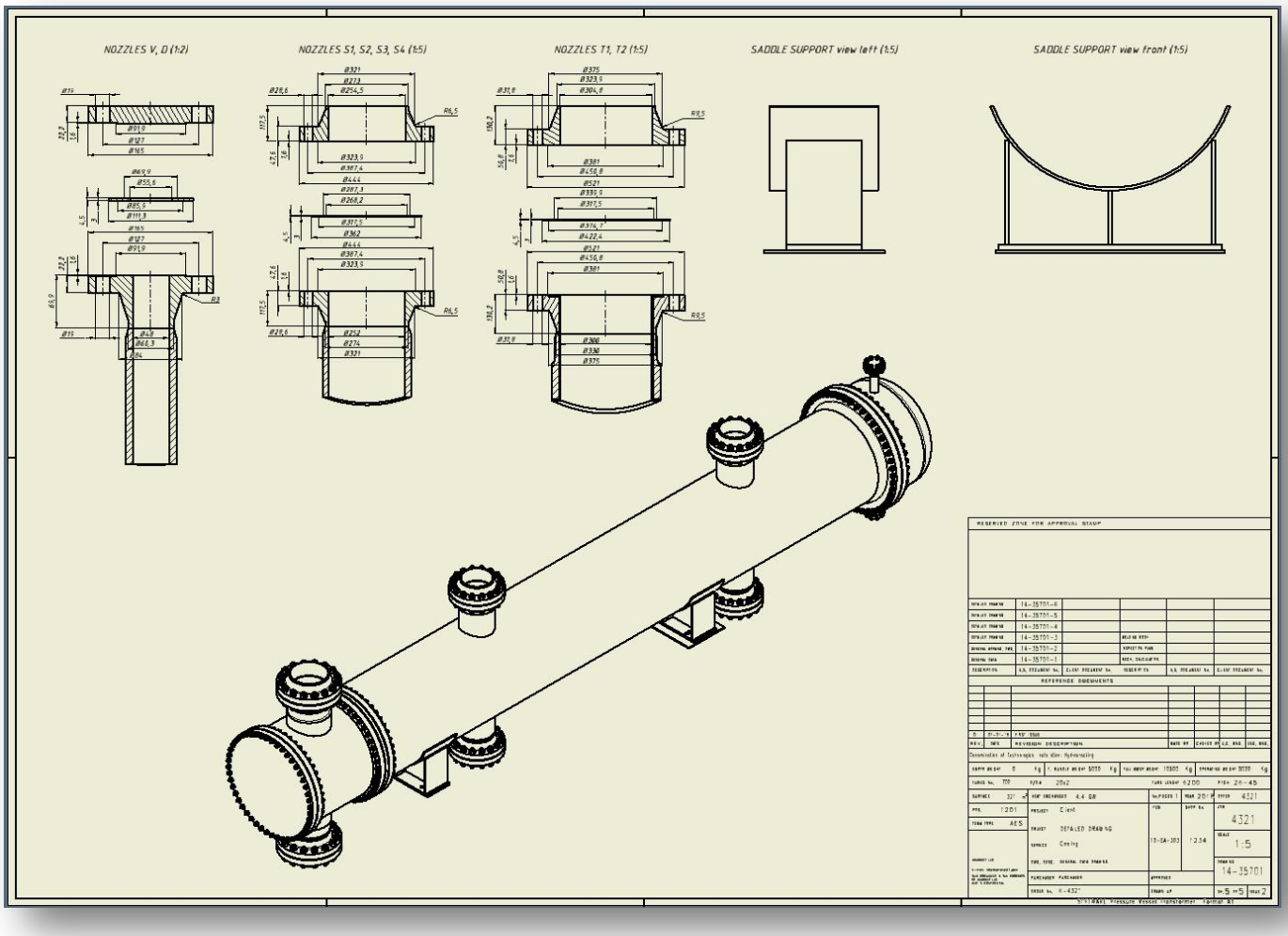


Fig. 6.2.1. AI drawing sheet similar to sketch sheet 6.2.1

Figure 6.2.1 shows AI drawing sheet corresponding to the sheet sketch in Figure 6.2.

6.2.2. List of the sheet views.

6.2.3. Sheet settings.

Enter the default values of the sheet options as described in paragraphs 3.1.2.3 and 3.1.2.4. The other parameters can be entered for each individual sheet.

6.2.4. View options.

The view type is shown above it on drawing and in the sheet tree with an individual key.

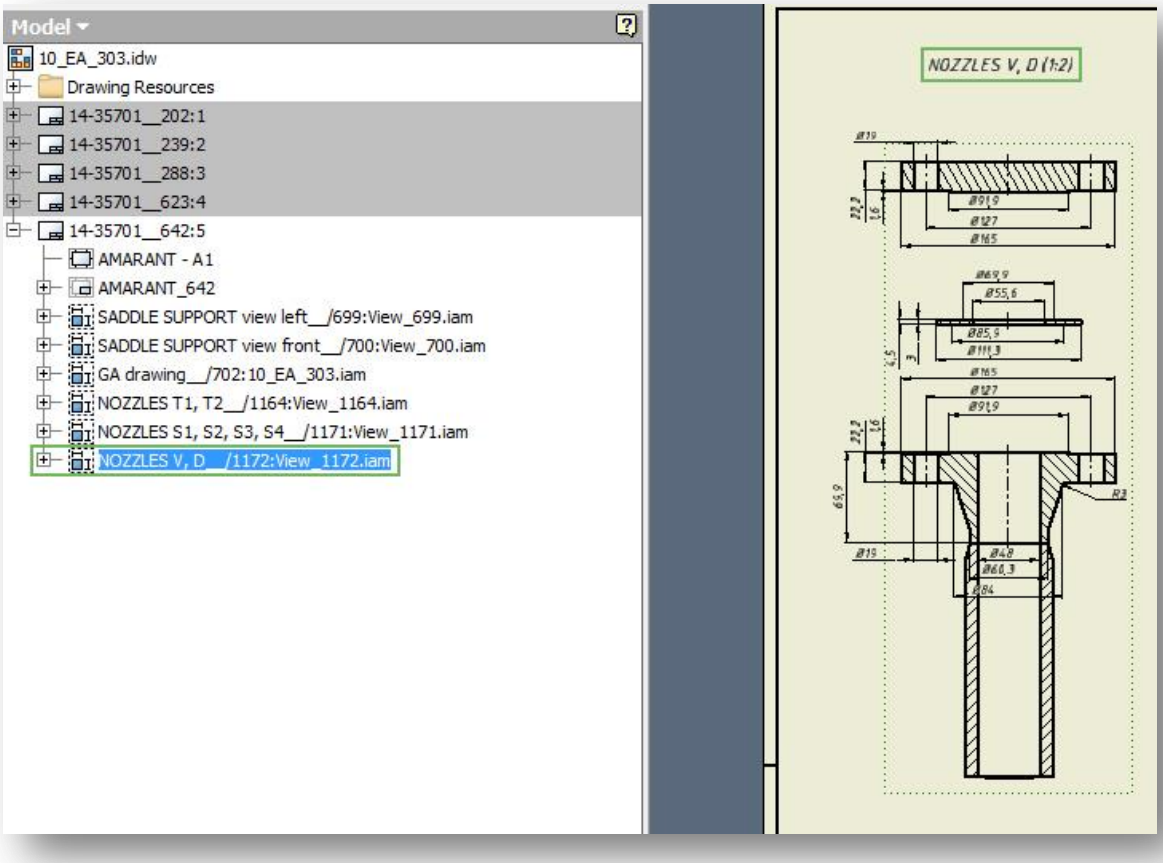


Fig. 6.2.4. View name

The view can be moved on the sheet be left mouse button dragging. Check the "Location is imported from the drawing" box, so the "x, mm" and "y, mm" values will take the appropriate values on the AI drawing("x, mm” and “y, mm” coordinates of the point in the upper left corner of the view frame). When adding a view, its width and height is unknown, so they will be known only after the first sheet building. The width and height of the form taken to be 100 mm, and after building the values be changed according to the AI drawing sheet forms.

6.2.5. The names of the developers of the vessel documentation.

6.3. Views.

Add a view to the list by clicking "Add" in the group 6.2.2. The views window appears.

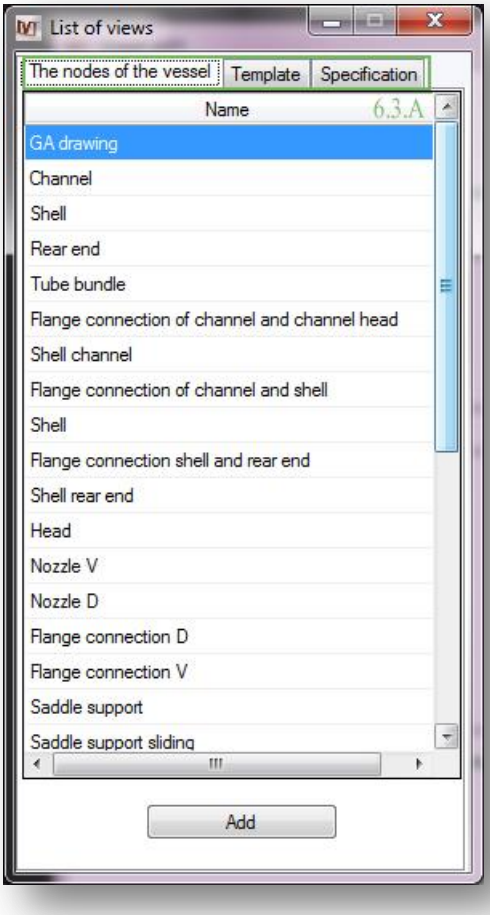


Fig. 6.3. List of views of the main assembly, sub-assemblies and units

6.3.A. Switching between sources of views:
6.3.A.1. AI Main assembly, sub-assemblies and units.
6.3.A.2. Template views (tables).
6.3.A.3. Specification.

6.3.1. Main assembly and subassembly.

When you double-click the main assembly or subassembly in the group 6.2.2, the settings window appears.

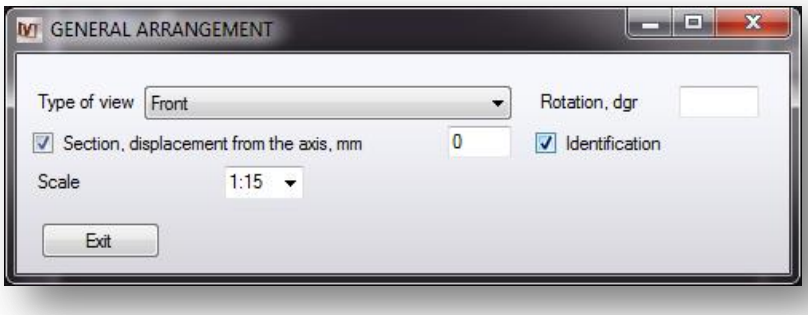


Fig. 6.3.1. Settings of the main assemblies and subassemblies view

In the settings window in Figure 6.3.1. are identical to AI views display.

6.3.2. Nozzle.

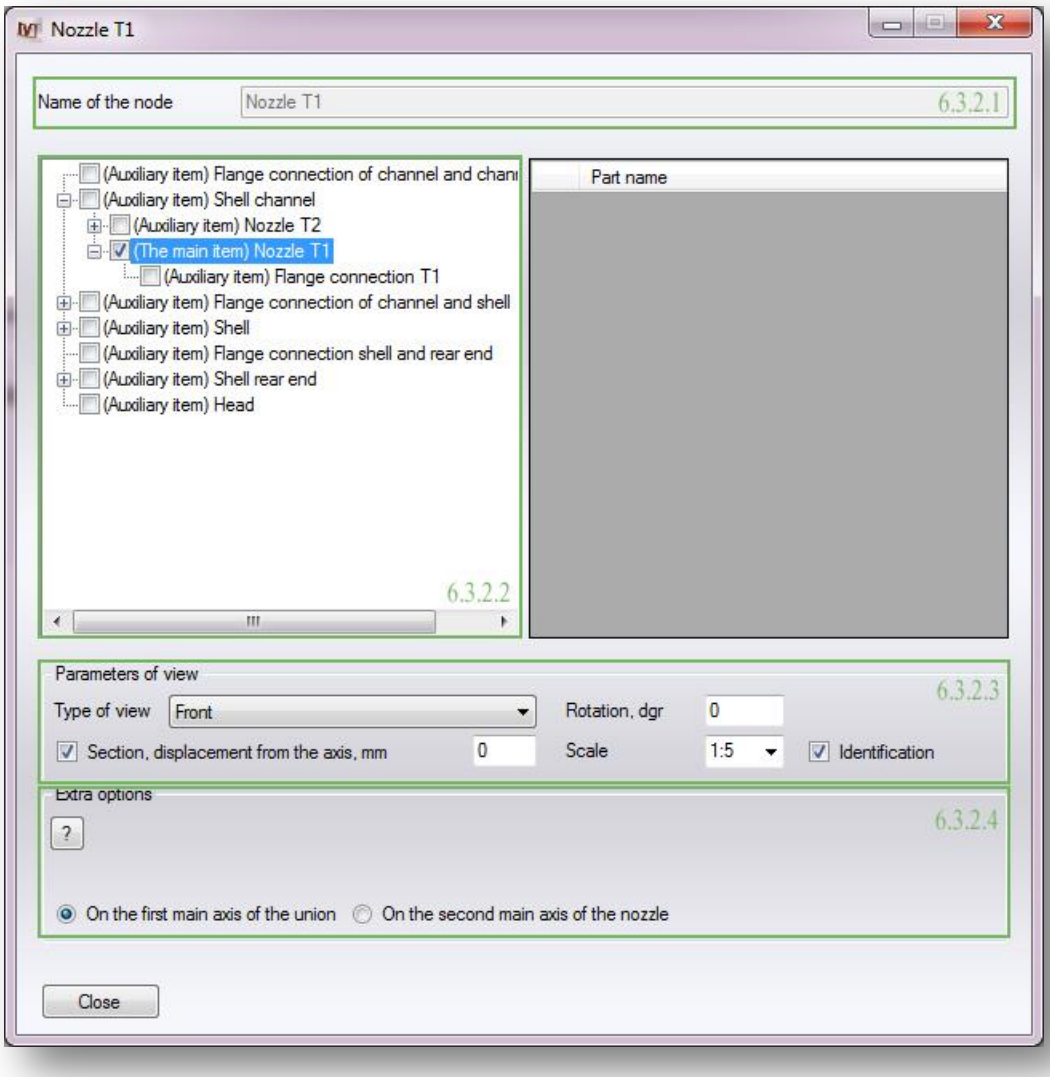


Fig. 6.3.2. Setting the view based on the nozzle parameters

6.3.2.1. Name of the base unit in the view.

When adding any view to the sheet except for the main assembly or subassembly, choose a base determining additional parameters group 6.3.2.4 contents. The user can attach other units to the main

unit by checking checkboxes 6.3.2.2 of the vessel tree units thereby assemble the view of the sheet like subassembly in para. 4.19. The chain of units view must be continuous.

6.3.2.2. Vessel units tree

6.3.2.3. View settings are similar to those described in paragraph 6.3.1.

6.3.2.4. Extra options.

Selecting the section on a plane oXoY or oZoY.

6.3.3. Flange connection.

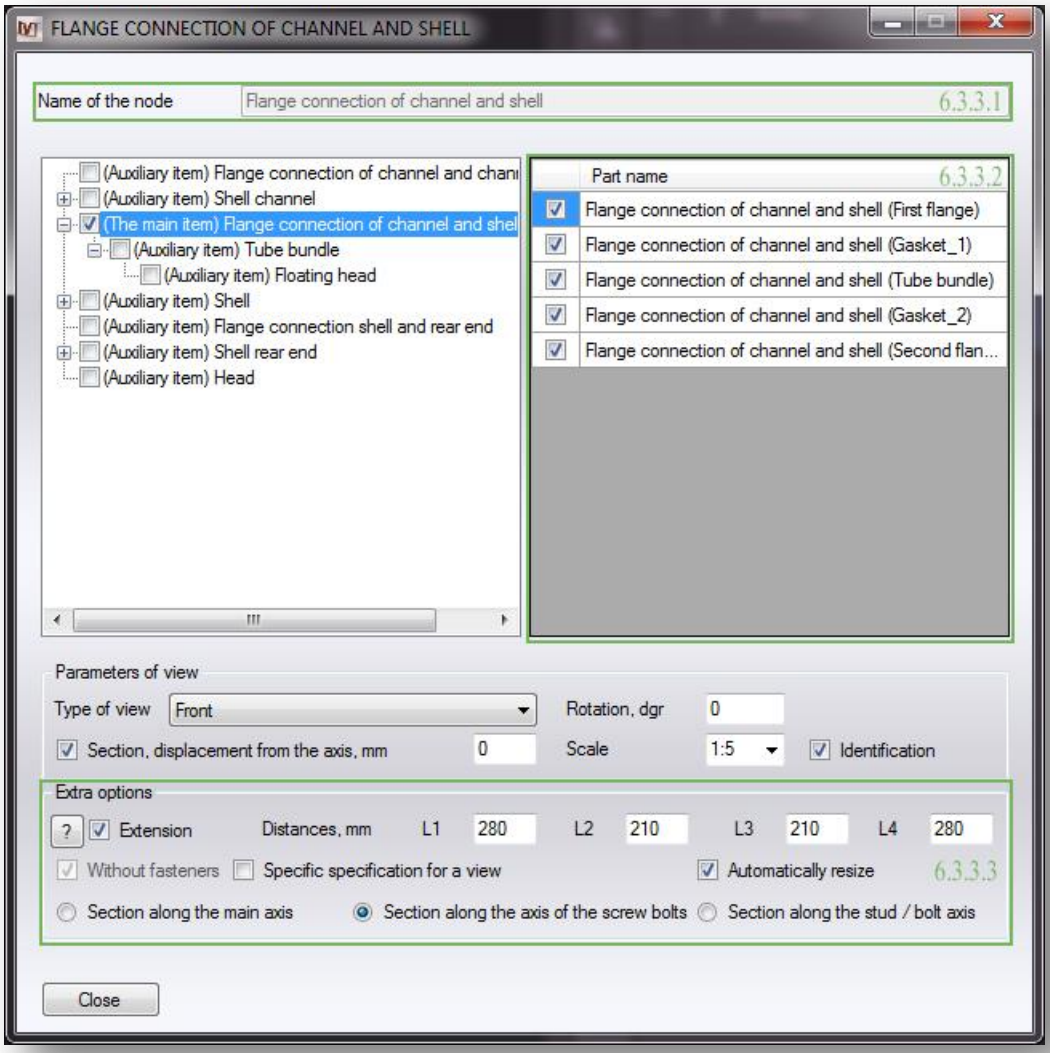


Fig. 6.3.3. View settings based on the flange connection

The view may contain both flanges, gasket, clamped part and second gasket If any, including the flange connection.

6.3.3.1. Base unit name - flange connection.

6.3.3.2. List of parts included in the flange connection.

Check/uncheck boxes to add/delete items in the view, wherein the composition is displayed for each unit including several details.

6.3.3.3. Extra options.

Check "Extension" to enable L1-L4 input fields. They correspond to the distance between the parts forming a flanged connection, the initial values of which are selected automatically based on the scale. When the extension is enabled, check box "Without fasteners" is automatically unchecked. The sizes can be specified in only for the parts included to the base unit. After rebuilding, the checkbox is unchecked automatically to avoid re-sizing. The bottom row of radio buttons allows you to select a section along: the main axis, screw bolt axis or the stud/bolt axis.

6.3.4. Floating head.

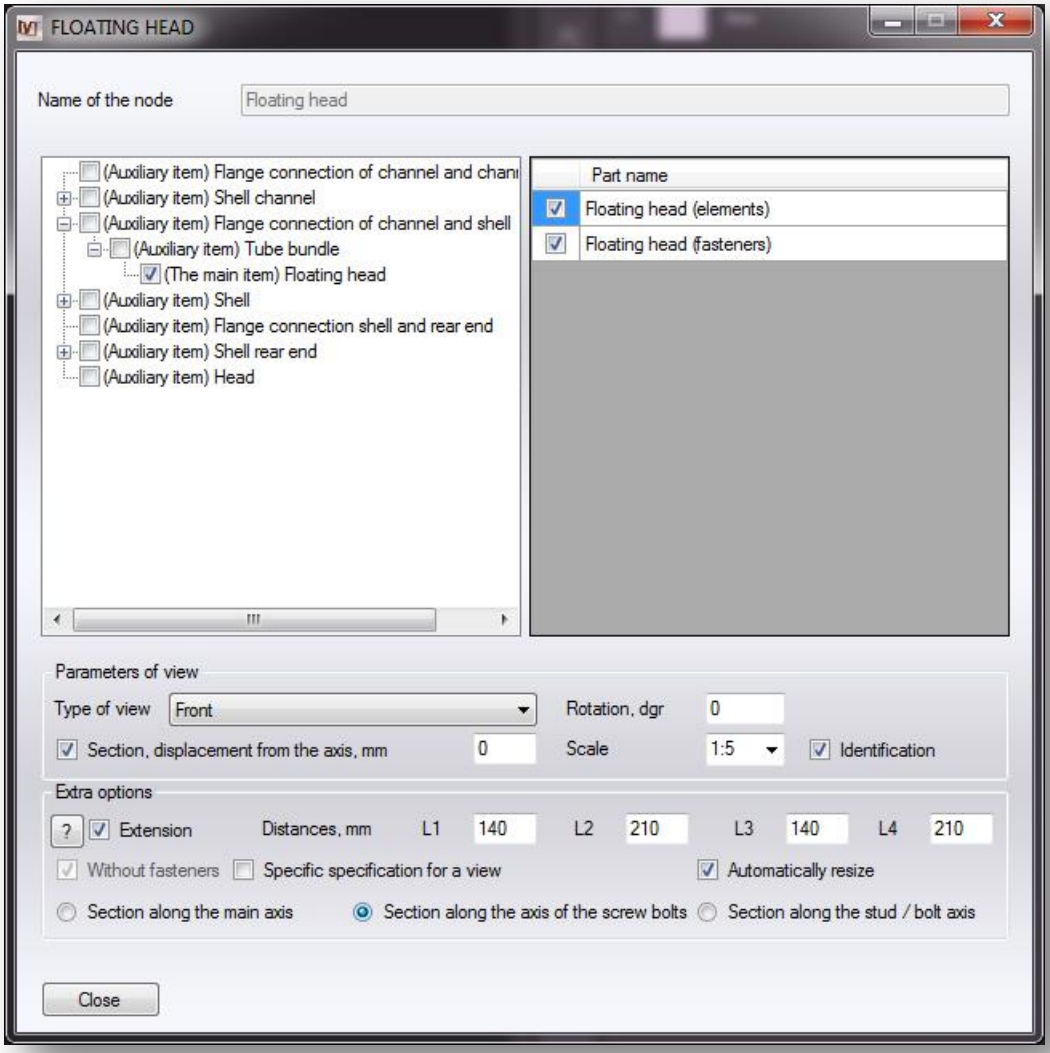


Fig. 6.3.4. View settings based on the floating head parameters

The interface is similar to the view based on the flanged connection described above in para. 6.3.3.

6.3.5. Other units.

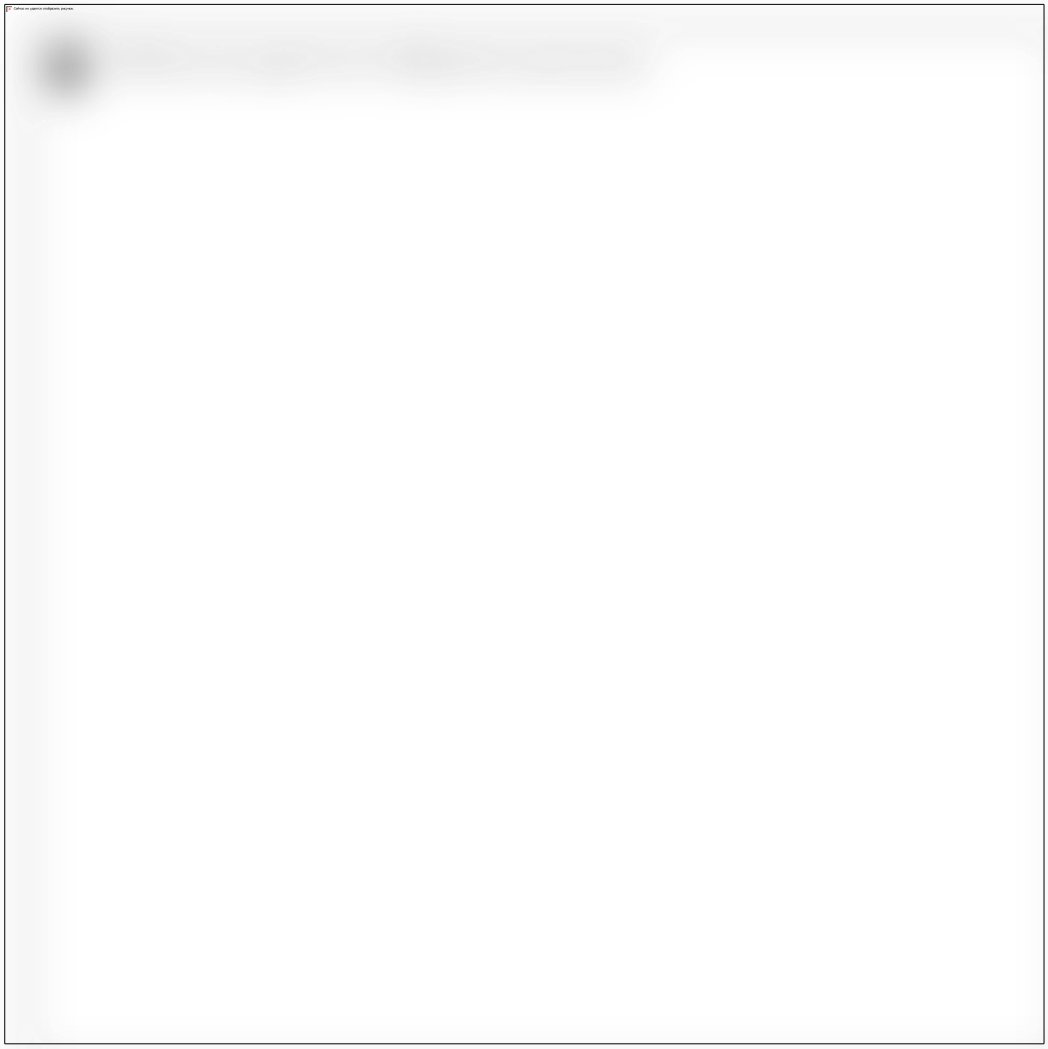


Fig. 6.3.5. View settings based on the remaining units

6.3.5.1. Vessel units tree.

In this example, the base unit is a tube bundle with units added:

6.3.5.1.1. Flange connection - tubesheet, gasket, second flange without fasteners the chamber and shell.

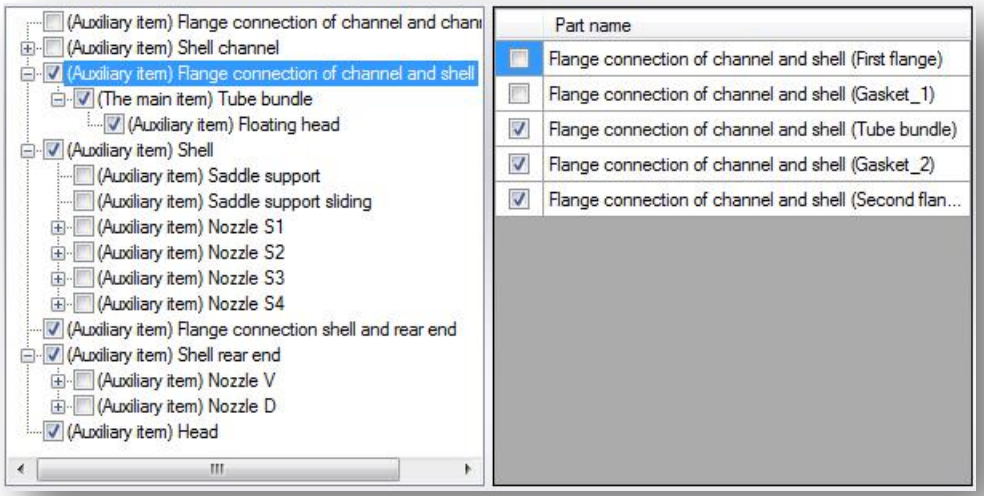


Fig. 6.3.5.1.1. Flange connection - tubesheet, gasket and second flange

6.3.5.1.2. Floating head - tubesheet.

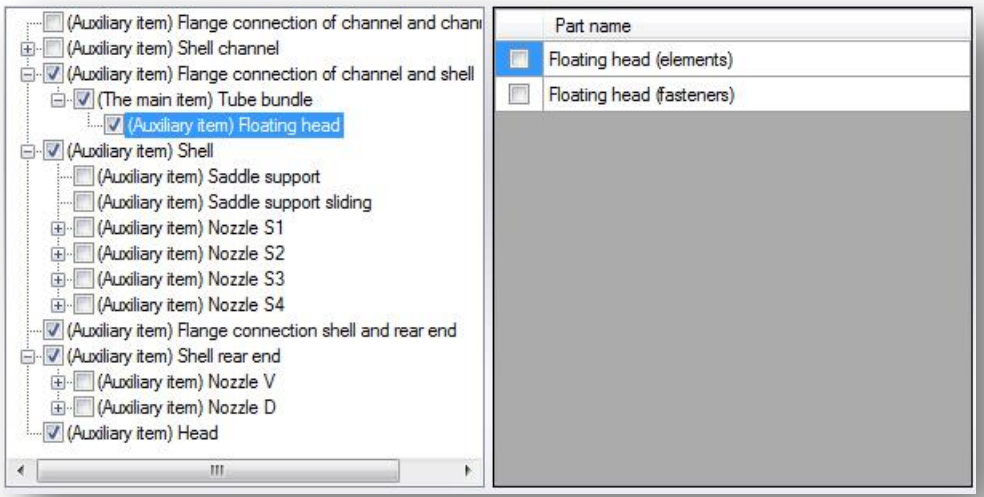


Fig. 6.3.5.1.2. Floating head - tubesheet.

6.3.5.1.3. Shell – shell.

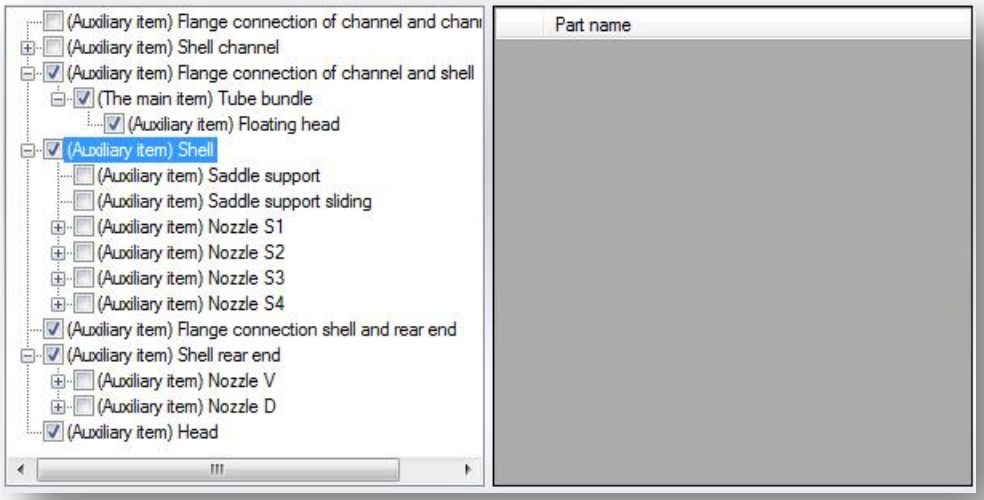


Fig. 6.3.5.1.3. Shell - shell

6.3.5.1.4. Flanged connection - flanges and gaskets of flange connection of shell and rear end.

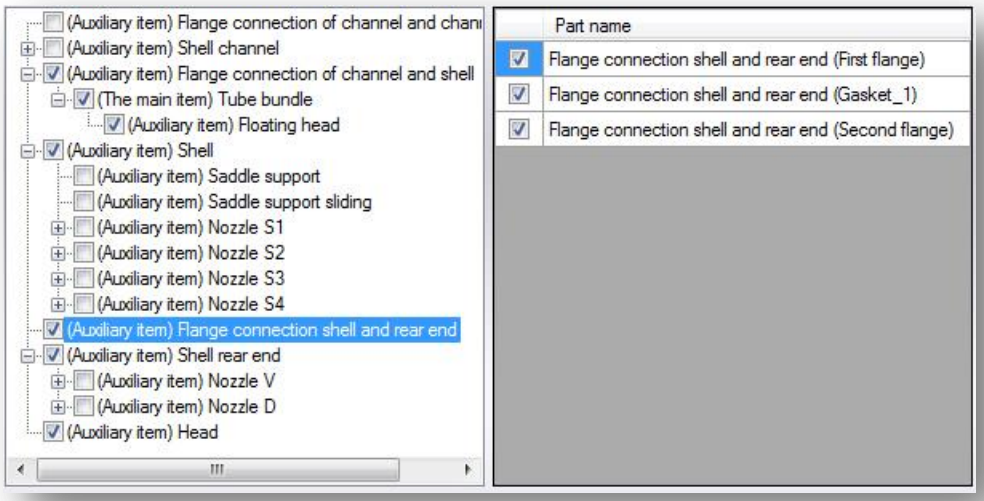


Fig. 6.3.5.1.4. Flange connection - flanges and gasket without fasteners

6.3.5.1.5. Shell - shell of rear end.

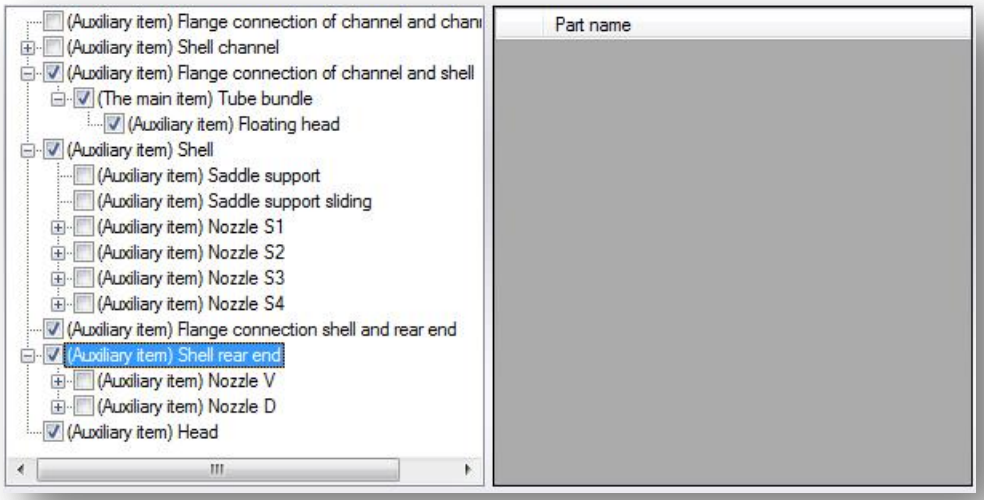


Fig. 6.3.5.1.5. Shell - shell of rear end

6.3.5.1.6. Head – head of rear end.

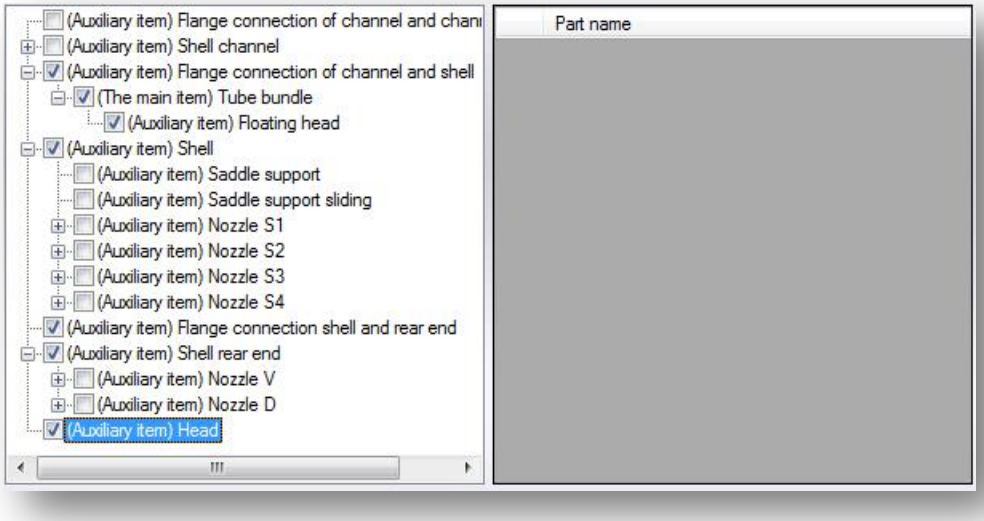


Fig. 6.3.5.1.6. Head – head of rear end

6.3.5 The view on the AI drawing sheet is shown in Figure 6.3.5.2.

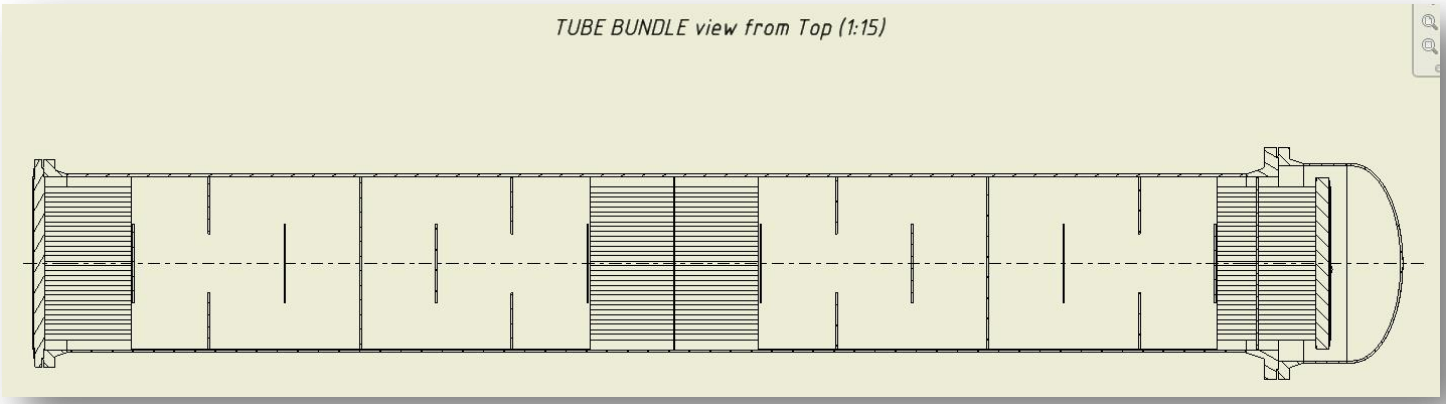


Fig. 6.3.5.2. Tube bundle with shell and rear end on a drawing sheet AI

6.3.6. Tables.

Fig. 6.3.6. List of drawing tables

The interface development is in progress.