Possibilities of computer-aided design of flange connections in pipe fittings based on the nanoCAD Mechanics graphic editor

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Abstract. The article discusses the possibilities of using the nanoCAD Mechanics editor, developed by the Russian company Nanosoft JSC (www.nanocad.ru), for the automated design of pipeline sections with threaded flange connections. It is shown that for solving the problems in computer-aided design, there are various tools presented in the ribbon interface of the program. Such tools include the Standard command from the Standard group on the Mechanics tab, which opens the Select Parts dialog box. In the Select Parts dialog box, a functional panel of the Element Base is built-in, including: folders Pipeline fittings and Welded pipelines; drop-down catalogs Flanges, Gaskets and Pipes with element sizes that comply with ESKD standards. On the “Mechanics” tab, the Bolt connection tool from the Design group with the Mounting Details dialog box included in it is used, after calling it and specifying the start and end points of the connection, the Mounting Details dialog box opens. The last lists show bolts made according to ESKD standards. Insertion of flanges, gaskets, bends, pipes and bolt joints and their automated selection are carried out by left-clicking and selecting parameters in the corresponding dialog boxes.

1. Introduction
Flange connections are widespread in pipe fittings (figure 1).

Figure 1. Examples of threaded flange connections in pipelines and apparatus housings.
joints in pipe fittings based on well-known foreign editors, for example, [11-15], their applications and additional modules, it is necessary to refuse and switch to domestic developments.

A direct competitor to the editors noted above is currently the nanoCAD editor [16-20] with direct support for ESKD standards.

NanoCAD is the graphic editor of the Russian company Nanosoft (www.nanocad.ru), which has a modern ribbon interface with numerous tool tabs, a large database of 2D drawings and 3D models made according to ESKD standards. The cost of nanoCAD is significantly lower than its foreign counterparts.

Given the above, it became necessary to assess the possibilities of using the domestic nanoCAD editor for the automated design of flange connections in pipe fittings.

2. Research methodology

The research methodology was to analyze the possibilities of computer-aided design of flange connections in pipe fittings in the nanoCAD Mechanics editor.

The nanoCAD Mechanics editor, version 20.0.5094.0501, assembly 5194 was chosen as a tool for research.

Access to the Element Base was provided by LC (Hereinafter in the text: LC – left click) on the button on the Standard Mechanics tab of the ribbon interface.

The analysis of the possibilities was carried out on the example of computer-aided design of the product "Pipeline section" with flanges and its components.

3. Research results

The sequence of designing the connections of the components of the pipeline section is presented:

1. using the data from the nanoCAD Mechanics Element Base, insert flange No. 1 on the drawing field: sequential double LCs on the Pipe Fittings folder, on the Welded Pipes folder, on the Flanges directory LC on the list GOST 12820–80 – LC indicate the point inserts - turn on the ORTO mode (F8 key) – by moving the mouse indicate the direction of insertion of the "Left" flange. In the dialog box GOST 12820–80 that appears, either set the necessary flange parameters, including its “Cutaway view” and scale, or complete the insertion by successively pressing the Apply, OK, and Esc keys on the keyboard – Figure 2 (Stage 1);

2. using the data from the nanoCAD Mechanics Element Base, a gasket is inserted in the drawing field: sequential double LCs on the Pipe Fittings folder, on the Welded Pipes folder, on the Flange gaskets directory – LC on the Gaskets list GOST 15180–86 – LC indicate the point Insertion Intersection (object snap tool F3 key). In the appeared Gaskets dialog box, GOST 15180–86 either sets the necessary gasket parameters, including “Section”, or completes the insert by successive pressing of the Apply, OK and Esc keys – Figure 2 (Stage 2);

3. using the data from the nanoCAD Mechanics Element Base, insert flange No. 2 on the drawing field: sequential double LCs on the Pipe Fittings folder, on the Welded Pipes folder, on the Flanges directory LC on the list GOST 12820–80 list – LC indicate the point Insertions Point (object snap tool F3 key) – turn on the ORTO mode (F8 key) – by moving the mouse indicate the direction of insertion of the flange “Right”. In the dialog box GOST 12820–80 that appears, set the necessary parameters for flange No. 2, including its “Sectional view”, or complete the insertion by successively pressing the Apply, OK and Esc keys – Figure 2 (Stage 3);

4. using the data from the nanoCAD Mechanics Element Base, pipe No. 1 is inserted into the drawing field: sequential double LCs on the Pipe Fittings folder), on the Welded Pipes folder, on the Pipes directory – LC on the list GOST 8732–78 – LC indicate insertion point Intersection (object snap tool F3 key) – turn on the ORTO mode (F8 key) – by moving the mouse indicate the direction of insertion of the pipe “Left”. In the dialog that appears, GOST 8732–78 either sets the necessary parameters of the pipe, including its “Sectional view”, or completes the insertion by successively pressing the Apply, OK, and Esc keys – Figure 2 (Stage 4);
5. pipe No. 2 is inserted with the direction "Right" similar to the above (step 4) or rhinestone after closing the GOST8732–78 dialog box with the insertion point Intersection (F3 key) – Figure 2 (Stage 5);
6. using the data from the nanoCAD Mechanics Element Base, bend No. 1 is inserted into the drawing field: consecutive double LCs on the Pipe Fittings folder, on the Welded Pipes folder, on the Taps directory – LC on the GOST 30753–2001 list (ISO 3419–81 ) – LC indicate the insertion point Intersection (object snap tool F3 key). In the dialog box GOST 30753–2001 (ISO 3419–81) that appears, set the necessary parameters for branch No. 1, including its “Sectional view” and its angle, or complete the insertion by successively pressing the Apply, OK and Esc keys – Figure 2 (Stage 6);
7. then insert the same bend No. 2, as in step 6 with the insertion point Intersection (object snap tool F3 key) – Figure 2 (Stage 7) – insertion can be done immediately, without exiting the previous command;
8. using the data from the nanoCAD Mechanics Element Base, pipe 3 is inserted into the drawing field: consecutive double LCs on the Pipeline Fittings folder, on the Welded Pipes folder, on the Pipes directory – LC on the list of GOST 8732–78 – LC indicate the point Insertion Intersection (object snap tool F3 key). In the appeared dialog box GOST 8732–78, either set the necessary parameters of the pipe, including its “Sectional view” and change the length from 55 (default) to

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**Figure 2.** Stages of product design "Pipeline section".
200, or complete the insert by successive pressing of the Apply, OK and Esc keys Figure 2 (Stage 8):

9. using the data from the nanoCAD Mechanics Element Base, insert flange No. 3 on the drawing field: sequential double LCs on the Pipe Fittings folder, on the Welded Pipes folder, on the Flanges directory LC on the GOST 12820–80 list – LC indicate the point Insertion Intersection (object snap tool F3 key). In the dialog box that appears, GOST 12820–80 either sets the necessary parameters of the flange, including its “Sectional view”, or completes the insert by successive pressing of the Apply, OK and Esc keys – Figure 3 (Stage 9);

10. flange No. 4 is inserted in the same way as above (Stage 9) with the insertion point “Intersection” (object snap tool F3 key) – Figure 3 (Stage 10);

11. using the data from the nanoCAD Mechanics Element Base and the Mounting Details dialog box, by analogy with the procedure [20], insert Bolt connection No. 1 (bolt M12) into the drawing field Figure 3 (Stage 11) and Bolt connection No. 2 (M12 bolt) – Figure 3 (Stage 12).

![Figure 3. Stages of product design "Pipeline section".](image-url)
4. Conclusion
Possibilities of computer-aided design of pipeline sections with threaded flange connections using the domestic nanoCAD Mechanics editor of the Russian company nanosoft (www.nanocad.ru) are fully justified and allow refusing to work in foreign editors-analogues Solid Works [3], AutoCAD [4], Autodesk Inventor [5] and in their various applications (www.autodesk.com and www.autodesk.ru).

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