

I.L. OBORSKY, O.B. DEMKIVSKY, T.I. DEMKIVSKA

Kyiv national university of technologies and design

**DETERMINATION OF THE CONSTRUCTION-ENGINEERING PARAMETERS OF CONNECTIONS WITH THE INTERFERENCE AND THE DESIGN OF THE RATIONAL TECHNOLOGY OF ASSEMBLING**

*Розроблені структура методів, що використовуються для складання з'єднань з натягом, а також алгоритм і графоаналітичний спосіб, що дозволяють забезпечувати вибір раціональних технологічних параметрів термічної зборки та конструктивно-технологічних параметрів з'єднань з натягом з урахуванням умов експлуатації, фізико-механічних властивостей використовуваних матеріалів, регулярного мікрорельєфу та проміжних прошарків у зоні контакту*

**Ключові слова:** графоаналітичний спосіб, технологічні параметри, регулярний мікрорельєф

To select efficient energy-saving process that ensures preparation of compounds with high tension strength, you must find out a lot of input design and technological factors of the technology designing [1–3]. The main of them include: operating conditions the connection, the positive dimensions of parts to be connected; physical and mechanical properties of materials used; the maximum permissible level temperature of heating and cooling by thermal methods of preparation and so on. It should also be noted that a significant effect on the strength of cylindrical joints with tension makes the technological preparation of surfaces that are combined. Currently in production is used in a complex technological method of preparing high quality surfaces of covered combined parts, causing regular micro lay and making connections by thermal methods, which give possibility to obtain landing of high operational safety. But the choice of rational parameters is very complex and time consuming.

***Objects and methods of study***

Connect with tension and technology of its preparation using combined thermal methods. Information model is developed and used and software system to verify the correctness of the proposed mathematical foundations of methods of preparation.

***Definition of task***

Ensuring while designing optimal choice of constructive-technological parameters of compounds of tension parameters and parameters of assembly technology in different thermal methods.

***Discussion of research results***

To implement the task of calculating the optimal parameters and method of forming compounds with the tension, a software package is created, which enables to calculate the design and assembly technology options for different ways and methods of assembly, including: with heating of covering part; with low-temperature cooling of covered parts; with cooling covered parts, and heating covering parts; with heating of covering parts and galvanized cover; with a low-temperature cooling of covered parts and galvanized cover; with a low-temperature cooling, heating and galvanized cover; with heating covering parts and glue; with heating and cooling of parts and glue.

On Figure 1 the block diagram of software selection of assembly method and constructive parameters of high-strength low-tension connections with tension is represented.

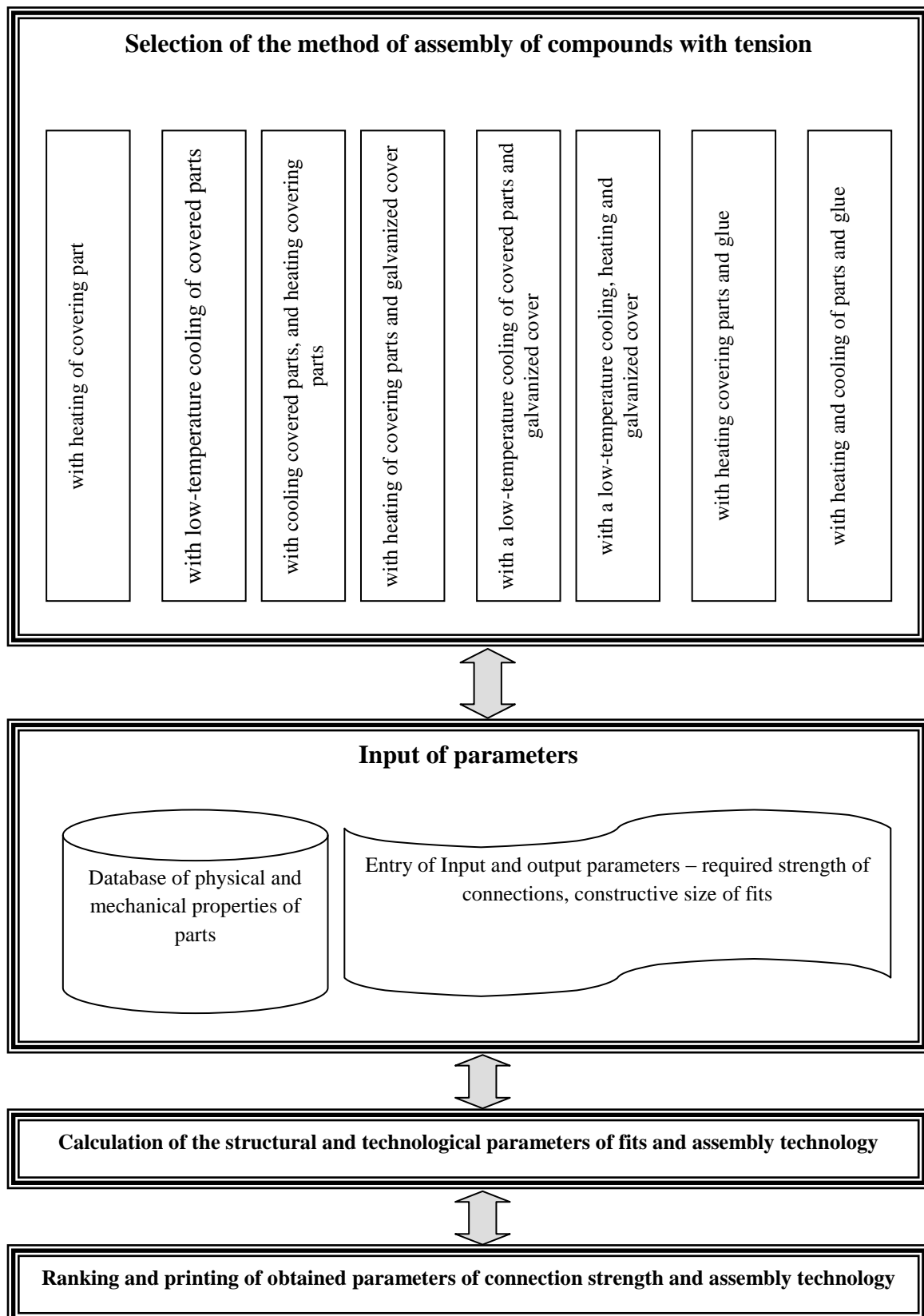


Fig.1. Block diagram of software selection of assembly method and constructive parameters of high-strength low-tension connections with tension

To use software system, database of values of constants, material properties of parts, structural and technological parameters which influence the strength of fits with tension, is designed.

The interface of software is made in multipage form and consists of the following pages:

- Main, which allows you to choose methods of assembly, which are under research, run computational procedures and print the results of calculations.
- Physical and mechanical properties of parts, which are combined.
- Parameters of parts, which are combined.

The result of the software system is to define parameters for different types of assemblies in case of difficulty or inability to reproduce this process in real production without changes in input parameters or materials. This allows to provide passive conduct experiments on the stage of choosing methods of assembling, and types of materials with inherent characteristics, which saves time and costs when developing new technologies.

The problem of choice of design and technological parameters of preparation of assemblies with tension in various ways includes the entrance of input and output parameters: the required strength of P compounds, constructive size of compounds, physical and mechanical properties of parts, adhesive compositions and galvanized covers [4]. After the data entry, optimal parameters of technology assembly are calculated.

It should be noted that a significant effect on the strength of fitting make parameters of regular micro lay in the zone of contact of details. To select these options, a method and a new graph-analytic approach are offered, which includes specially designed nomogrammes (Fig. 2 – 4) [5, 6].

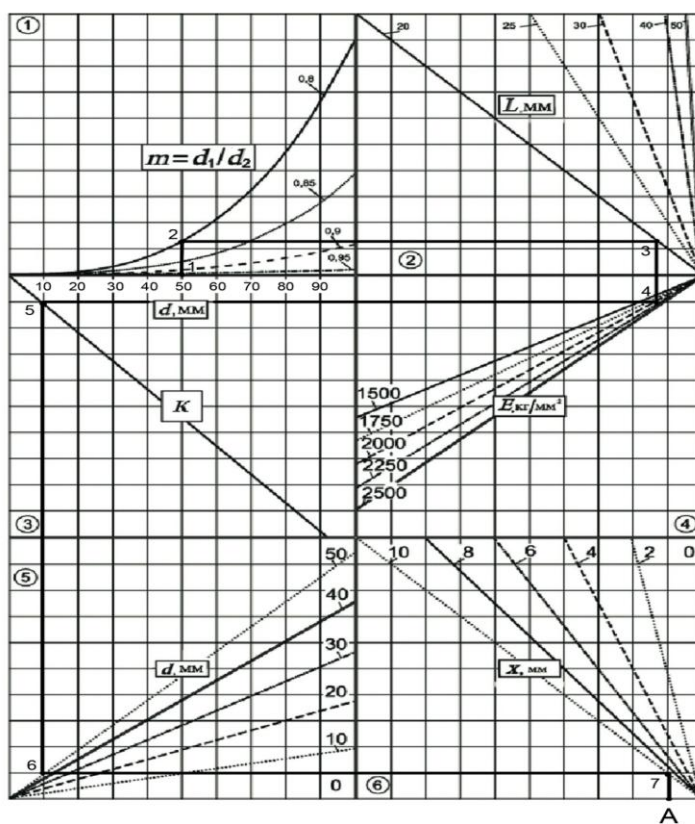


Fig. 2. Nomogram 1 for determination of temporary parameters of strength of connections with tension.

On the nomogram (Fig. 2 – Fig. 4) in the direction from point 1 to point 15 can be determined parameters of covered parts surface preparation technology taking into account the strength of connections with tension, molded by thermal method, cooling and combined thermal method - CTM (with heating and cooling), taking into account the structural parameters of compounds, physical and mechanical characteristics of details materials. Nomogram (Fig. 2) consists of 6 quadrants. On the abscissa of 1<sup>st</sup> quadrant deferred values of fitting diameters  $d$  in mm. The curves correspond to the first quadrant's value of  $m = d_2/d_1$  ratio of covering part outer diameter  $d_2$ , and the internal diameter  $d_1$  of covered part.

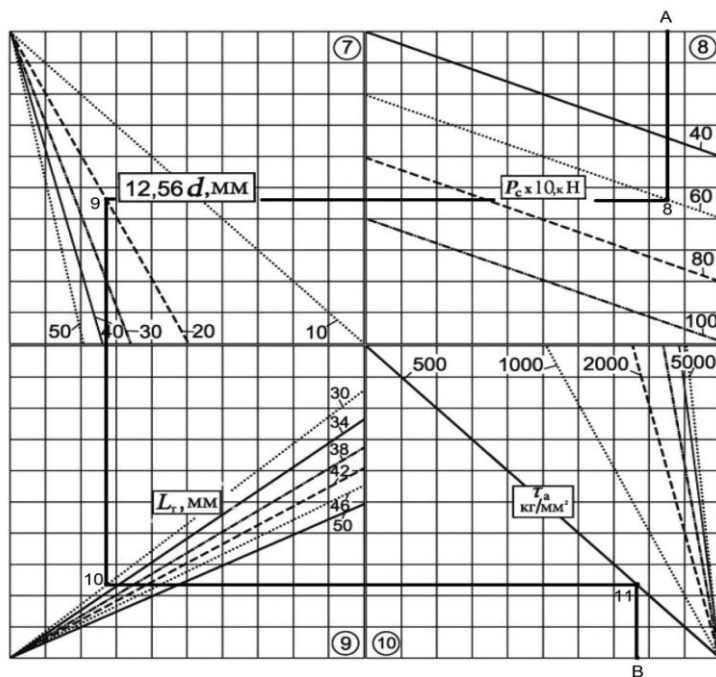


Fig. 3. Nomogram 2 for determination of temporary parameters of strength of connections with tension.

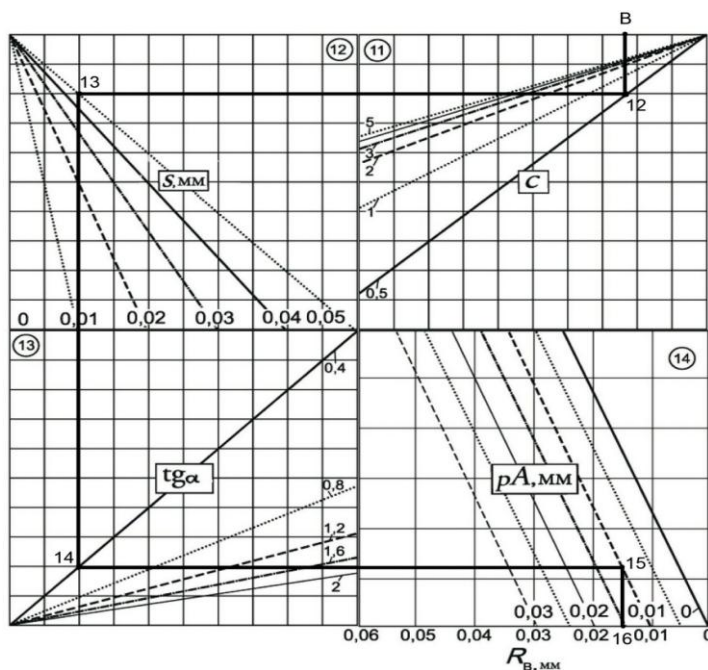


Fig. 4. Nomogram for determination of parameters of technology of preparation of combined covered parts surfaces, for obtaining required high-strength of connections with tension

In the second and third quadrants are marked oblique lines, which correspond to the values of fitting length  $L$  (connection of tension) in mm and elastic modulus  $E$  for the material of parts in units MPa. In the fourth quadrant is marked oblique line, which takes into account the proportion of  $2/96$  of a square number ratio = 3.14. In the fifth quadrant are marked oblique rays, which correspond to the product of  $d$  (mm) number  $\pi^2 = 3.14$  in diameter of fitting  $d$  in mm. In the fifth quadrant are marked slopes, which correspond to part  $X = x \cdot 2$  (mm) of length  $L$  connection, performed without regular micro lay on the surface of compound covered part. On the horizontal axis of sixth quadrant deferred values of strength connection  $P_T$  (kN) from the ends, i.e., on two areas where regular micro lay is absent.

The second nomogram (Fig. 3) consists of the 4 quadrants. On the horizontal axis of seventh quadrant deferred values of strength connection  $P_T$  (kN) from the ends, in the quadrant are marked oblique lines, which correspond to the strength connection  $P_c$  in the middle part of length  $L - 2m$  with regular micro lay.

In quadrant 8 are marked the rays, which correspond to the value of the product  $\pi d$  in mm and in quadrant 9 there are oblique lines, which correspond to the values of fitting length  $L_c$  (connection with tension) in mm in the middle part of length  $L - 2x$  with regular micro lay.

In quadrant 10 are marked the rays, which correspond to the values of the shear stress for material of covering part, in units MPa.

The third nomogram (Fig. 4) consists of 4 quadrants. In the eleventh quadrant are marked rays, which correspond to the value of expression  $(1+C)/C \tau_a$  (1/ MPa), where  $C = \tau_b / \tau_a$  and  $\tau_b$  – the shear stress for the material of covered detail in units of MPa.

In the twelfth quadrant are marked oblique lines, which correspond to the step  $S$  (mm) of the execution of regular micro lay on covered part, and in quadrant 13 – rays, which correspond to the value of the angle tangent  $\operatorname{tg} \alpha$  of micro lay profile at its top. In quadrant 14 are marked oblique parallel lines that match the value in mm works contact pressure  $p$  on the parameter  $A$ . On the horizontal axis of quadrant 14 are marked values of height of regular micro lay  $R_b$  (mm).

By adopting the design parameters and connection parts: diameter of landing  $d$ , the ratio of outer diameter  $d_2$  of covering part and the internal diameter  $d_1$  of covered part equal  $m = d_2/d_1 = 2$ , the length of the fitting  $L$ , modulus of elasticity, number  $\pi = 3,14$ , length of connection on the ends and the application of regular micro lay on the surface of covered part  $L-2x$ , given strength of the connection  $P_c$ , shear stress of micro lay for material of covering part  $\tau_a$  and covered part  $\tau_b$ , step  $S$  deposition of micro lay on the surface of covered part, the angles  $\alpha$  at the top and side slope  $\beta_y = 85-90^\circ$ , side, which bear the pressure, and contact pressure  $p$ , which creates assembled tension, on abscissa of quadrant 14 we will find the height of a regular micro lay  $R_b$  in mm.

### Conclusion

The algorithm and graph-analytic method have been developed, which can provide choice of rational technological parameters of thermal assembly and build constructive and technological parameters of connections with tension, taking into account conditions of exploitation, physical and mechanical properties of materials, regular micro lay and intermediate layers in the contact zone.

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**Определение конструктивно-технологических параметров при проектировании технологии сборки соединений с натягом**

Оборский И. Л., Демкивский А. Б., Демкивская Т. И.

*Киевский национальный университет технологий и дизайна*

Разработаны структура методов, которые используются для сборки соединений с натягом, а также алгоритм и графоаналитический способ, которые позволяют обеспечивать выбор рациональных технологических параметров термической сборки и конструктивно-технологических параметров соединений с натягом с учетом условий эксплуатации, физико-механических свойств используемых материалов, регулярного микрорельефа и промежуточных прослоек в зоне контакта.

**Ключевые слова:** графоаналитический способ, технологические параметры, регулярный микрорельеф.

**Determination of the construction-engineering parameters of connections with the interference and the design of the rational technology of assembling**

Oborsky I.L., Demkivsky O.B., Demkivsky T.I.

*Kyiv national university of technologies and design*

They are developed the structure of the methods, which are used for assembling of connections with the interference, and also algorithm and the grapho-analytic method, which make it possible to select the rational technological parameters of the thermal assembling and the construction-engineering parameters of connections with the interference taking into account operating conditions, the physicommechanical properties of the utilized materials, regular the microrelief intermediate layers in the contact zone.

**Keywords:** graph-analytic method tehnolohichnni options, regular microrelief.