

COMPUTER SYSTEM FOR CALCULATION OF NORMS OF CONSUMPTION OF WELDING CONSUMABLES FOR MANUFACTURE AND REPAIR OF STEEL PIPELINES

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The paper describes the structure and main functions of a system for calculation of norms of the welding consumable consumption for welding of parts and assemblies of steel pipelines. The content of data and knowledge base of the system is given. Examples of forms with prepared source data and calculation results are given.

Keywords: *welding, steel pipelines, welding consumables, norms of consumption, computer system for calculation*

Large scope of works on construction and repair of the pipelines is performed in the Republic of Belarus each year and tendency to their increase can be noted. Variety of types of the pipelines (gas-, oil- and steam pipelines etc.), methods of welding being applied (gas-shielded consumable and nonconsumable electrode arc welding with filler metal, submerged arc welding, manual arc welding, gas welding), welded materials (steel, copper, cupronickel alloys etc.), welding consumables (coated and tungsten electrodes, metal solid and flux-cored wire), types of welded joints and equipment can characterize manufacture of the pipelines.

An improvement of welding methods and creation of new equipment as well as development of new technologies is necessary considering a constant increase of the pipeline length and application of large diameter pipelines from alloyed, corrosion-resistant and high-strength steels.

Significant scope of works on process preparation of welding-erection production is stipulated by large volume of welding operations in the pipeline construction.

Development of the technological regulations for welding of pipes is related with the necessity of making of the design solutions during selection of the method of welding, equipment, materials to be welded and consumables, the calculations for determination of norms of the welding consumable consumption, norms of the standard time and parameters of welding as well as performance of the large scope of routine operations connected with the preparation of process documentation.

Thus, the necessity of PC application for automation of a design of the technological regulations during manufacture of parts and assemblies of the pipelines is obvious for the purpose of reduction of consumable and labor outlay, improvement of quality of design solutions and process documentation as well as promotion of image of the designers.

The Institute of Welding and Protective Coatings of the NAS of the Republic of Belarus deals with the

development of data-analytical and reference-information systems for PC. A system for calculation of norms of the welding consumable consumption for manufacture and repair of the steel pipelines was developed in scope of this subject. The system consists of a program complex, data (DB) and knowledge base (KB).

The program complex contains the design procedures for dialog preparation and entry of the source data, calculation of norms of the welding consumable consumption, determination of the weld lengths and formation of the output documentation.

A form, content and amount of the source data, controlled through the data being entered by the user, were developed and displayed for preparation and entry of the source data. This allows providing a confidence of the source data required by program for solving of a specific task and eliminating of the errors in data preparation. Numeric data, typing from the keyboard, are controlled by the maximum and minimum allowable values. An error message is displayed in the case of out of limits of the allowable values. An example of the system window with prepared source data is given in Figure 1. All fields for preparation of the source data can be divided into two types: data

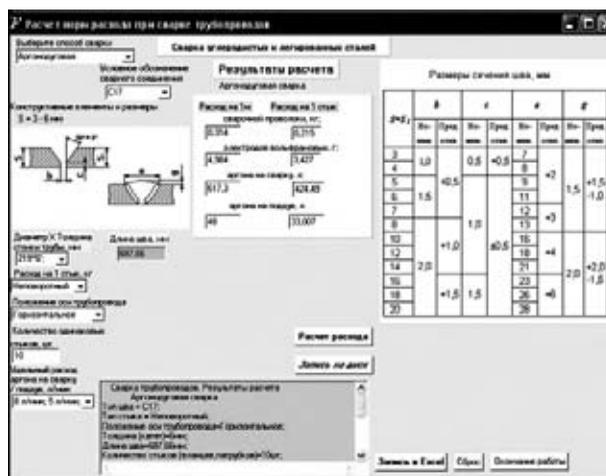


Figure 1. Main window of the system with prepared source data and calculation results

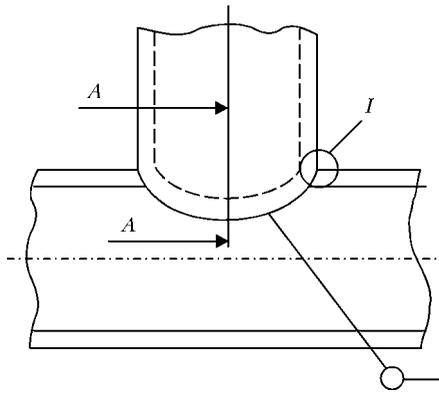


Figure 2. Scheme of pipe to pipe fillet joint (branch, fitting)

sampling from the lists, opened by a keystroke, and data typing from the keyboard. Content of information which should be entered and sampled, is described in the marks over the each field. The keys are designed for carrying out of the operations recorded on them.

The system allows calculating of norms of the welding consumable consumption in manual arc, gas, argon-arc and combined methods of welding of parts and assemblies of the pipelines from carbon and low-alloyed steels. The welding method is selected by the user. Structural dimensions and reference designations correspond with GOST 16037-80.

The procedural materials and data, given in [1-6], were taken as a basis for development of an algorithm and program. Production norms of the welding consumable consumption for position butt joints of the pipes are given in from of the tables. The correction factors depending on method of welding and other conditions [1, 3-5] are used in the system for determination of norms of the welding consumable consumption for roll butt welding. Norms of the consumable consumption for welding-in of the branches positioned over the pipeline normal to its axis are indicated in the tables of standards. The correction factors, imbedded in the system, are used for correcting the norm of consumption at side or bottom position of the branch in the pipe and at angles different from normal one. Combined welding is used for performance of multilayer welds. At that a weld root (the first layer of the weld) is carried out by argon-arc welding, and manual arc welding with coated electrode is used for the rest ones. Pure consumption of the consumables, difficult to remove wastes and losses formed during welding operation performance, i.e. electrode stabs, rests of the wire in bundle, losses for burn-off, spattering and slag formation are considered in the production norms.

A program for determination of length of the welds during welding of tubular blanks at normal and acute angles was developed. It can be activated independently (including during operation in other systems) as well as automatically in particular system. Entry data and calculation results of this program are given in Figure 3.

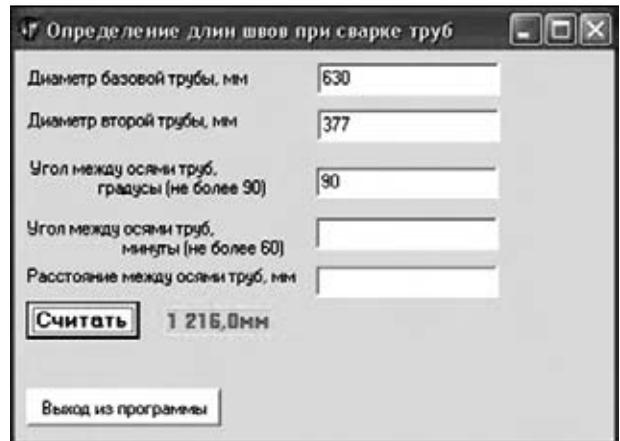


Figure 3. System window with prepared source data and calculation result

DB and KB of the system, having multilevel hierarchical structure, consist of number of files and contains:

- tables of reference data on norms of the consumable consumption per 1 m of the weld and per one butt joint (flange or branch), formed as separate files by methods of welding;
- drafts of structural elements of the prepared edges and welds;
- reference designations of the welded joints;
- tables of dimension characteristics of structural elements of the welded joints.

The following basic requirements, i.e. quick access to data, simple and open interface, possibility of data correcting without system correcting are provided in DB and KB operation.

The files divided on methods of welding compile the results of calculation and can be displayed or printed in Excel table format by the user request.

The system is designed for independent application at the enterprises involved in construction and repair of the pipelines as well as for its implementation as a component in a structure of corporate information systems of the enterprises.

Reduction of the labor costs for preparation of production and costs on materials due to more accurate and technically-grounded calculations is the result of efficiency of the system implementation.

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