



## WELDING UNITS A1569M(M1) FOR AUTOMATIC SUBMERGED-ARC WELDING OF CIRCUMFERENTIAL ROTATABLE JOINTS IN DEEP GROOVE



In April 2014, new welding (surfacing) units A1569M and 1569M1, were implemented at OJSC «Turboatom» (Kharkov) by the specialists of the PWI Experimental Design-Technological Bureau (Kiev).

The equipment is designed for multi-pass automatic and semi-automatic submerged-arc welding of circumferential welds of turbine rotors in deep groove as well as surfacing of outer surfaces of cylindrical products.

A1569M unit with SU415 control system is installed at «Shumakher» shop bench. Welding of rotors of steam turbines and water turbine shafts with groove achieving 400 mm is carried out at the bench. It can be also used

for surfacing of blade journals of guide vanes and other cylindrical surfaces of 250–1500 mm diameter.

Two-head unit A1569M1 with SU410 control system is installed at the shop portal. Welding of rotors of stream turbines of 1000 MW power and more, water turbine shafts as well as surfacing of bodies of water turbine wheels and surfaces on water turbine shafts is carried out on the portal unit. Maximum length of parts makes 10 m, outer diameter is 3450 mm and groove depth achieves 400 mm.

Welding is carried out at strong inductive heating of part up to 350 °C. Welding equipment was developed for operation in high-temperature zone up to 120 °C. Application of water-cooled shield allowed reducing temperature over shield to 65 °C.



The works on project were carried out by two departments, namely «Welding equipment», and «Control systems», based on performance specification of «Turboatom». Spare parts of foreign and domestic producers were used in the equipment. The units are carried out in to versions: single A1569M and coupled A1569M1.

**Both units consist of:**

- mechanisms of horizontal and vertical movement, based on rack-and-gear drive;
- mechanism of wire feeding with changeable feeding gear rollers for different wire diameters;
- mechanism of nozzle turn, which includes overtime clutch in its structure for prevention of nozzle failure due to groove wall being welded.

All the mechanisms are actuated with the help of the NORD worm gear gear-motors (German production), selected and equipped with additional functions based on equipment service peculiarities.

There is a system for flux feeding with manual sliding shutter. The units are delivered with changeable nozzles, current-conducting nozzles and spirals for different groove depth and various diameter of welding wire.

Structure of A1569M1 differs from A1569M by the fact that coupled unit has two heads installed at one horizontal beam. Each of the heads has own movement mechanism. Coupled variant is designed for increase of





efficiency by means of welding of two rotatable joints, simultaneously.

Electric equipment of control system (SU415) of A1569M unit is located in separate control cabinet standing close to machine. Controls are included into main stationary panel, located at cabinet door and in manual panel of the unit.

Electric equipment of control system (SU410) of A1569M1 unit is located in separate control cabinet standing far from the unit. Controls are in two main panels, located close to the unit as well as in manual panels of the unit. SU410 system provides for complex regulation of all equipment, namely welding unit, drives of portal carrier movement as well as control of power drive (37 kW) of part rotation bench.

The control systems also carry out remote switching and regulation of voltage of welding current sources of VDU-1250 type.

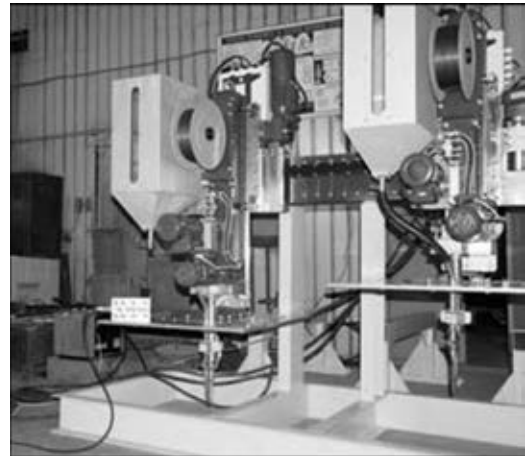
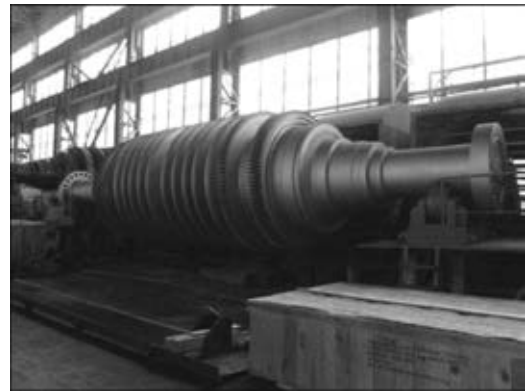
The control system provides for entering of all necessary process parameters, indication of measured welding parameters, displaying of emergency and technological messages as well as sound and light alarm at the emergency situations.

There are three possible modes of electric equipment operation, namely Setting, Semi-Automatic, and Automatic. Setting mode is designed for verification of operation of all mechanisms of the unit and performance of setting movements before welding. Semi-automatic mode is designed for regulation of welding process by manual (by operator decision) turning of the nozzle for beads positioning and lifting-up of the unit to further weld layer. Automatic mode is designed for regulation of technological process of multi-pass welding with automatic positioning of beads and lifting-up of the unit to next layer.

Specific attention during system development was given to ergonomics and ease of operator work. Operator enters the process parameters in real units. The system automatically maintains set linear speed of welding at part diameter change. Control of process as well as diagnostics of system faults with displaying of alarm messages is provided.

At present the equipment is operated in three-shift mode. It is proved to be safe and reliable in course of operation. Process of welding (surfacing) of some parts is carried out continuously during 3 or more days.

In course of last months number of standard parts — rotors of low and average pressure as well as water turbine wheels were welded and surfaced using our equipment.



**Specification**

Groove depth, mm .....	not more 400
Groove width, mm .....	24–36
Welding current, A (100 % duty cycle) .....	500
Welding wire diameter, mm .....	1.2–3.2
Wire feed rate, m/h .....	30–350
Value of head lifting-up .....	not more 500
Displacement of head along part axis, mm .....	not more ±75 (A1569M); ±170 (A1569M1)
Rate of head lifting-up, m/min:	
operating .....	0.05
cruising .....	1.5
Rate of displacement along part axis, m/min:	
operating .....	0.05
cruising .....	1.5
Groove filling by beads (in automatic mode), pcs .....	1–3
Temperature of preheating of part to be welded (surfaced), °C .....	not more 350
Voltage and frequency of power main .....	3 × 380 V, 50 Hz

*V.S. Romanyuk, S.I. Veliky, A.V. Semenenko, A.K. Polishchuk, M.I. Dubovoj, PWI EDTB*

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11, Bozhenko Str., 03680, Kyiv, Ukraine

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