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CONTENTS

FLASH-BUTT WELDING OF THICK-WALLED PIPES FROM HIGH-STRENGTH STEELS OF K56 STRENGTH CLASS

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Technology was developed for flash-butt welding of 1219 mm diameter pipes with 27 mm wall thickness from 10G2FB steel of strength class K56, designed for construction of off-shore gas pipelines. Admissible limits of variation of the main welding parameters ensuring the required quality of welded joints were determined. Required level of mechanical properties of the joints is achieved by local postweld high-temperature heat treatment in combination with accelerated cooling.

Keywords: *flash-butt welding, pipelines, high-strength steel, normative requirements, weldability, welding mode, welding mode parameters, welding process programming, flashing process, set power, mechanical testing, reject indications, heat-affected zone, joint quality, heat treatment, microstructure, grain, ultimate tensile, strength, impact toughness*

In 1980–1990s flash-butt welding (FBW) was widely used for joining position butts of pipes in construction of various pipelines with up to 20 mm wall thickness from steels of K52–K54 strength class.

Technology and equipment for FBW performance were developed at the E.O. Paton Electric Welding Institute together with Pskov Plant of Heavy Electric Welding Equipment (PPHEWE) with the participation of organizations of USSR Minneftegazstroj. Starting from 1980, PPHEWE mastered industrial production of equipment complexes «Sever-1», which include in-pipe welding machine USO 400 (K700) with internal flash-remover, external flash-remover, device for cleaning pipe inner surface to accommodate contact shoes and mobile electric power plant of 1000 kV·A power. «Sever-1» complexes were used to weld more than 6000 km of 1420 mm diameter pipelines (predominantly in Extreme North regions). Here high productivity of FBW process was achieved at minimum labour consumption [1]. Experience accumulated over many years of FBW application is indicative of stable high quality of welded joints that is practically independent of weather conditions or operator qualifications.

Over the last decade, intensive construction of super high-capacity pipelines operating at increased pressure (12–150 MPa) is observed. They are constructed of pipes from high-strength steels of K56–K65 strength class with wall thickness of 27–36 mm and more. Higher requirements are made of the quality of such pipe joints that is specified in modern normative documents.

As labour consumption of operations on welding position butts of thick-walled pipes in pipeline construction is considerably increased, application of high-efficient FBW process is highly promising.

Equipment available for performance of FBW, as well as «Styk» complexes for flux-cored wire arc welding, which were widely applied in the USSR, cannot be used to solve the above task, because of their technical capabilities. In addition, higher requirements are now made of mechanical property values of welded joints compared to normatives of 1980–1990s.

In this connection in recent years the E.O. Paton Electric Welding Institute and «Pskovelektrosvar» plant (RF) performed integrated development of new generation technology and equipment for FBW of thick-walled pipes. Under this project, weldability of thick-walled pipes from 10G2FB steel of strength class K56 was studied. These steels are applied in construction of off-shore pipelines. The objective of these investigations was development of the technology of welding pipes from the above-mentioned steel with 27 mm wall thickness that ensures improvement of mechanical properties of the joints, in keeping with current standards [2, 3].

Selection of the scope of investigations was determined by customer requirements to the first samples of developed equipment for the purpose of its application at construction of off-shore pipelines.

Development of welding technology was performed on large-size samples-sectors with welded cross-section of 8640 mm^2. Sectors of width B = = 320 mm were cut out of pipes with wall thickness δ = 27 mm, made from sheet steel 10G2FB produced