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Address:
E.O. Paton Electric Welding Institute,
International Association «Welding»,
11, Bozhenko str., 03680, Kyiv, Ukraine
Tel.: (38044) 200 82 77
Fax: (38044) 200 81 45
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BRAZING OF TITANIUM ALLOYS BY USING ALUMINIUM-BASE FILLER ALLOYS

V.F. KHORUNOV, V.V. VORONOV and **S.V. MAKSYMOVA**
E.O. Paton Electric Welding Institute, NASU, Kiev, Ukraine

Investigations on brazing of titanium alloy samples by using different compositions of aluminium filler alloys were carried out. Silicon-free aluminium filler alloys were found to be acceptable for producing the brazed joints on titanium alloys. The 670–690 °C brazing temperature range is optimal for the selected filler alloys.

Keywords: *brazing, titanium alloys, aluminium alloys, commercial brazing filler alloys, wetting, microstructure, mechanical properties*

Since the 1960s, Al-base filler alloys have been widely used for brazing of titanium alloys. Pure aluminium or alloys of the Al–Si, Al–Si–Cu and Al–Mg systems are mainly applied as brazing filler alloys [7]. Compositions of some Al-base filler alloys are given in Table 1.

Key advantages of aluminium filler alloys are low melting temperature, low specific weight, good compatibility with titanium alloys base metal and, in particular, good wetting and flowing into the gap. Therefore, special consideration has been given to the aluminium filler alloys since the time when the Ti-base alloys have found application in aerospace engineering.

An important drawback of the Al-base filler alloys is their active reaction with the base metal. Even a relatively short time of contact of titanium with molten aluminium may lead to a deep erosion of the base metal. Silicon is added to the Al-base filler alloys to reduce reactivity of pure aluminium and decrease the brazing temperature (hence, decrease the probability of formation of intermetallics). But in this case silicides may form at the titanium alloy–filler alloy interface. However, the main problem is the Al_2O_3 film on the aluminium filler alloys, which prevents their spreading over the base metal.

Despite a large amount of the investigations conducted in Eastern Europe and particularly in Ukraine to study brazing of titanium by using aluminium filler alloys, brazing of titanium with this type of the filler alloys failed to receive acceptance. There are publications on development of new aluminium filler alloys for brazing of titanium alloys [7], this evidencing the industrial demand for commercial medium-melting point filler alloys for brazing of titanium and its alloys.

Wide application of aluminium filler alloys in this case is hindered by a low strength of the resulting brazed joints, which is much lower than that of the joints brazed with titanium filler alloys. One of the promising areas of using aluminium filler alloys is brazing of lamellar-ribbed thin-walled structures and thin-walled honey-

Table 1. List of standard aluminium-base brazing filler alloys

Grade of filler alloy	Manufacturing country	Composition of filler alloy	T_{br}, °C
AD1	USSR	Al–0.4Si–0.3Fe	665
AL2	Same	Al–13Si	560–700
AVCON 48	USA	Al–4.8Si–3.8Cu–0.2Fe–0.2Ni	610–680
AA3003	Same	Al–1Mn–0.6Si–0.7Fe	660–670
TiBrazeAl-600	»	Al–12Si–0.8Fe	590–610
TiBrazeAl-630	»	Al–1.5Mg–4Cu–2Ni	630–660
TiBrazeAl-640	»	Al–(4.4–5.2)Mg–(0.7-1)Mn–0.2Cr	640–660
TiBrazeAl-642	»	Al–5.3Si–0.8Fe–0.3Cu–0.2Ti	650–680
TiBrazeAl-645	»	Al–(4.3–5.5)Mg–0.25Si–0.4Fe–0.2Ti–0.2Cr	640–660
TiBrazeAl-655	»	Al–6.3Cu–0.3Mn–0.2Si–0.2Ti–0.2Zr	650–670
TiBrazeAl-665	»	Al–2.5Mg–0.2Si–0.4Fe–0.2Cr	660–680