In fusion welding of steels to aluminum, brittle layers of intermetallic phases are formed in the contact zone [1]. It is possible to significantly decrease the thickness of the layer in brazing, that is, in the interaction of a more refractory solid metal with a molten low melting one. Therefore a stainless steel-aluminum bimetal was produced by diffusion of 12Kh18N10T steel in molten A995 or AD1 molten aluminum with a small amount of superheating above the melting point of the aluminum and subsequent combined cooling of the steel and aluminum at a controlled rate.

The mechanical strength in tension of the steel-aluminum joint was determined on an RM-103 tensile machine. Tubular samples with a diameter of 25-30 mm and a wall thickness of 1-2 mm were used for the investigations. The total length of the samples was 65-80 mm and the length of the aluminum component of the bimetal 35-40 mm. The clamps and intermediate fastening elements of the samples provided transmission of the tensile force strictly along the axis of the cylinder. The tests were made at a constant rate of tension of 0.2 mm/sec.

In the 12Kh18N10T + A995 bimetal a 3-5 μ thick layer of a new phase is formed in the boundary between the stainless steel and the aluminum (Fig. 1). This reliably bonds the components of the bimetal. In the mechanical tests of this bimetal the samples failed in the aluminum at a distance of 5-15 mm from the joint with a stress of 49-54 MPascals, that is, the zone of contact of the metals was stronger than the aluminum base. Tubes of the 12Kh18N10T + A995 bimetal may be flattened without failure of the zone of contact. The bimetal withstands a single bending by 180 deg. In this case failure also occurs in the aluminum.

Normally in producing bimetals an attempt is made not to form a layer of a new phase. However, even in such short-time processes as explosive welding nevertheless in "the zone of the joint of the metals nonetching areas with a microhardness up to 6 GPa cals are formed" [2], that is, on the boundary a layer of intermetallides is formed. In addition, the absence of an intermetallide layer is not a reliable guarantee of high quality in a bimetal. The layer may not be formed because of failure of contact between the metals in the presence on their surfaces of films of oxides and other nonmetallic compounds and also of adsorbed contaminants. In this case the mechanical properties of the bimetal are determined to a significant extent by the degree of cleaning of the surfaces of the metals being joined [3] and the adhesion strength of the layers varies within wide limits at different points [4].
Therefore it is more realistic not to attempt completely to avoid the formation of an intermetallide layer but to limit its thickness to that at which the intermediate layers do not have a negative influence on the properties of the bimetal under the specific service conditions. In [5] it was noted that with a layer thickness of more than 10 μ the mechanical strength of the steel–aluminum contact zone is poorer than the strength of the aluminum and samples fail in the joint. However, in the stainless steel–aluminum bimetal produced by brazing a 20–25 μ thick layer of the new phase still does not have a negative influence on the mechanical strength in tension. Data of investigation of 12Kh18N10T + AD1 bimetal (Figs. 1b, 2, and 3) show that a 20–25 μ thick layer of the new phase does not lead to weakening of the zone of contact of the metals. The samples fail, as in the case of the 12Kh18N10T + A995 bimetal, in the aluminum at a distance from the joint. With a layer thickness of 25–30 μ the start of brittle failure of samples is found in the joint although the strength of this zone is close to the strength of aluminum. An increase in layer thickness beyond 30 μ leads to a sharp drop in the strength of the contact zone and the samples fail in the joint. A very large spread is characteristic of mechanical test results in this case. Therefore a layer thickness of 20–25 μ must be assumed to be the maximum for a stainless steel–aluminum bimetal. We should note that such a thickness is acceptable in operation of a bimetal in tension and under conditions of thermal cycling with low loads. It is possible that under other service conditions a 20–25 μ thick layer of the new phase may have a negative influence on the strength of the bimetal.

The increased strength of the portions of aluminum adjoining the steel may be explained by the higher content near the zone of contact of elements which have passed from the steel into the molten aluminum in brazing. In solidification of the aluminum an "aluminum + intermetallide" eutectic is formed. This, as is