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NASA TECH BRIEF

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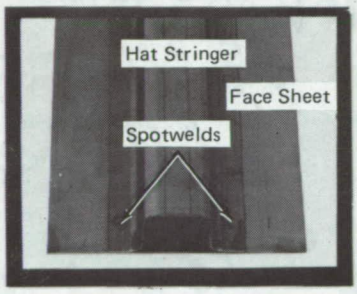
The Weld-Brazing Metal Joining Process

Weld-brazing is a process which combines the use of resistance spot welding and of brazing to provide a joining process capable of producing joints, between faying surfaces, which have mechanical properties superior to those obtained from joints produced by either process alone. The weld-brazing process also simplifies the brazing process without complicating the procedure used for resistance welding.

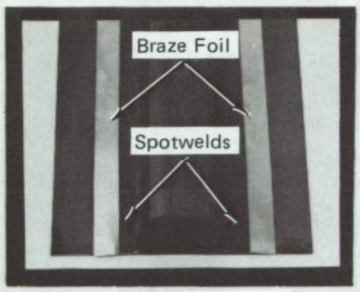
Some of the advantages of weld-brazing are:

1. The spot welds maintain alignment of mating surfaces during brazing which simplifies the brazing process and eliminates the requirement for complex jigs and tooling normally needed for brazing.
2. Structures fabricated by weld-brazing should possess superior fatigue and static mechanical properties as compared to conventional riveted structures because of the continuous bond of the weld-brazed joint.
3. The elevated temperature properties of a weld-brazed joint are normally superior to those of a brazed joint because of the strength contribution of the spot welds.
4. Corrosion problems encountered between the faying surfaces of spot welded or riveted joints are eliminated, as weld-brazed joints are hermetically sealed.

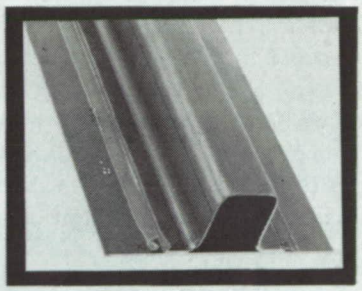
The weld-brazing metal joining process is essentially a two-step technique. The mating surfaces are joined



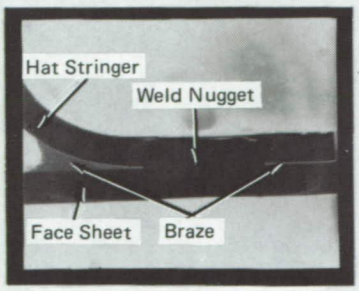
A. Spotwelded Prior To Brasing



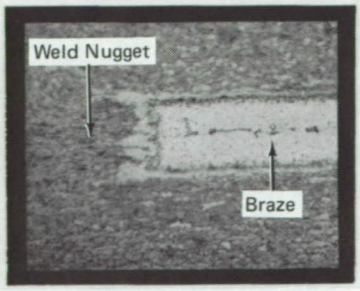
B. Braze Foil In Place



C. Weld-Brazed



D. Weld-Brazed Joint (10 X)



E. Weld Nugget-Braze Interface (400 X)

WELD-BRAZING OF TITANIUM STRUCTURAL COMPONENT

(continued overleaf)

together by precise resistance spot welding, and then braze alloy is drawn between the faying surfaces to complete the process. The process should be applicable for fabricating structures from nickel base and refractory metal alloys using appropriate braze alloys, and has been used to join titanium structural members using an aluminum braze alloy.

1. The spot welding is accomplished in the conventional manner; however, the production of a uniform gap between the mating surfaces of the proper tolerance to facilitate brazing is very important. The attainment of this gap is brought about by control of the heat input and welding pressure. The strength of the welds is primarily gained by means of the number of welds per unit area and the size of the weld nugget. Therefore, a wide range of parameters is available to obtain a welded joint possessing the desired characteristics.
2. The brazing is accomplished by placing a braze alloy (foil or powder) at the spot welded joint, and the surfaces are then heated in a vacuum or inert gas furnace to the appropriate brazing temperature which will allow the alloy to be drawn between the faying surfaces by capillary action.

View (a) of the figure depicts a Ti-6A1-4V titanium alloy skin stringer specimen that has been spot welded to establish a faying surface gap suitable for aluminum alloy brazing. Following resistance welding, braze alloy foil was placed along the exposed edges of the joints as shown in View (b). The assembly was then brazed in a vacuum furnace to produce the specimen shown in View (c). During brazing the braze alloy melted and was drawn into the existing gap by capillary action as shown in View (d). The braze alloy was drawn through the gap to form a fillet between the face sheet and the inner radius of the hot stringer. View (e) is a photomicrograph of the weld-brazed joint showing the good integrity of the joint in the vicinity of the weld nugget.

An alternate method of brazing is possible if the braze alloy does not wet the metal sufficiently to be drawn into the gap by capillary action. In this case it is possible to pre-punch the braze foil and spot weld the surfaces together through the holes in the foil.

Weld-brazing could be used in industry as a fabrication process for producing a variety of hardware. Utilization of the process could be made by the aerospace industry for fabricating lightweight skin stringer-type structures and for fabricating thin wall pressure vessels. Industry could employ weld-brazing whenever an overlap joint is used or a hermetic seal is necessary.

Note:

Requests for further information may be directed to:

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Reference: TSP72-10683

Patent status:

This is the invention of a NASA employee and a patent application has been filed. Inquiries concerning license rights may be made directly to the inventors Messrs. Thomas T. Bales and W. E. Arnold, Jr., Langley Research Center, Hampton, Virginia 23365.

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