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The Aluminum Association based in Arlington, Virginia, works globally to aggressively promote aluminum as the most sustainable and recyclable automotive, packaging and construction material in today's market. The Association represents U.S. and foreign-based primary producers of aluminum, aluminum recyclers and producers of fabricated products, as well as industry suppliers. Member companies operate approximately 180 plants in the United States with many conducting business worldwide.

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Foreword

The principles underlying soldering of aluminum are identical to those that make metallurgical bonding of other metals possible. After aluminum’s tough protective oxide coating is removed, the soldering of aluminum proceeds along lines similar to those used with other metals, utilizing essentially the same techniques and equipment. But, it is precisely the difficulty in removing aluminum’s protective oxide coating that makes soldering of the metal challenging. This is why the role of cleaners and fluxes is so important in the aluminum soldering process.

Properly made, aluminum joints are long lasting, gas tight and strong. Depending on the solder chosen, aluminum joints can be as strong as the metal joined. When tested, these joints fail at the base metal.

Aluminum is joined by soldering when many joints are to be made simultaneously and economically; when nearby material precludes the higher heats of brazing and welding; when component distortion must be avoided; when temper loss is to be held to a minimum; when equipment investment funds are limited; and when rapid field repairs with hand-held tools are needed.

Soldered aluminum joints are widely used in spacecraft, electronics, electrical power plants and power lines, household goods, refrigeration systems and air conditioning. The list of current and future solder applications is virtually endless.

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Introduction to Aluminum Soldering

Soldering is an inexpensive and rapid means of permanently joining aluminum to aluminum and to other metals. Properly made joints are leak-proof and strong. Soldering is used for joining aluminum wires, making heat exchangers, spacecraft, plumbing and thousands of other applications far too numerous to list here.

Aluminum soldering can be straightforward when proper solder alloys, cleaners, and fluxes are used. Single joints are readily made in the field and shop with low-cost hand tools. Single and multiple joints, often numbering in the thousands, are automatically produced with comparatively low-cost equipment by semi-skilled personnel.

Purpose of Aluminum Solder Connections

The first step in proceeding with aluminum soldering is to understand the type of connection being made, as follows:

Tinning – This technique is used to render the relatively non-solderable surface of aluminum (by ordinary soldering fluxes) solderable by coating the aluminum with a more solderable alloy.

Thermal/Electrical – The connection described here will be able to transfer electrical or thermal energy from one metal into another through the connecting solder media.

Structural (Joint Formation) – The formation of a structural joint holding two metals involves the process of joint clearance and assistance of solder flow. This is an important consideration, since aluminum has a higher surface tension with respect to solder, than other metals, like copper. Therefore, when making a capillary joint one has to consider the space necessary to facilitate solder flow.

Load-Bearing – Like a thermal/electrical or a structural joint, this type of connection is also expected to bear a certain amount of stress. When creating a joint that is to bear a known amount of stress, joint design and solder alloy choice are key factors.

Advantages of Soldering

By the accepted American Welding Society definition, soldering is a joining process wherein coalescence between metal parts is produced by heating to suitable temperatures, generally below 449°C / 840°F, and by using a filler metal having a liquidus not exceeding 449°C / 840°F and below the solidus of the base metals. The solder is usually distributed between the properly fitted surfaces of the joint by capillary attraction. Brazing, by the same definition, is a similar process accomplished at temperatures above 449°C / 840°F, but below the melting point of the metals to be joined. Welding requires that