

**Q: What is the correct amount of overlap to use when brazing tubular aluminum pieces together? Is the amount of overlap for aluminum different than for other metals such as stainless to stainless?**

**A:** As a general guideline, I suggest that the amount of overlap for aluminum brazed joints be about 1T to 3T, where T is the thickness of the thinner of the two aluminum pieces being joined. Figure 1 shows sketches of a sheet metal joint and a tubular joint with the recommended overlaps.

Note that this overlap is less than the typical 3T to 6T overlap that is recommended for all other base metals. The reason for this relates to the closeness of the melting temperatures of the aluminum brazing filler metal (BFM) and the aluminum base metal being joined. Often, the solidus temperature (melting temperature) of the aluminum-based BFM is only a few degrees lower than that of the aluminum base metals being joined.

Thus, when the BFM has reached its melting temperature and is ready to flow,

there appears to be a stronger driving force for the BFM to react with and diffuse into the base metal rather than merely skate over the base metal surface and flow deeply into the joint by capillary action.

Figure 2 is a cross-sectional sketch of a poorly brazed joint I encountered. It shows how the aluminum BFM flowed at the top of the assembly where the smaller tube goes into the fitting and the BFM also nicely filled in at the bottom of the assembly, but there is a large void around the interior circumference of the joint.

Challenge questions to the reader: How could this happen? What is wrong with this joint design?

I was curious about how this joint was brazed, so I asked the brazing personnel how it was possible for the BFM to travel all the way through the joint, and yet leave a large void between.

His answer did not surprise me. He admitted he could not get the BFM to flow all the way through the joint after repeated attempts on several samples. Therefore, he just added extra BFM at the bottom of the joint to make a nice

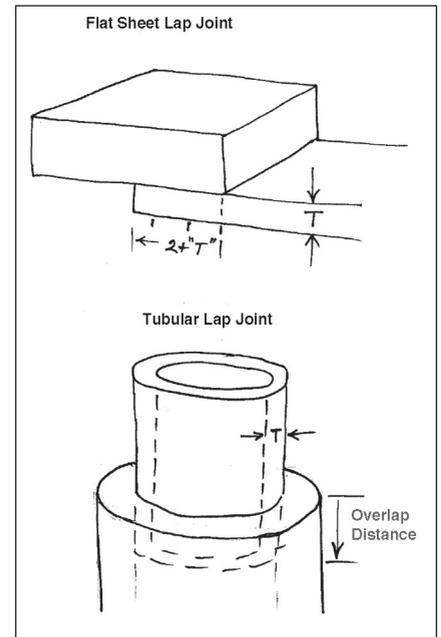


Fig. 1 — When joining aluminum base metals, the overlap should be only 1T to 3T, where T is the thickness of the thinner member.

brazing fillet at the other end of the joint, which looked satisfactory to him.

Note: Brazing should never involve feeding BFM to both sides of the joint to create a fillet on each end. Proper brazing requires filling the faying volume between the two mating surfaces in the joint. Thus, an important rule of brazing is “feed the BFM from one end of the joint, then inspect the other.”

Question: What should the designer of this brazement have changed to ensure complete joint penetration by applying the BFM at one end of the joint?

As you can see from Fig. 2, the brazed joint did not meet the 1T to 3T overlap criterion for aluminum brazing. The overlap shown is about 10T, far more than is needed for full strength and leak-tightness (hermeticity) in an aluminum brazed joint. With this excessive overlap, it would be extremely difficult, if not impossible in my opinion, to get the BFM to flow all the way through that long joint.

Had this assembly used only 2T or 3T overlap, the joint would have allowed the BFM to flow through to obtain complete joint penetration and allowed visual inspection of the opposite side of the joint. It would also have saved time, money, and materials by eliminating the need to apply a lot of extra BFM to the joint.

My recommendation is to practice

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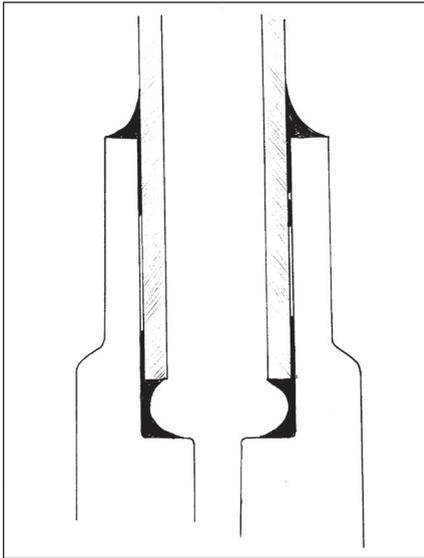


Fig. 2 — Cross section of a 6061 tube brazed into a 6061 fitting using AWS BAlSi-4 (4047) brazing filler metal. The excessive overlap prevented the filler metal from penetrating the full length of the joint.

brazing using 1T to 3T overlap to develop confidence in the strength and leak-tightness it achieves. Too many people, in my experience, try to ascertain the “goodness” of a braze joint by how they “feel” about the amount of overlap. People have told me, “Oh, I don’t think that’s enough overlap,” depending more on their gut feeling rather than on hard facts gained from testing and experience.

It’s only with experience that designers can develop confidence that overlaps of only 1T to 3T are satisfactory for making aluminum brazed joints. ♦

*This column is written sequentially by TIM P. HIRTHE, ALEXANDER E. SHAPIRO, and DAN KAY. Hirthe and Shapiro are members of and Kay is an advisor to the C3 Committee on Brazing and Soldering. All three have contributed to the 5th edition of AWS Brazing Handbook.*

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*Readers are requested to post their questions for use in this column on the Brazing Forum section of the BSMC Web site [www.brazingandsoldering.com](http://www.brazingandsoldering.com).*

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