Frequently asked questions #6

Does contact with ammonia lead to corroded brazed joints?

The short answer to this question is 'yes'; however this definite response does not reflect the true situation in every case! There is a wealth of technical literature that explains that if copper or copper-containing materials are allowed to come into contact with ammonia solution they will be corroded. Under these conditions it can be considered that 'wet' ammonia is, effectively ammonium hydroxide, (NH_4OH), and this dissolves copper to produce the soluble copper salt, cupro-ammonium hydroxide, ($Cu\ NH_4OH$). Thus the general rule is that in cases where there is a risk of an assembly coming into contact with 'wet' ammonia in service no part of that assemble should contain copper! Clearly this is quite an easy 'rule' to obey, and this explains the almost exclusive use of steels for items that are to be exposed to ammonia in service. Clearly, welding is an approved joining method for steels. However, with the recent trend in the refrigeration industry to change the refrigerant gases from CFC's to ammonia, the problem of how to make joints in small- and medium-sized heat-exchangers by welding have had to be addressed. Since welding of these items was found to be troublesome, the obvious solution was brazing, but which filler materials should be used? Even a cursory glance at the filler materials on offer from the major suppliers will show that brazing alloys that are free from copper are quite rare, and those that do meet this criterion are either too expensive on account of their containing one or both of gold and/ or palladium, or in the case of the nickel-base alloys difficult to use since furnace brazing is mandatory if they are to be used..

This problem was, however, originally addressed some four decades ago and two materials were developed. These are shown below:

1. 75%silver: 25% zinc

This material has a melting range of 710 –715ºC, and a working temperature of 720ºC. When molten, the alloy has excellent flow properties, but due to its very short melting range the production of a fillet at the joint is close to impossible.

This material was originally developed for the brazing of mild steel in conjunction with a fluoride-base flux conforming to EN1045 Type FH10; however it must **not** be used to braze stainless steel. It is a widely known fact that when stainless steel is to be brazed the filler material selected for the process **must** be ***free from both cadmium and zinc***. Clearly, the zinc-content of this material means that if it is used on stainless steel it is inevitable that there will always be the risk of premature joint failure due to the mechanism of crevice corrosion.

2. 85%silver: 15% Manganese

This material has a melting range of 960 - 970ºC, and a working temperature of about 990ºC. Like the 75% silver: zinc alloy, this material also has a very short melting range, but on account of its comparatively high manganese-content, even when molten it is relatively 'sluggish' and does not flow well. As a result the production of a fillet at the joint is relatively easy to achieve.

Brazing is best carried out with a relatively intense heat-source, perhaps oxygen-acetylene, in conjunction with a fluo-borate flux conforming to EN1045 Type FH10. The incorporation of gas-flux into the flame will assist in removal of the oxides from the external surfaces of the joint, but the use of gas-flux alone will ***not*** provide the necessary penetration of the joint by the molten filler material. Since this filler material is free from both zinc and cadmium it is not subject to failure by the mechanism of crevice corrosion.

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