Brief Information of

Copper Alloy Welding Wire (Rod)

A) Choosing Welding Wire (Rod)

In choosing copper alloy welding wire (rod), besides fulfilling the normal requirements of its technical and metallurgy properties, most importantly is the control of its impurity content and raising its deoxygenating ability to prevent the welding joint against heat crackle, blowhole and other defects. Red copper welding wires (rods) are added deoxidants of Si, Mn, P and other elements but for the red copper weldment that requires higher electroconductibility is not suitable for use the wires (rods) contain P. Adding Si in brass welding wire (rod) can prevent evaporation of Zn, oxidation and increasing the resistance of crackle and corrosiveness of weld joint as well as increasing liquidity of the metal in the molten pool. Adding Al can be used as alloying agent meanwhile it can also deoxidize and refining the microstructure of weld metal, increasing the plasticity and corrosion resistance of the joint. Addition of Fe in the welding wire (rod) will increase the tensile strength, hardness and abrasiveness of the weld metal. Sn is added in the welding wire (rod) to increase the liquidity of the metal in molten pool and to improve the welding technology. It is put into good use in gas shielded arc welding that to add single or compound element of Ti, Zr and B in the welding wire (rod) will get better effect of deoxygenating. When welding pure copper, the choice is CHM-Cu1898/CHG-Cu1898 (AWS ERCu) that contains Si, Mn, P and Sn can prevent heat crackle and blowholes in welding joint. In welding bronze the first choice is bronze wire (rod) that has same composition; nevertheless the choice of aluminium bronze wire (rod) for welding other bronze, such as silicon bronze, can also ensure the mechanical properties of the weld metal. For inert-gas brass welding, in order to prevent massive Zn evaporation, do not choose brass wire (rod) and instead use silicon bronze one of CHM-Cu6560/CHG-Cu6560 (AWS ERCuSi-A), Si can suppress the Zn burned out and better result can be obtained.

B) Choosing Shield Gas

The gas used in MIG and TIG welding of copper and copper alloy are argon (Ar), helium (He) or their mixture and the purity of gas is 99.99% or more, if not blowholes easily present when welding.

C) Defects in Welding and Preventive Measures

The major defects of copper and copper alloy welding are blowholes, crack, lack of fusion, undercut and slag inclusion.

a) Blowholes

Causes of its occurrence:
Blowholes in copper welding are mainly due to the presence of hydrogen in the molten pool. Sources of hydrogen are: base metal, welding wire (rod), shield gas, wire feeder, welder's gloves or ambient humidity is too high, also contaminated welding wire (rod) and contaminated weldment and oxide coating covers welding wire (rod) as well as there is oil contamination or sweat droplets on wire feeder

Preventive measures:

1) To control the hydrogen content in base metal and in welding wire (rod), it should be ≤0.4%ml/100g.

2) The welding surface should be free of oil contamination and oxide coating, storage period of cleaned weld zone not more than 4 hours before welding if not the welding grooves must be covered by dry, clean and lint-free material.
3) Polished welding wire (rod) should be used as far as possible, or else the above handling procedures should be adapted.
4) Shield gas impurity content: $H_2 \leqslant 0.001\%$, $O_2 \leqslant 0.02\%$, $N_2 \leqslant 0.01\%$, $H_2O \leqslant 0.02\%$.
5) Shield gas tubing: Normally using stainless steel tube or copper tube while plastic hose are used for flexible tubing instead of rubber hose or other water absorbing hose; pre-welding inspection of water cooling pipe to ensure no leakage. In the case of high humidity, the shield gas should be pre-heated and the tube should be blown dry.
6) Wire feeder should not with oil contamination and wire feeding hose should be made by teflon. Pre-welding clean contaminant and cold frozen water in the hose away.
7) Job site environment: temperature not higher than 25℃, humidity not more than 50% and keep environment clean.
8) Welder: As far as possible the working uniform to be white in color for early detection and cleaning of contaminant. During welding, caution of sweat and oily matter to dirty the weldment.
9) Test-weld on the testing plate before formal welding to check the suitability of shield gas and tubing.
10) Welding techniques and preventive measures: Applying welding by both sides instead of by one side; the thinner the welding layer the easier the air release; welding wires with larger diameter help to reduce blowholes; pre-heating before welding, gradual cooling after welding; reducing arc voltage, increasing welding current and lowering welding speed helps reduce blowholes also.

b) Crack

Causes of its occurrence:
Low weldability of base metal or non consideration of crack resistance when choosing welding wire (rod); the welded joints are subjected by over restraint intensity.

Preventive measures:
1) For weldment of copper which has low weldability, pre-welding consideration should be taken regarding its crack resistance and not just its tensile strength. If necessary annealing the weldment before welding and quenching it aging after welding.
2) Choosing welding wire (rod) with higher crack resistance, such as the one containing Si or other low melting point elements.
3) To minimize restraint intensity of welding joints, appropriate welding in turn, enabling the welding joint has margin of transverse shrinkage in order to reduce stress. Do not apply tack welding unnecessarily, wherever possible, to apply tack welding by both sides instead of by one side if necessarily.
4) As far as possible to apply welding by both sides instead of by one side.

c) Lack of Fusion

Causes of its occurrence:
Welding speed is too high; welding current is too small; there are higher impurities in the base metal; oxide coating or rust are not cleaned thoroughly.

Preventive measures:
1) Applying correct welding technical parameters to carry out welding.

2) Choosing welded metal with higher degree of purity as far as possible.
3) Clean out impurities of oil contamination, rust, oxide coating and moisture on the surfaces to be welded before welding.

d) Undercut

Causes of its occurrence:
Welding current and voltage are too high, welding speed is too fast so welding wire (rod) deposited too little.

Preventive measures:
1) Take appropriately welding technical parameters and suitably increase wire (rod) feeding speed or slowing welding speed.
2) The welder should be qualified after training.

e) Slag Inclusion.

Causes of its occurrence:
Pre-welding cleaning is not thorough and existing too much of oxidate with high-melting-point on the welding zone, welding speed is too fast.

Preventive measures:
1) To improve cleaning the welding zone before welding and in the case of mult-pass welding clean each layer and every track.
2) Suitably reduce welding speed to enhance the oxidate floating upward

D) Storage for Welding Wire (Rod) and Preventive Measures for Oxidation

a) The storeroom should be arefaction and ventilated. The temperature is better 10℃-40℃ and relative humidity (RH) ≤60%. Moisture should be avoided and repulsing any liquid or mordant effumability materials, such as water, acid, alkali and so on, far away from fire also.

b) The welding wire (rod) can not be put on ground directly and it should be put on pallets that made by wooden/metal/ plastic and the distance of the wire (rod) against the wall of storeroom at least 300mm.

c) Moving wire (rod) must be careful and do not damage any package of it. Shifting a full spool/reel of uncovered wire with short distance should use fingers of two hands to hook two ends of the inner bore instead to shift it when it flatwise.

d) When open a package of the wire (rod) it is better to run out of it in short time and it can not be exposed in atmosphere exceed 40 hours if not it easy be oxidation particularly in the environment with moisture and mordant.

e) Take the principle of first-in, first-out to use the wire (rod) to shorten the storage time.

f) It is important to store the wires (rods) respectively according to the types and specifications and do not misapplication.