Coil and Motor Manufacturing Tips

Selecting Solder to Control Copper Dissolution When Soldering Fine Gauge Magnet Wire

When molten solder and copper alloy, a good solder joint results. The dissolution of copper, termed by some as "copper gobble," ordinarily is not a problem at normal soldering temperatures (250-375°C) with large- or medium-size copper wire. However, if AWG #40 and smaller copper wire is used, dissolution of the wire by the solder must be considered when the soldering process is established.

Rate of copper dissolution at a given temperature varies widely with solder composition. The accompanying table shows that the 450°C dissolution times for AWG 42 magnet wire range from 1 second for Sb 5 solder to 60 seconds for Ag 1.5 solder.

The amount of dross or oxide formation on top of a solder bath also depends on solder composition. The 450°C oxidation rates of the solders listed range from very slow for solders containing 1.5% silver to extremely fast for the indium-bearing solders. Therefore, the Ag 1.5 solders, combining low copper dissolution rate and low dross formation, emerge as attractive candidates for use in soldering fine magnet wire insulated with high temperature (155-180°C) solderable insulation.

DISSOLUTION RATE OF COPPER IN 450° SOLDER

Solder Composition (Percent)						AWG 42* Dissolution Time (Seconds)
Sn	Pb	Ag	In	Sb	Cu	
1.0	97.5	1.5	—	—	—	60
5.0**	93.5	1.5	—	—	—	45
—	95	—	5	—	—	45
10	90	—	—	—	—	25
—	75	—	25	—	—	20
50***	48.7	—	—	—	1.3	6
63	37	—	—	—	—	4
95	—	5	—	—	—	1
95	—	—	—	5	—	1

*Polyamide/ester-imide magnet wire supplied by Belden Corp.
**HMP alloy supplied by Multicore Solders, Ltd.
***Savbit 687/55 alloy supplied by Multicore Solders, Ltd.

A very high solder temperature or a very long dwell time of the wire in heated solder can cause a small-gauge wire to dissolve completely in Sn 63 solder.

The problem of dissolution time (the time required for magnet wire to be completely dissolved in solder) is magnified when 450°C solder is used to heat-strip 155°C rated solderable insulation in 1 to 2 seconds. At 450°C, Sn 63 and similar solders do not provide an adequate margin between tinning time and copper dissolution time. Other solders, therefore, must be considered.

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