Soluble masks protect pc boards from solder

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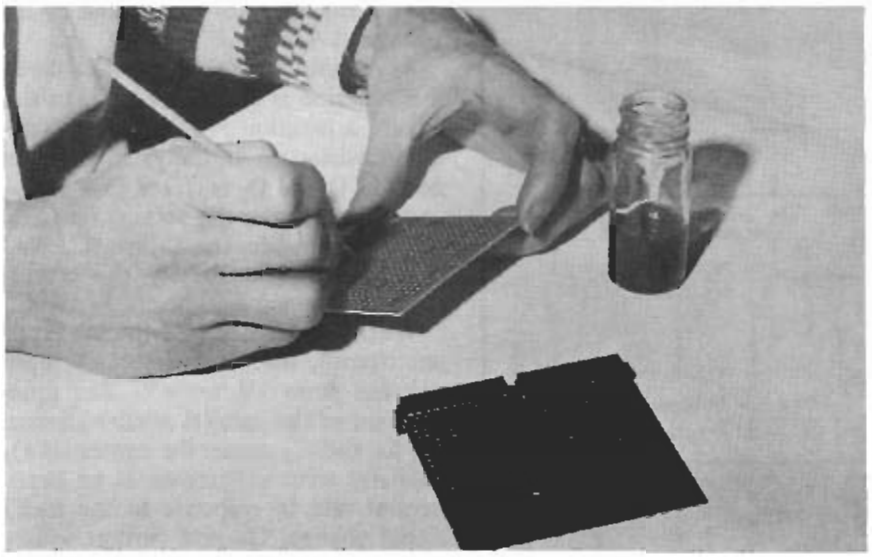
Two kinds of water-soluble solder masks can, when applied to a circuit board before wave-soldering, keep solder out of plated-through holes. These holes must be kept open to permit dry components—thermally sensitive electrical devices—to be hand-soldered to the circuit board after the wave-soldering operation. Most previously known solder-mask or resist materials must be removed with solvent cleaning, which is expensive, or they leave questionable residues that impede hand-soldering. (Although a fluffy white residue appears when one of the two new materials is applied in excess, if allowed to dry for several days, it is easily brushed or blown off.)

Water-soluble masks are also useful for protecting large tab areas or other large areas of copper that are not to be soldered. Masking prevents solder from bridging between circuit lines on a printed-circuit board, even when hand-soldering or non-wet components are not involved. And, when parts of a board are to be coated with something, water-soluble masks can protect the areas that are not to be coated when the coating itself is not water-soluble; otherwise its application would wash off the mask material.

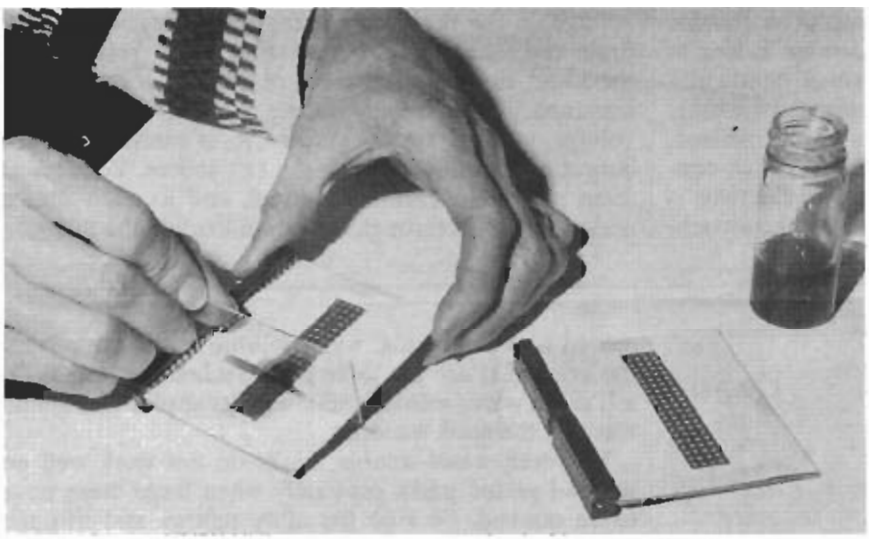
However, water-soluble masks do not work well on tin-lead plated parts, especially when large areas have to be masked, because the alloy reflows and lifts the mask from the circuit board.

The two new materials are based on sodium silicate and gum arabic, or acacia, both in water solution and both with small quantities of other materials added. The materials have different characteristics and react differently in any production process. However, both meet the primary objective—to prevent solder from wetting the masked areas, whether soldered as soon as the mask has dried, or days or weeks later. And neither material hampers any subsequent production process, nor permits solder reflow, which could cause bridging between masked circuit lines.

Like most other water-soluble masking materials, the new ones meet current regulations of the U.S. Occupational Safety and Health Administration and state agencies; they are, in fact, pollution-free. Even if large quantities of mask materials were accidentally spilled, no pollution limits would be exceeded because all of the ingredients have extremely high tolerance levels in waste water. They are also relatively nontoxic; continued exposure of production workers to either of the two



Mask-maker. Brushing and screening are two of several methods by which new water-soluble masking materials can be applied to printed-circuit boards. The materials keep solder away from selected areas as the board moves through a wave-solder machine.



materials has no serious or long-lasting effects.

A good solder mask must be pliable to permit normal handling after masking, and it must adhere to the substrate throughout any subsequent processing steps. In previous evaluations of gum arabic as a masking material, it has adhered poorly after extended shelf life. However, the new formulation contains a humectant—a substance such as ethylene glycol—that promotes moisture retention, so that there is no loss of adhesion from physical abuse, from successive mechanical handling processes after masking, or from extended exposure to temperatures as high as 150°F.

The new water-soluble masks can be left on the surface for several months at ambient or elevated temperatures without corroding, as some materials do. Furthermore, they actually improve the insulation-resistance, which on a series of test boards averaged an order of magnitude higher than on boards made with the IBM standard mask. The lower resistance encountered with the standard mask—still well up in the thousands or even millions of megohms—is caused by minute traces of the mask material, too small to affect soldering, but nevertheless sufficient to establish a tiny current path.

The constituents of both materials, which can be purchased from any chemical supply house at a low price, are easily mixed in a laboratory. The total costs will depend on production levels, mask-preparation time, and operator technique.

Water-soluble masks can be applied by any of several methods, such as by brushing, spraying, dipping, or screening. All application methods are relatively simple. However, when the gum-arabic mask is silk-screened, long fine strings or webs of material sometimes form when the screen is lifted off the substrate. As these webs break and fall to the substrate, they mask areas that should not be masked. This webbing apparently occurs only with samples of gum that have *not* been stored for a long time in a warehouse; natural aging of the gum eliminates the webbing.

Accelerated aging—heating at 75°C for one week—gives the same effect by driving off interstitial or bound water from the gum molecules. If a gum of any age is aged further by heating, a mask material made from it leaves no web. Webbing is also eliminated immediately by adding a small amount of potassium chloride to gum of any age; the chloride eliminates the forces that cause webbing. Because chloride addition is minimal, negligible residues are left after mask removal.

The mask material must not dry while being applied, but, once on the substrate, the film must dry quickly to prevent flow of material into non-masked areas. Gum arabic in water solution satisfies these requirements, but sodium silicate, if dried too fast, leaves a residue after soldering and cleaning. Adding a humectant to the mask formulation makes it dry to a non-flowing tacky film in three to five minutes and dry completely within 10 minutes.

Water-soluble masks can be used effectively on plated-through holes as large as 0.25 inch in diameter, small and large surface areas, and even large tinned surfaces, although the tin should be precleaned to increase adhesion. The masks can be adapted to nearly any production process by varying the chemical constituents of the material.

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