Optimizing process controls for the new generation Diazo Phototool films

The new generation Diazo Phototool Films offer the PCB manufacturer added performance of increased scratch resistance and a chemical resistant feature for use in the LPISM Department helping to prevent the LPISM inks from attacking (sticking to) the diazo film emulsion. Previous Diazo Phototool films were designed primarily for Dry Film Resist applications before Liquid Photo-Imageable solder mask inks were widely available. These films offered some scratch resistance as compared to a silver phototool film but did not offer any chemical resistance to the harsh LPISM inks and related solvents.

The new diazo film emulsions, now widely available in the marketplace, offer both improved scratch and a chemical resistance as these new emulsion designs incorporate new proprietary film emulsion chemistry and manufacturing improvements. Previous diazo film needed a moist developer environment (a developer which incorporates liquid ammonia in a heated chamber), 26 Baume "A" aqueous ammonia, and a film plane developer temperature of 145 F - 155 F degrees (the film plane is what the actual sheet of diazo film is seeing temperature wise as it passes through the diazo developer). These setting were the required specification for these films. The new generation diazo films available today with their new improved emulsion chemistry and manufacturing techniques require a moist developer environment, 28 - 30 Baume "A" Ammonium Hydroxide and a film plane temperature of 155 F - 165 F degrees to activate the new emulsion chemistry.

Today the end user requirements have changed as the USA and European PCB production models and have moved from a blend of prototype, short production runs and "long runners" to primarily prototype jobs. As this change occurred the diazo manufacturers have refined their product offerings to one design offering a unique blend of a chemical and scratch resistant emulsion. Diazo is increasingly the popular choice as the working photomask (Phototool) for liquid photo image able solder inks allowing for easy registration to the panel (due to its molecular dye emulsion that the film technician can see through vs. the silver grain gelatin emulsion films). Likewise diazo has a home in both the outer and inner layer imaging areas for its outstanding ability to reduce both artwork and board rework/touchup/scrap associated with handling scratches during the production process. Additionally the new and improved chemical resistant feature of the diazo film allows for easy cleaning / removal of solder mask inks from the film. This same chemical resistant feature also prevents damage to the actual image on the film. Silver film gelatin emulsions are easily attacked and permanently damaged by many of the liquid solder mask inks on the market. Finally the scratch resistant feature of the diazo film provides superior protection as compared to a silver Phototool film on the production floor.

Today’s new generation diazo film is the outcome of 40+ years of listening and understanding the market needs and creating the ultimate diazo phototool film to meet those requirements. Improvements in both the chemical and scratch resistant properties are the hallmark of the latest generation film offering. The "new" diazo films have a new emulsion design vs the "old" diazo films. The new emulsion designs require better developer control to insure full development of the films emulsion. Superior resolution properties are the result of reducing the matte particulates while still allowing for air evacuation during the contact exposure stage (both from the silver master to the working Phototool and during the imaging step for on the production floor). The medium orange color emulsion was specifically designed to fall between the darker style emulsion diazo films and the lighter style diazo emulsion films for ease of registration to
the panel. It should be noted that the actual visual color of the film(s) has no relationship to the UV light blocking ability. Manufacturer D-Max release specs are in excess of 4.5 D-Max which is more than adequate for any and all imaging applications - from dry film photo resists to liquid photo imageable solder mask inks. The mid range color is actually a significant benefit on the production floor allowing for easy visual registration verification on the panel.

On the processing side it is pretty much business as usual. You expose, develop, and touch up in a similar manner as with past diazo films. However care should be taken in all of these areas to achieve optimum results. Let’s walk thru the entire process as a review.

In the artwork generation/photo lab: Starting with either a diazo or silver master you first want to inspect it for any damage - touch up any pin holes or scratches. Verify image acuity/sharpness and check for any visible damage - re-plot your silver master if you encounter any fuzzy/blurred lines or creases or dents on the film.

Next clean the master with the appropriate film cleaner. Clean the exposure unit to reduce any imaged on defects caused by dust, dirt, lint, etc. Center the films in the contact vacuum frame emulsion to emulsion and start the vacuum drawdown. I recommend increasing the drawdown time to a minimum of 60 seconds and preferable 120 seconds. With less matte in the emulsion air evacuation during this drawdown stage requires a little additional time. Check for Newton rings over the entire film surface - this insures a good contact and that the resulting image will have crisp sharp line edges on the diazo duplicate. (Note that if you have used a Stouffer 21 step wedge to verify the correct exposure time you want to see a clear step 1 and 2 with a visual step 3).

Moving to the development stage make sure the developer has seen the proper warm up time of approximately 30 minutes and then verify the developer "film plane" temperature (what the film actually seeing going through the developer - this can be verified using temperature tapes - disregard the thermometer on the side of many developers as this only indicates the tank temperature - not the film plane) you want a minimum of 155 degrees F and a maximum of 165 degrees F. Verify that the metering pump is delivering 15-17 cc/ml in 10 minutes. I recommend using 28 to 30 "Baume A" ammonium hydroxide (not technical or diazo grade). Now pass the film through the diazo developer.

With the improvement to the diazo chemical resistance feature, I recommend a minimum of 4 passes thru the developer to ensure complete development. Keep in mind that unlike a silver film, diazo cannot be over developed - hence if there is any question as to whether the film is completely developed just pass it a few more times thru the developer. (Note - if you are using a densitometer to verify D-Min and D-Max remember to first perform a "burn back" on the diazo by placing the film base toward the exposure lamp and exposing at 2 times the original exposure time setting BEFORE taking you density readings)

Next visually inspect the film for any imaged on defects and touch up accordingly. Clean the film; place it in a protective sleeve. You are now ready to send the film to the production departments.

This article first appeared in PCD&M. JEFF JARVIS is the Global Business Manager for Exopack Advanced Coatings. He can be reached at Jeff.Jarvis@Exopack.com.