McGRAW COLORGRAPH

SYSTEMS

FOR GRAVURE ETCHING

McGraw Colorgraph Co.

GRAVURE PROCESSING INSTRUCTIONS

Type 37: A general purpose, medium contrast carbon tissue recommended for continuous-tone and hard dot single-acid etching, which features fine grinding and controlled penetration, as well as complete freedom from frilling.

Type 44: A medium contrast carbon tissue recommended for publication and line work where higher transparency of the resist is required, also features controlled penetration and better dark effect; never requires low Baumé Irons to finish etch.

Type MAG-7: A higher contrast carbon tissue of maximum transparency and darkest color incorporating standard McGraw qualities: freedom from frilling, smoother etching and controlled penetration.

CARBON TISSUE PROCESSING INSTRUCTIONS

SENSITIZER: 3½% potassium dichromate (reagent or photo grade) in distilled water, 35 grams per liter, (4.5 ounces per gallon or 1.12 ounces per quart). The sensitizer solution must *not* have been used for another make of carbon tissue.

McGraw Sensitizer Wetting Agent, can be used at the rate of 15cc per 20 liter (one-half ounce per five gallons) of sensitizer to facilitate wetting. If any other brand of photographic wetting agent is used its concentration must be limited to one part per 100,000 parts of sensitizer.

SENSITIZING TIME AND TEMPERATURE: Sensitize carbon tissue gelatin side up, gently rubbing the surface with rubber gloves to remove air bells, while keeping the tissue submerged. 3½ minutes at 13°C (55°F) is the total sensitizing time counted from the first wetting until the start of squeegeeing. If the tissue is sensitized by rolling, there must be a large enough volume of dichromate solution in the trough to keep the upper side of the roll immersed during the entire sensitizing period.

The sensitized carbon tissue is squeegeed to a drying support of press polished vinyl or cast acrylic plastic (plexiglass, perspex, etc.). These polished sheets which only require cleaning with 50% alcohol, ferrotype the tissue and serve as a rigid support during the drying period.

The sensitized sheet should be squeegeed firmly to the plastic. Start at the center and squeegee toward the edges for best results. With a mechanical wringer be sure the leading edge is lightly squeegeed to the plastic surface before the saturated tissue is run thru the wringer.

DRYING: Blow a large volume of air 21°C (70°F), at 60% Relative Humidity over the backing paper. Sufficient drying air will enable the tissue to strip easily from the drying support in two hours. Extending the drying time by reducing air volume or raising the absolute humidity will increase the speed and raise the melting point of the sensitized tissue.

EXPOSURE: The screen exposure, either conventional or hard dot, is approximately 500,000 ft. candle seconds. The tone exposure for conventional gravure should be approximately 400,000 ft. candle seconds. A variable area tone exposure should be approximately 200,000 ft. candle seconds. The tone exposure should be adjusted so that the maximum positive density (1.65) starts to etch vigorously in 10 seconds when the 39½°-41° Baumé Single Acid solution has wetted the resist.

EXPOSURE REPEATABILITY: In as much as carbon tissue is only sensitive to ultraviolet and blue light, any light meter or integrator used to control exposure should be filtered to pass only the ultraviolet-blue end of the spectrum. The wedge contrast obtained with a specific carbon tissue will depend on the ratio of ultraviolet to blue light in the light source used. Black Light tubes give the lowest contrast, mercury arcs an intermediate wedge contrast and white flame arcs the highest practical contrast.

COPPER CLEANING: After degreasing with a caustic alkali (2% sodium hydroxide), the cylinder should be polished with a mild abrasive such as Rottenstone, French Chalk, Tripoli, etc., followed by weak hydrochloric acid, or a mixture of salt and acetic acid (1 part sodium chloride, 4 parts 28% acetic acid, 4 parts water). If preferred, a mixture of Tripoli and salt and acetic acid can be used for polishing away any oxidation. A mineral acid should be part of the final treatment followed by a thorough rinse. The cleaned copper surface should be squeegeed dry.

LAY DOWN: Use air free distilled water, deionized water or mounting solution, (mounting solution consists of 25% isopropyl alcohol plus 8% magnesium sulphate [Epsom Salts]: 80 grams Epsom Salts added to 1 liter of 25% alcohol), and avoid excessive pressure. Begin laydown *within* one second of any wetting of the leading edge of the carbon tissue. A surface speed of 13 cm to 18 cm (five to seven inches) per second is suitable. Too slow a laydown overswells the tone image and prevents the surface from making contact. Too fast a laydown may not give enough wetting to adhere to the copper.

HOT WATER DEVELOPMENT: Wet the backing paper with full strength alcohol, drain away the excess alcohol and immediately flood with warm water. If the full strength alcohol floats in the hot water tray it will coagulate the dissolved gelatin. After removing the backing paper, continue developing at 46°C (115°F) for 10 minutes. Rapid rotation of the cylinder is desirable. Swabbing should be avoided. After the hot water washout is complete, continue rotating the cylinder in clean air free water at room temperature until *uniform cylinder temperature is achieved.*

ALCOHOL POUR-OVER: Immerse in 75% alcohol with vigorous rotation or pour 75% alcohol intermittently over the slowly turning cylinder until the resist is fully saturated. Flood the resist repeatedly over a period of several minutes. When alcohol clings to the cylinder as a smooth glassy sheet, stop the rotation and drain to a non-image space until the resist begins to dry, and then gently blot up droplets.

MOISTURE DISTRIBUTION: Alcohol saturation usually requires a full 5 minutes in 75% alcohol in order to displace excess water and shrink the resist to a safe thickness. Careful handling during staging and reconditioning before etching will ensure even penetration. Although full strength alcohol will dry faster, it will usually cause fine reticulation and permanently damage the resist.

CYLINDER DRYING: Blow a large volume of conditioned air over the slow turning cylinder in order to dry it rapidly and uniformly.

CYLINDER HOLDING AND RECONDITIONING: Protect the cylinder during staging from localized heating or moisture absorption. Recondition the cylinder before etching by rotating slowly and blowing conditioned room air uniformly over resist. Do not place the cylinder over a wet tank or in a wet etching machine because the moisture distribution will be disturbed.

ETCHING: Rotogravure Iron (acid free, containing 4% ferric sulphate) is used for the entire etching time. Hand or machine etching is suitable. It is absolutely necessary to avoid swabbing the resist with high Baumé Iron as a preliminary etching step because this destroys the moisture distribution throughout the resist and reverses the shadows. The entire conventional tonal scale is etched in a single bath of constant Baumé for a 20% to 30% longer time than the time from start to highlight penetration. The total time is programmed into the etching machine or calculated for semi-automatic operation and the resist instantly flushed off when this time is reached. Highlights will be 2 or 4 microns deep for 20% to 30% additional etching time after highlight penetration for conventional gravure. The exact percentage depends on the agitation rate of the etching system. Etching proceeds at a speed dependent upon the moisture content of the resist and the rate of agitation. A variable area tonal scale requires a 5 to 7 micron depth in the highlights and will require 50% to 60% additional etching time after highlight penetration to reach this depth. A correctly exposed resist should start etching vigorously in 10 seconds and the shadows should appear to rush in. However, the shadow tones will continue to separate during the entire etching time. McGraw carbon tissue resists have controlled highlight permeability and can be etched to completion in rotogravure iron chloride solutions in the 39½°-41° Baumé range—(suitable Rotogravure iron chloride solutions contain 4% ferric sulfate and less than 1/10 of 1% free acid).

GENERAL

TISSUE STORAGE: For maximum shelf life, store carbon tissue in a cool, dry location: 21°C (70°F) or lower. Tissue from opened packages handles best at 21°C (70°F) and 55% to 60% relative humidity.

LIGHT FOG: From sensitizing to hot water development, carbon tissue should be protected from ultraviolet and blue light. Yellow or weak tungsten bulbs and gold fluorescent lamps are practical safe lights. Light fog causes speed variation, adhesion and etching difficulties.

STORAGE OF SENSITIZED TISSUE: Protect sensitized carbon tissue from all light. Unless the relative humidity can be held close at 60%, the tissue should be wrapped in a vapor proof material, after removal from the drying support, to prevent distortion. Since sensitized carbon tissue will gain speed at approximately 7% per day at 21°C (70°F) and only 7% in four weeks at 5°C (41°F), refrigerated storage in sealed, vapor proof packages is recommended. After removal from refrigeration, moisture will condense on the package until the package is warmer than the room dew point. It should be noted: the Dark Effect and Continuing Action proceed as usual on warmed tissue and the effects are accumulative.

DARK EFFECT: The gradual gain in "speed" of sensitized, but unexposed carbon tissue — with time, is called "Dark Effect." It is a temperature-controlled effect which stops at −18°C (zero degree F). If freshly sensitized tissue is used within eight hours at room temperature or stored under refrigeration and used within eight hours of removal from refrigeration, no exposure compensation for "Dark Effect" is required.

CONTINUING ACTION: Carbon tissue gains "speed" when held at room temperature after exposure. This gain in speed after exposure is called "Continuing Action," and is greatest immediately after exposure. After one hour, the rate of change becomes very slow. If all of the carbon tissue, to be etched on one cylinder, cannot be exposed simultaneously, it is advisable to wait an hour after the end of the last exposure before starting laydown. This will minimize differences due to Continuing Action. Continuing Action, like Dark Effect, is minimized by low temperature and can be eliminated by refrigerated storage immediately after exposure.

POSITIVES: The G.T.A. standard for continuous tone positives is .35 to 1.65, range 1.30. Since carbon tissue produces a linear gradient and does not suffer reciprocity failure, resists of identical etching characteristics can be produced from positives with different densities by changing the carbon tissue tone exposure or matching the positives' minimum densities. Non-printing margins around pictures and type are protected by the density difference between fog level and the positive's minimum density. The density of type should be controlled to 1.65 or less if the engraver does not want deeper type than picture areas. If it is not possible to control the type density, type areas should be flashed to a level of 1/60 of the tone exposure.

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McGRAW COLORGRAPH company

GRAVURE TECHNICAL BULLETIN

(SUPPLEMENTING OUR GRAVURE SINGLE-ACID ETCHING SYSTEM LITERATURE)

HOW IRON AGITATION RATE AFFECTS ROTOGRAVURE ETCHING

BRIEFLY:

(1) RATE OF IRON AGITATION DURING ETCHING DOES NOT AFFECT PENETRATION TIME FOR ANY TONE IN A CARBON TISSUE RESIST.

(2) IRON AGITATION RATE PROFOUNDLY AFFECTS THE COPPER REMOVAL RATE AND, HENCE, THE CONTRAST (SLOPE, OR "GAMMA") OF THE ETCH.

(3) FOR REPEATABILITY OF CELL DEPTH RANGES THE RATE (VIGOR) OF IRON AGITATION MUST BE KEPT CONSTANT AND UNIFORM DURING ONE ETCHING AND MUST BE REPEATABLE FOR CONSECUTIVE ETCHINGS.

METHOD:

Two identical carbon tissue resists of identical step wedges were produced side by side on one copper plate. This plate was etched in a tray of 40.5° Baumé iron with gentle and random rocking, but with continuous stroking of one of the wedges with a soft brush at the rate of one stroke per second.

RESULTS: (See figure #1) TEST #1

Matching steps opened simultaneously throughout the etch on both the gently and on the vigorously agitated resists. The cell depth range varied enormously. Note that highlight (.35) cell depths matched. Note that both etchings are smooth and linear.

TEST #2:

The above test was elaborated by producing <u>four</u> identical side-by-side resists on one copper plate. During etching in a bath of 40.5° Baumé iron with gentle and random rocking Wedge #1 was stroked with a brush once each 30 seconds, #2 was stroked once each 15 seconds, #3 once each 5 seconds, and wedge #4 was stroked once per second for the whole duration of the etch plus the Sinking Time period.

RESULTS: (See Figure #2)

As shown in the Opening Time Curves, all matching steps on each of the four wedges opened simultaneously. The Cell Depth Curves show systematically increasing cell depth slope for systematically increased AGITATION RATE. Again, note that each etching is linear.

CONCLUSIONS:

Since cell depth "gamma" is so directly and emphatically influenced by iron agitation rate during etching, it follows that:

1. **Agitation input energy must be kept constant and equal on each unit area of an etching cylinder throughout the whole of the etching period.**
2. **The agitation energy level and uniformity must be kept repeatable and constant from etch to etch if repeating cell depth ranges are to be expected.**
3. **It seems unlikely that a high degree of repeatability and uniformity can be expected from hand agitation by different operators.**
4. **In automatic and semi-automatic etching stations with air bubbling, spray jets, or contact rolling:**
   a. **Level, volume and flow rate of iron must be kept constant.**
   b. **Cylinder rotation rate must be kept constant.**
   c. **Air pressure must be kept constant (whole length of cylinder).**
   d. **Air or iron orifices must be kept constant in diameter and at a fixed and constant distance from cylinder surface.**
5. **If two or more cell depth ranges are required within a gravure house it may be feasible to achieve them by varying the agitation rate only, keeping carbon tissue exposure, iron baumé and temperatures, etc., constant.**

WHILE THIS NEW APPRECIATION FOR THE MAGNITUDE OF AGITATION EFFECT HELPS TO EXPLAIN CELL DEPTH RANGE VARIATIONS REPORTED BY SOME, IT IN NO WAY ALTERS ANY OF THE PRINCIPLES WHICH UNDERLY OUR SINGLE-ACID ETCHING SYSTEM, SINCE THESE PRINCIPLES WERE EVOLVED USING SYSTEMATICALLY UNIFORM IRON AGITATION.

June 1969

McGRAW COLORGRAPH company

GRAVURE TECHNICAL BULLETIN

MOISTURE EQUALIZATION OF GRAVURE RESISTS FOR ROTOGRAVURE ETCHING

The most important factor for uniform and controlled etching of a rotogravure cylinder is the even distribution of moisture throughout the resist: outer to inner surface, edge to edge and around the cylinder.

After the hot water wash out, the cyliner is cooled with room temperature water until its temperature is completely uniform.

In order to shrink the swollen resist to its correct thickness and displace the absorbed water, the resist must be saturated with 75% alcohol for a full 5 minutes. Either multiple pour overs or immersion with continuous agitation is satisfactory.

After staging, before etching, the cylinder should be reconditioned by rotating and blowing conditioned room air uniformly over the surface of the resist for 5 minutes.

The etching machine or etching tank should be completely dry when the cylinder is placed there — to avoid moisture pick up before etching.

The resist must **not** be swabbed with a high Baume' iron before etching starts. Any such swabbing destroys the moisture equilibrium of the resist and leads to halos and shadow reversal.

Bichromated carbon tissue has a straight line reproduction curve. This Perfect photographic reproduction can be converted into proportional cell volumes throughout the tonal scale if a rotogravure iron chloride solution of constant Baume' and specific temperature is used for the entire etching period. Carbon tissue with controlled highlight peretration enables the etching to proceed smoothly and exactly without additions to the rotogravure iron.

The McGraw percentage etching system in conjunction with uniform moisture distribution over the entire resist area guarantees the accurate predetermination of highlight cell depths.

A skilled etcher can accurately note the penetration of any specific tonal area. He cannot determine when the highlight cells reach the correct depth because the gravure cylinder etches at a rate dependent on the moisture distribution within the resist.

The McGraw Etching System sets the highlight cell depth by NOTING THE TOTAL ELAPSED TIME UP TO THE START OF HIGHLIGHT TONE PENETRATION — THEN CONTINUING THE ETCH FOR A PREDETERMINED PERCENTAGE OF THIS TIME. The percentage chosen determines the depth of the highlight cells. 25% - 30% is usual for two to three micron "Conventional" highlight cell depths. 50% - 60% added to the total elapsed time to highlight peretration, produces five to six micron "Hard Dot" highlight cell depths. The exposure of the resist in conjunction with the Baume' of the single iron etching bath determines the contrast of the etch and the depth of the shadow cells. The moisture content of the resist determines the penetration and etching rate of the resist. A correctly exposed resist will start etching vigorously in less than 15 seconds and will finish in less than 15 minutes for depths under 45 microns. The etcher does not attempt to etch for a fixed time nor does he judge a control patch differing in density from the highlight density.

COLORGRAPH TECHNICAL BULLETIN

(SUPPLEMENTING OUR GRAVURE PROCESSING INSTRUCTIONS)

HOT WATER "DEVELOPMENT" OF CARBON TISSUE

GENERAL:

The gelatins selected for carbon tissue must be "meltable" in warm water. This "melting" is of a very peculiar and interesting kind. If dry carbon tissue is heated to a high temperature in an oven, the gelatin layer will not melt - rather, it will char and carbonize.

To become meltable, gelatin must first be allowed to absorb water, molecule by molecule, into its own molecular structure. This takes time and always involves the gelatin becoming swollen.

If the temperature of the gelatin, with its absorbed water, is now gradually raised a precise temperature will be found at which the gelatin will structurally fail and slowly "melt", "run", or "wash" away.

After being sensitized in dichromate the gelatin layer of carbon tissue must still be meltable in warm water as described above.

The melting point of our carbon tissue, sensitized, is below 95^{o}F.

LIGHT EFFECT:

The basic effect of light on dichromate-sensitized gelatin is to raise the melting point of the gelatin.

Light (ultraviolet plus blue) accomplishes this dramatically. The melting point is raised from under 95^{o}F. to over 200^{o}F. - to nearly the boiling point of water. The mechanism of this molecular transformation is complex, and not well understood, but it is, fortunately, highly repeatable.

This effect is called, variously, "tanning", "insolubilizing", "burning", "fogging", "flashing", or, simply, "exposing". The important fact for gravure is that this "tanning" action takes effect from the surface of the carbon tissue straight into the gelatin layer - the depth of the effect being strictly proportional to the VOLUME of the light falling upon it. (Intensity multiplied by Time equals Volume).

If we put a continuous tone positive between the light source and the carbon tissue, the positive will "modulate" the light intensities falling upon the carbon tissue. The "highlights" (bright) will tan the gelatin deeply, while the "shadows" of the picture (dark) tan the gelatin to a remarkably shallow depth.

Thus, a geometrically perfect, bas-relief, light-tanned "image" is now imbedded in the gelatin layer. Its melting point is over 200^{o}F., while the surrounding gelatin, not affected by the light, remains meltable under 95^{o}F.

WETTING THE BACKING PAPER WITH ALCOHOL:

The only purpose of this operation is to prewet the backing paper fibers through to the gelatin. The water is now able to penetrate through the backing paper and into the gelatin. The gelatin will absorb the water, swell, and become meltable (see above). Since full strength alcohol penetrates the paper very quickly, contact with the "development" water can follow the alcohol treatment within fifteen to thirty seconds. This time is not critical.

BACKING PAPER PEEL-OFF:

Most rotogravure plants handling large cylinders start development in water heated to about 90°F. gradually building this temperature up to its terminal point (we recommend 115°F., see below). The backing paper will loosen and begin to lift away when the water temperature, measured close to the tissue, is about 110°F., assuming that the time, from first wetting with 90°F. water has been about six to eight minutes.

At this point the rotating cylinder should be slowed down and all paper backing sheets removed and discarded, and the cylinder speeded up again.

FOAM:

The foam is melted gelatin and is harmless throughout development. If any remains in the developing tray at the end of the cylinder cooling* cycle, the tray should be lowered and the cylinder flushed with clean cool water before the alcohol pour-over* begins. The alcohol is apt to "set" bubbles, after bursting them, leaving their remains as imperfections on the dried resist.

RAPID ROTATION DESIRABLE:

By "rapid" we mean a cylinder surface speed of about 100 feet per minute. This is quick enough to keep the gelatin temperature uniform during development. Combined with the gentle scrubbing action of the foam, the removal of the melting gelatin from the imbedded image proceeds efficiently.

DEVELOP FOR TEN MINUTES AT 115°F.:

Extending the developing time from our recommended 10 minutes (after paper backing removal) to fifteen or even twenty minutes, will do no injury at 115°F., but it is unnecessary. This time would be better used in the cylinder cooling operation - to achieve the true cylinder temperature uniformity, that is so important, before the cylinder drying* operation is begun. (For consistent results stick closely to the time schedule chosen.)

THE DEVELOPED IMAGE:

1. The light-tanned carbon tissue image is geometrically perfect.
2. The image gelatin is superswollen and exceedingly tender - especially its upper surface.
3. When dry, all of the image gelatin, including the upper surface will become a remarkably tough, leathery substance well able to stand up to the stresses, including swabbing, of the etching operation.

*See our Processing Instructions

SWABBING IS UNDESIRABLE:

The "color" picked up by a swab at the end of development is this tender, light-tanned, upper surface. IT SHOULD NOT HAVE BEEN REMOVED. Shops "get away" with this treatment only because they are scraping off the top of the screen wall gelatin formation. Since the screen (or hard dot positive) was exposed heavily to produce gelatin so thick as not to etch through at all, the amount scraped away by the swab is not ordinarily fatal. If the swab fibers could reach into the cell bottoms, which control the actual etching, the resulting damage would ruin the resist.

Swabbing does not accomplish what its practitioners imagine. But, thanks to the high relief of the gelatin screen walls, swabbing is not often disastrous. Since it accomplishes no useful purpose, and is hazardous, it should not be practiced.

DEVELOP AT 115^{O}F.:

The shadows in a continuous tone positive are dark (dense). They keep the light intensities on the carbon tissue at a low level during exposure. The tanning is shallow, and the developed image very thin. (Typically, nine-millionths of an inch thick, after drying.)

This thin gelatin is equivalent to the "upper surface" referred to above. It is exceedingly tender while still wet, though it will be very tough and leathery when dry. It will suffer no damage at 115^{O}F., even with long development, but it can be injured ("chewed away") and its geometric perfection upset by prolonged development at temperatures around 125^{O}F. or higher.

Since 115^{O}F. is 20^{O}F. above the melting point of the untanned gelatin which is to be removed, development will proceed quickly and smoothly to completion and the cylinder, not having been overheated, will be easier to cool.

SUMMARY:

Hot water "development" of carbon tissue consists, basically, of: prewetting the paper fibers with alcohol so water can penetrate to the gelatin; allowing the gelatin to absorb the water and to swell with it; raising the temperature to some reasonable degree above the melting point of the gelatin <u>not</u> tanned by the action of light; giving the untanned gelatin time to melt away.

Exposure and hot water development determine the <u>quantity</u> of gelatin in the image.

Subsequent procedures (cooling the cylinder, alcohol rinse, drying and holding) influence the <u>etching rate</u> of the gelatin, and will be the subject of another technical bulletin.

FOR CONSISTENT RESULTS:

Work out time schedules, temperatures and techniques consistent with the above principles and stick to them closely.

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