**Graphic Communications Technology**

## Instructional Package 505/6-13

# THE DAMPENING SYSTEM

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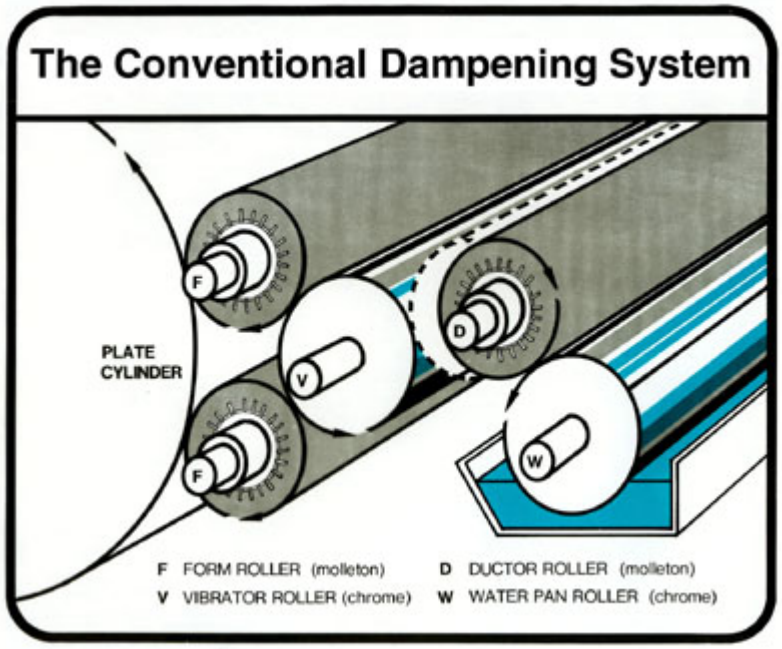
|---|---|
| Function of the Dampening System<br><br>• Moisten the non-image areas of the lithographic plate so that they will not accept ink from the ink form rollers.<br>• A typical configuration is shown at right. |  |
| Relative selectivity of image and non-image areas of the lithographic plate:<br><br>• Ability for image areas to attract ink and repel dampening solution<br>• Ability for the non-image area to attract water and repel ink.<br>• Something that attracts water is **hydrophilic**.<br>• Something that repels water is **hydrophobic**.<br>• Something that attracts ink is **oleophilic**.<br>• Something that repels ink is **oleophobic**.<br>• The GREATER the difference in relative selectivity, the less water is | |

necessary (waterless litho plates require no water because their surfaces are either completely oleophilic or oleophobic)

- A hydrophilic material that has become hydrophobic is called **sensitized**.
- To enable a sensitized area to become hydrophilic again, you must **desensitize** it.

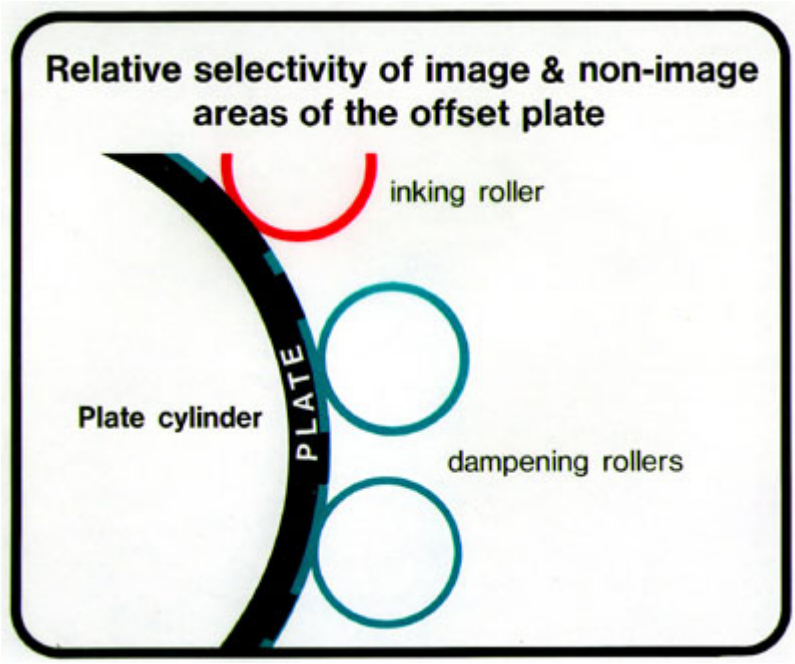
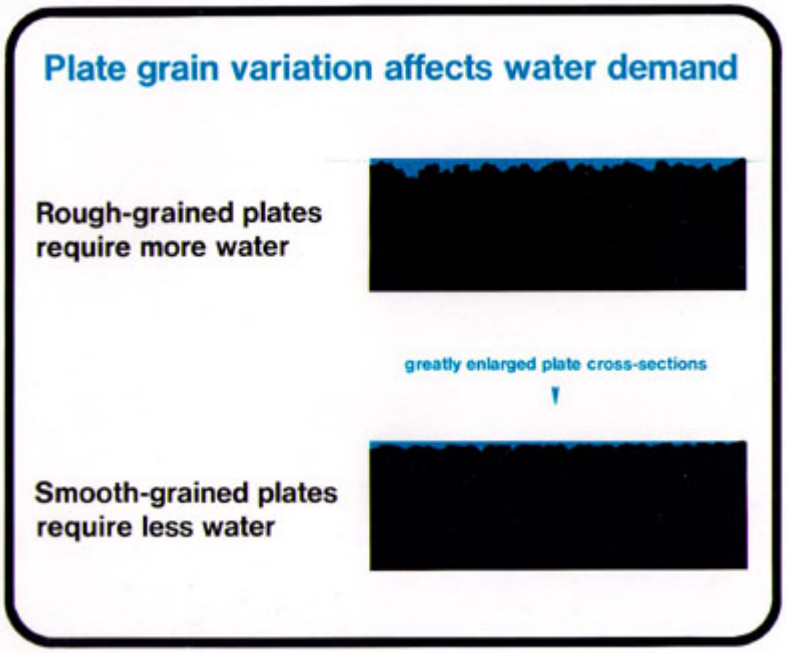



Plate Grain

- Grain is scratches or grooves in the surface of the plate material that hold water like a reservoir.
- The greater the grain, the more water is required.
- The greater the grain, the more latitude in dampening settings.

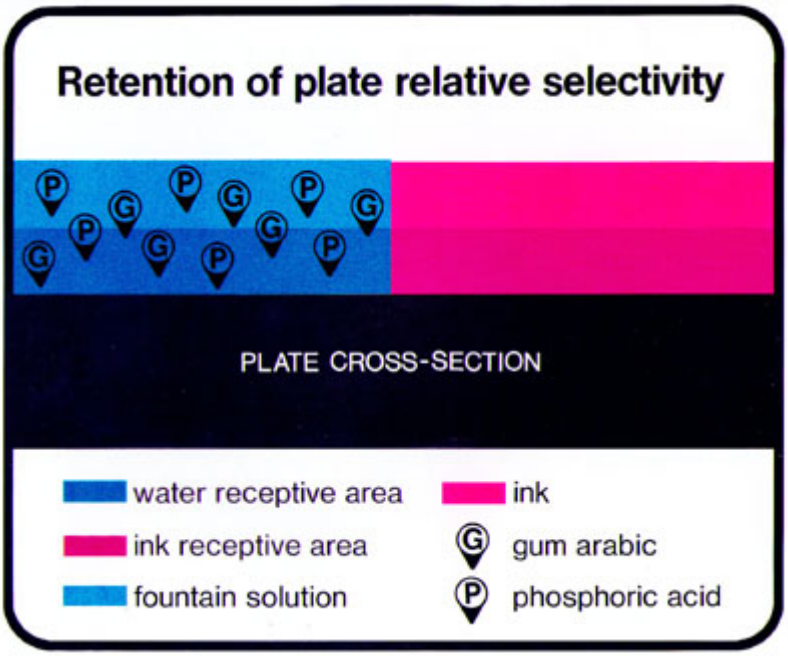



Retention of plate relative selectivity

- The hydrophilic material (non-image) of the plate gradually becomes hydrophobic during the press run (becoming **sensitized**).
- Sensitized non-image areas must be **desensitized** continuously.
- Gum arabic (the sap of the Middle-Eastern Gum Acacia tree) is a natural desensitizing agent. Gum arabic is the "sticky" that you lick on envelopes or stamps and is also an emulsifier used often in food products like candy.

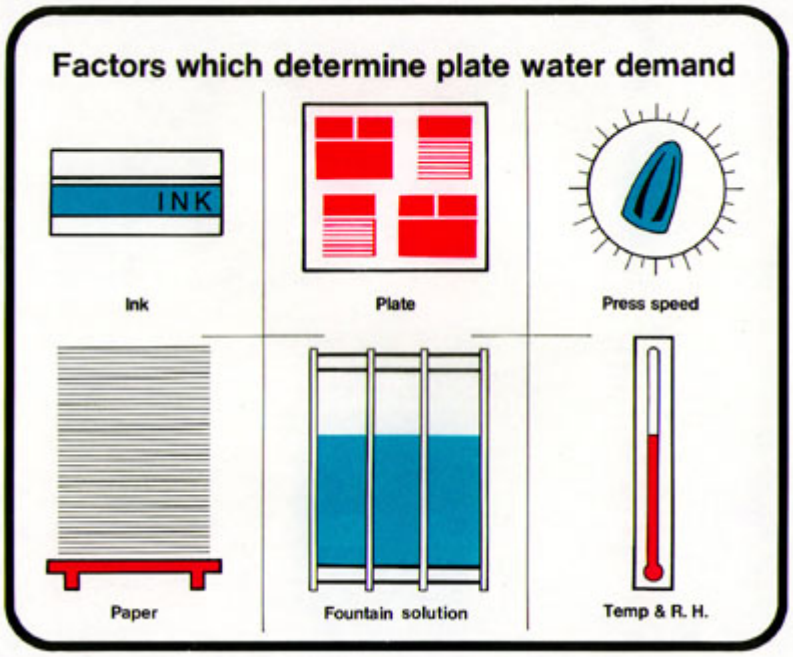
Gum arabic is also identified as "manna" in Hebrew scripture.

- Gum arabic works as a desensitizer only when it is in a mild acidic solution (phosphoric acid shown in diagram--may be other acids as well).
- Adding gum arabic and acid to the water used in the dampening causes that water to become a desensitizing agent.
- The combination of water, gum arabic, and acid is called **fountain solution** (fountain solution may also contain other chemicals).




Factors which determine the amount of dampening solution a plate requires

- Ink (more oily ink requires less water)
- Amount of image on the plate (more image results in less water demand)
- Press speed (faster speeds may result in the need for less water--less evaporation time per impression)
- Paper (more absorbent paper requires more water)
- Fountain solution (type of additives in water)
- Temperature (higher pressroom temperature results in faster evaporation leading to more water required)
- Relative humidity (higher humidity retards evaporation leading to less water demand)




- Temperature and relative humidity are the only two of these variables that are not job-specific. Thus, they can be controlled.
- Temperature and relative humidity are controlled through the proper use of air conditioning (actually invented for printing plants)

Water Balance

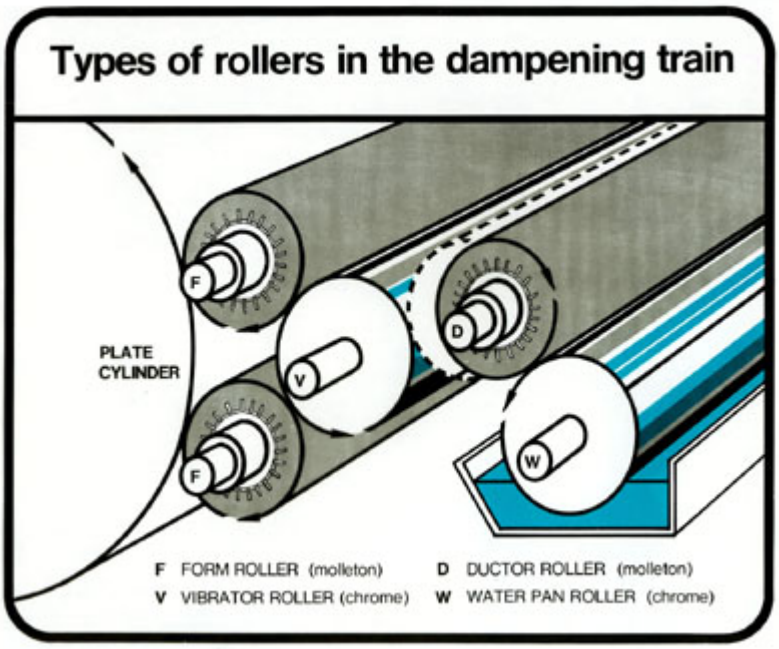
- The amount of water fed to the plate **is critical** in order to obtain good lithographic printing.
- The system used to put the water on the plate must be able to provide a constant controlled flow of dampening solution to minimize problems.
- Inaccurate dampening solution flow results in variations in color and spoiled sheets.

Types of rollers in the dampening system

- Forms: covered with absorbent paper or cloth called molleton.
- Pan (fountain) roller: aluminum, stainless steel, or chrome plated steel (best)
- Ductor: covered with molleton
- Vibrator: aluminum, stainless steel, or chrome plated steel (best)

- All rollers must be clean--free from ink--to prevent an interruption of water flow (ink is hydrophobic).

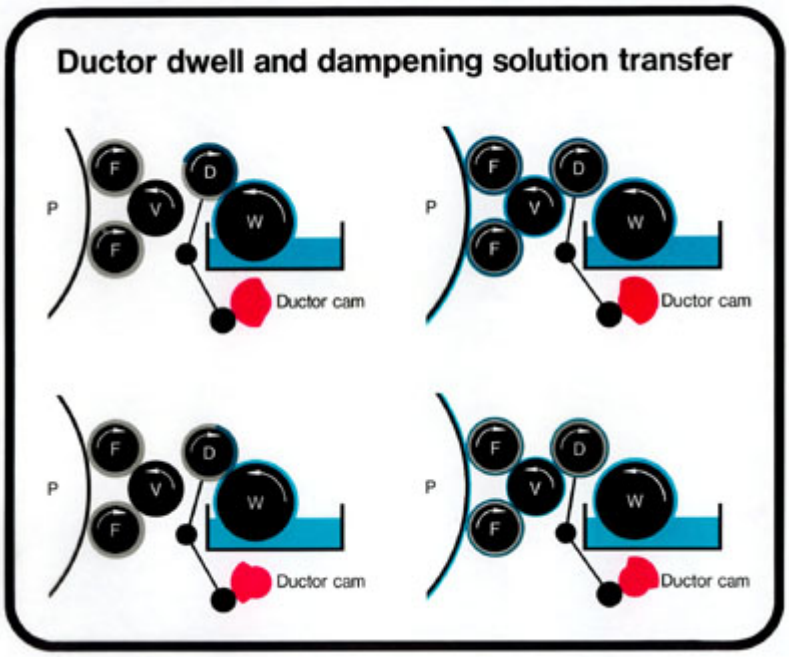
- Molleton covers soak up water in much the same way as a bath towel--once they're too wet, it takes a long time from them to dry. **This phenomenon results in the "gets-wet, stays-wet" problem** and causes changes made to the water flow by the press operator to to take effect slowly.




Ductor dwell adjustment

- Ductor dwell is the amount of time the ductor contacts the fountain pan roller.
- The ductor dwell can be adjusted to change the amount--and evenness--of the water reaching the plate.
- The top illustrations show how a long ductor dwell results in more even dampening than a short ductor dwell (shown at the bottom).

- When the ductor is touching the fountain pan roller, the rest of the system "starves" for water.
- When the freshly-dampened ductor returns to the vibrator, the system is suddenly flooded.
- This "feast or famine" results in an uneven flow which can cause sheets to vary in color **and is one of the most important problems caused by the dampening system.**

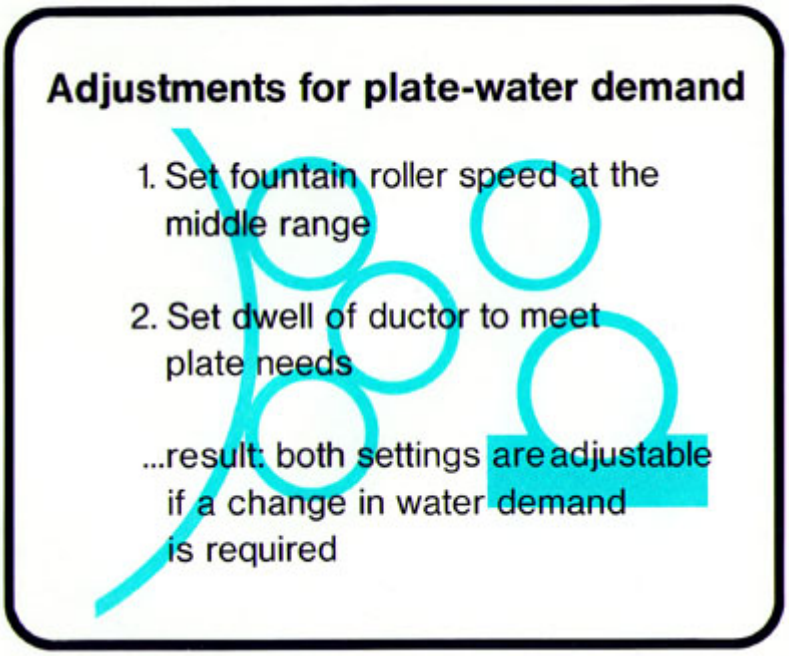



Adjustments for plate water demand

- Fountain roller movement is controlled by either a ratchet system or separate motor (better).
- Speed (motor) or "swing" (ratchet) can be adjusted to expose more or less of the ductor to water during ductor dwell.
- See settings recommended at right.

Ratchet systems only:

- The ratchet setting determines how far the fountain pan roller turns during the ductor dwell.
- The fountain pan roller turns only during ductor dwell--the roller stops turning otherwise.
- Thus, much of the water on the fountain roller slips back into the fountain when the roller is stopped. As a result, when the ductor returns to the fountain roller, the first part of the fountain roller it touches is dry.
- Therefore, constantly-turning motor-driven fountain rollers are better than ratchet driven devices.

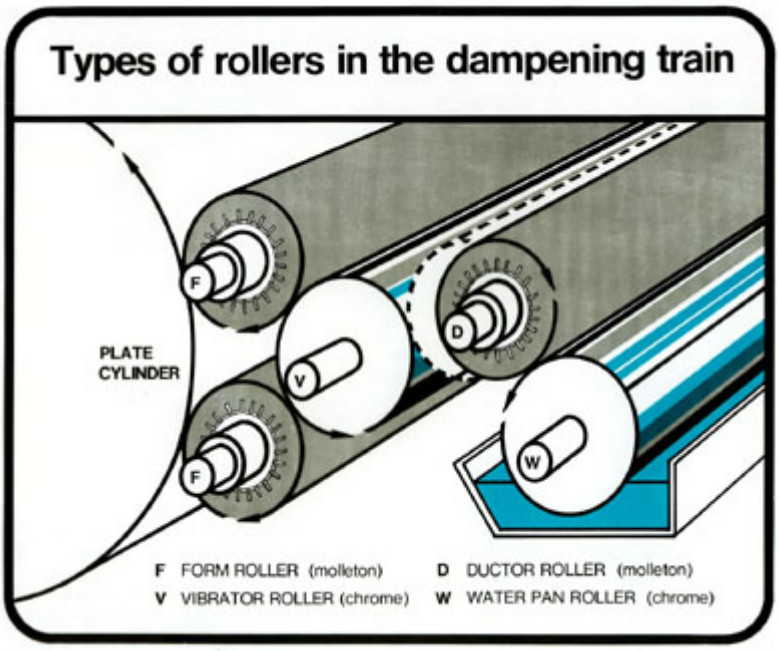



Roller settings

- For accurate water transfer, all rollers must be correctly set.
- The ductor must be correctly aligned to both the vibrator and fountain

rollers.

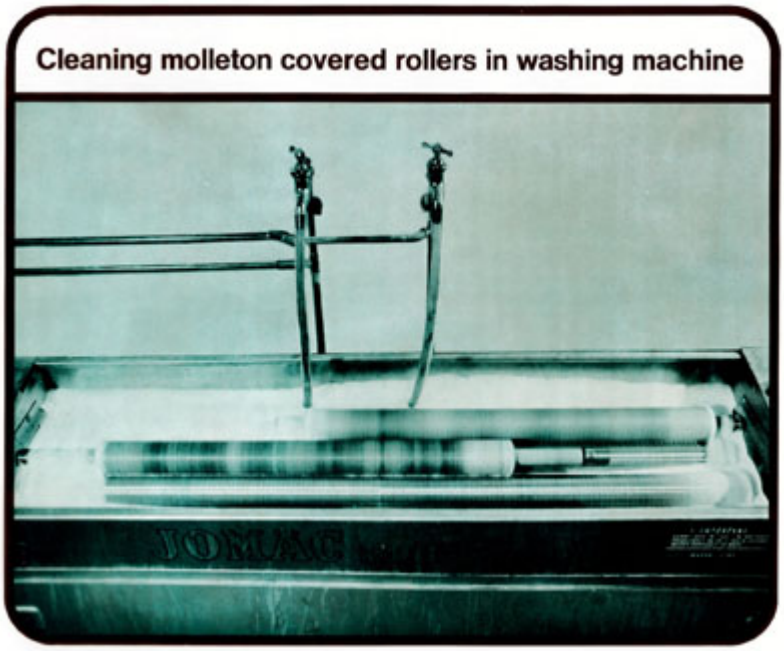
- The forms must be set tight enough to the vibrator so that the gear-driven vibrator will turn the forms without slippage.
- The forms must be set to the plate with only enough pressure to dampen the plate--no more. Excessive pressure causes a "squeegeeing" effect and will cause premature plate wear.




All dampening rollers must be clear to prevent an interrupted water flow.

At right, you see a special "washing machine" that is used to clean molleton-covered forms and ductors. A strong soap is used (as you can see by the suds).

Ink can be removed from molletons, but the fabric will remain stained.



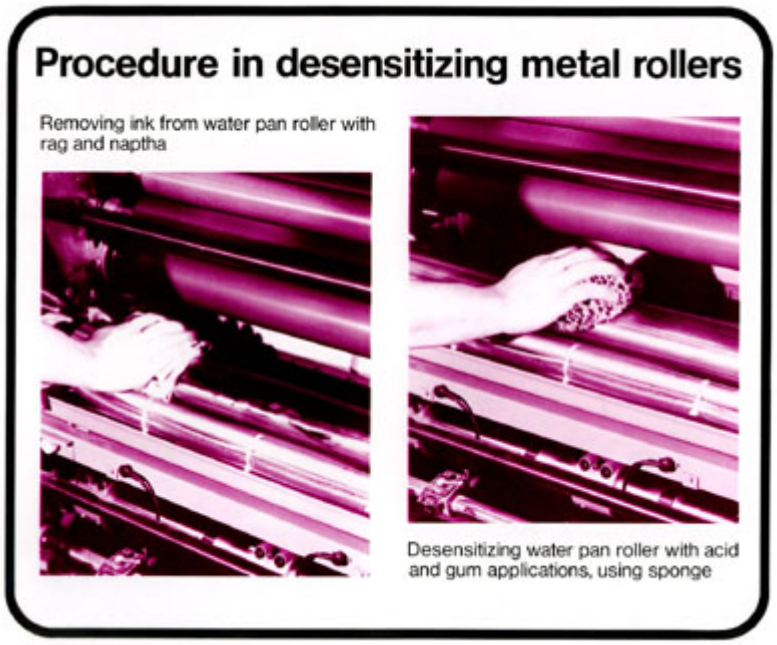

Desensitizing metal rollers in the dampening system

If metal (aluminum, stainless steel, or chrome) dampening rollers become covered with ink, the ink must be removed with solvent (ignore the "naptha" mentioned in the illustration).

Care must be taken to not allow solvent to soak into molletons.

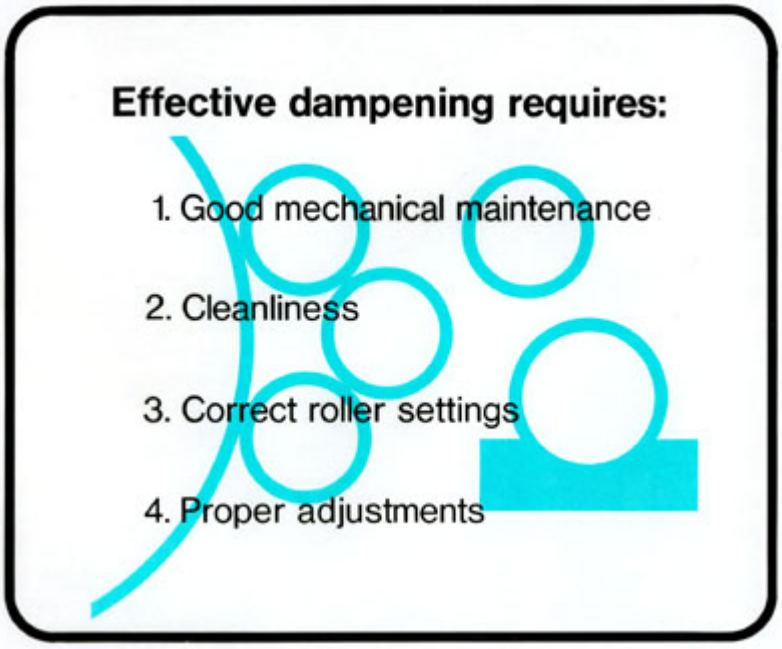
Aluminum, stainless steel, or chrome rollers must then have a solution of gum arabic applied to counteract the oily residue of the

solvent. Gum arabic **must always be buffed dry** and never be allowed to dry in streaks.




Effective dampening requires:

- good mechanical condition: gears and bearings must be clean and lubricated.
- cleanliness: ink on the rollers will prevent water flow.
- correct roller settings: either too high or too low pressures will prevent good water flow.
- proper adjustment of ductor dwell.




After several washings, molleton-covered rollers become too worn-out to be properly set against the plate. Or, the molleton can become so impregnated with ink that it must be replaced.

In the illustration, you see how a razor blade was used to start a cut in the cover. Then, the molleton is torn from end to end.

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| New molleton must be the same size as the roller being covered. The roller is tacky (sticky), so the cover won't just slip on. Therefore, a dampening cover tube must be used to slip the cover over the roller. |  |
| New molleton can either be purchased prefabricated to fit a given roller or on rolls. Roll material is more versatile than prefabricated covers because you don't need to stock as many sizes. However, roll material must be cut to length as shown. | |

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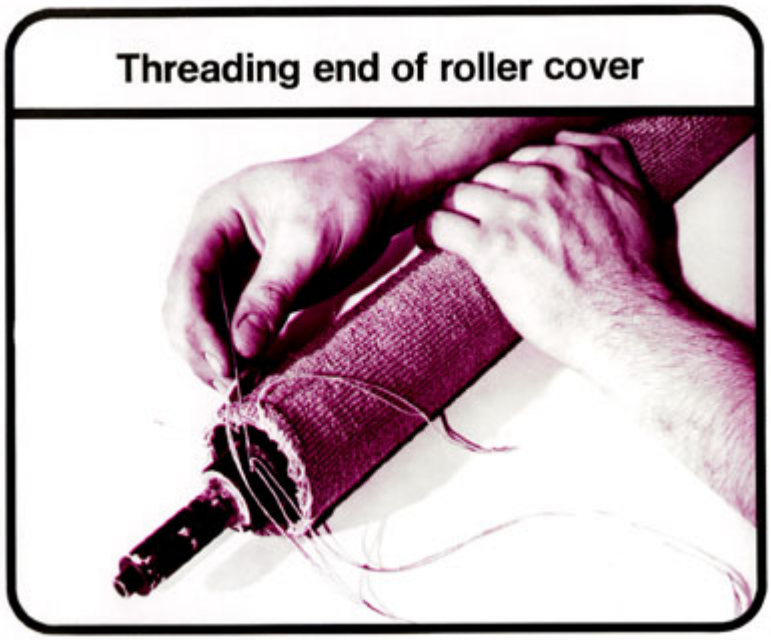
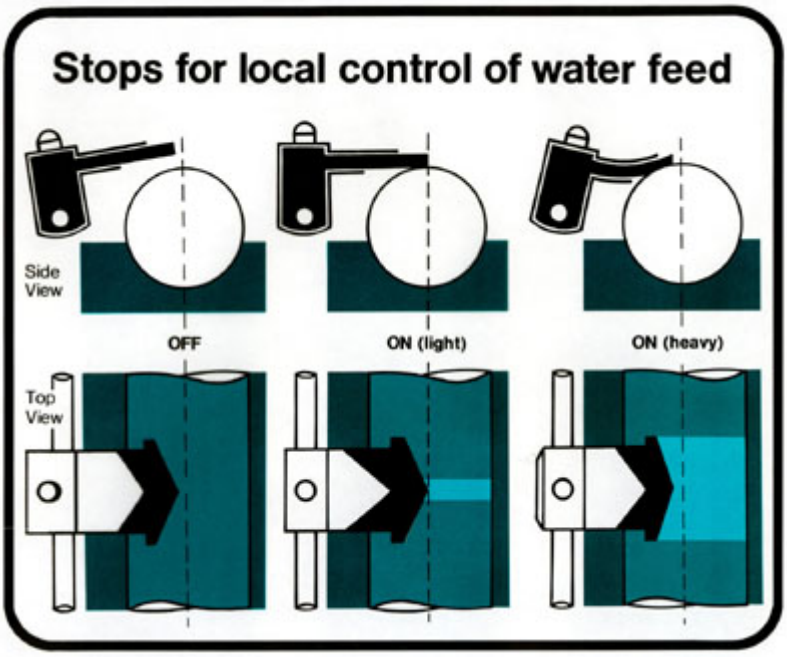
| If you purchase rolls of molleton, the cover material must have draw-strings sewn onto the ends of the roller. |  |
| Once the draw-strings are sewn onto the roller, the ends of each draw-string are pulls taut and tied. | |


Roller covers--other than roll-based molleton--are illustrated at right.

The paper dampening sleeve illustrated at the extreme right can be used on the last-over ink form as a hickie picker.

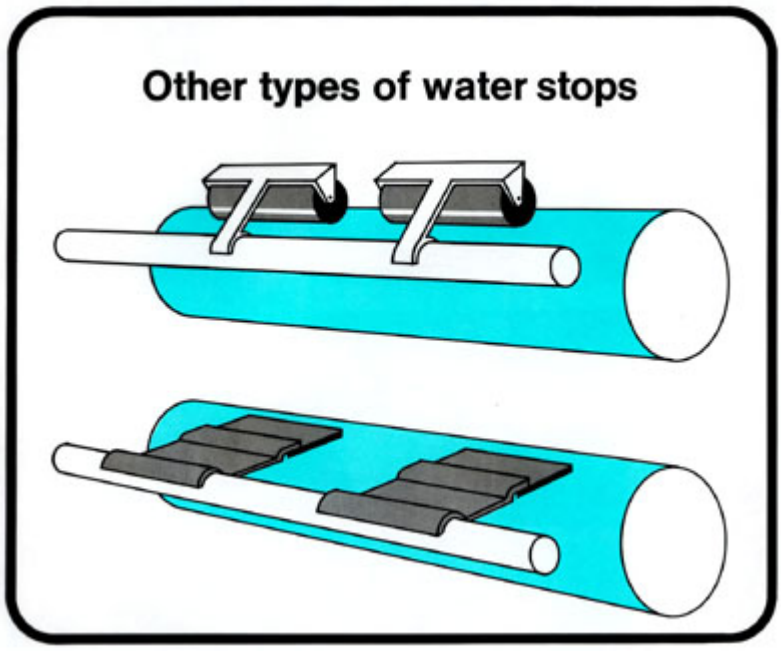

Water stops

- Unlike the inking system--which allows for variations of ink flow through the use of fountain keys or wedges--a water fountain does not allow for local control of water feed.
- The pointed-arrow type of water stop shown at right is a squeegee that can be adjusted to scrape various amounts of water off the water fountain roller.
- These pointed water stops are the most useful water stops.




Other types of water stops

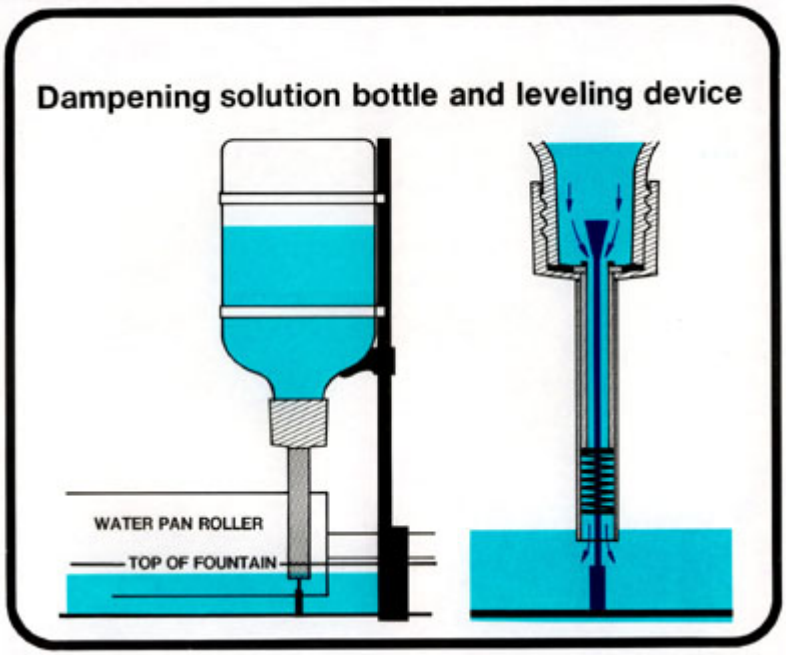
- The roller-type or flat squeegees are not adjustable.
- Flat squeegees can be cut to different widths to remove varying amounts of water.




The dampening solution bottle

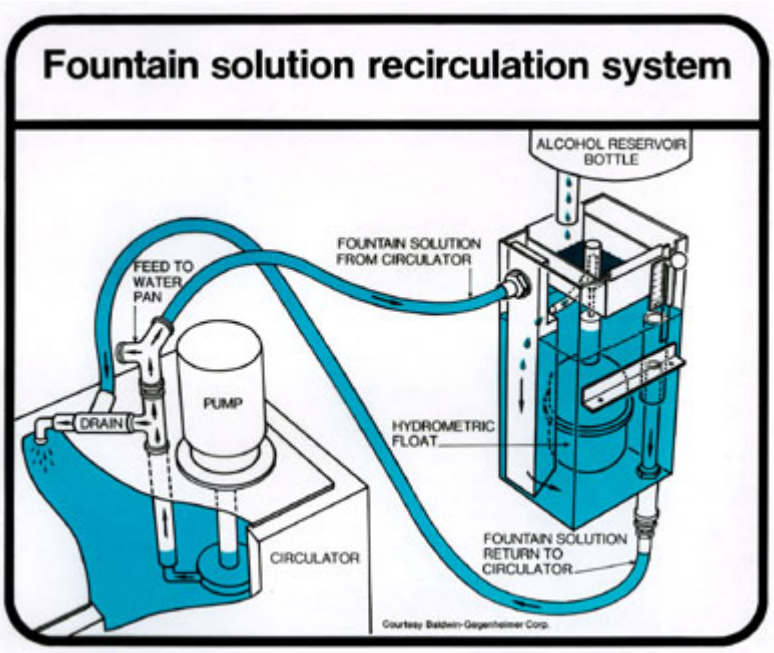
- Keeps the water in the fountain at more or less the same height.
- A spring-loaded plunger prevents the water from draining out when the press operator turns the bottle over to install it on the press.
- The end of the plunger contacts the bottom of the fountain, is pressed up (compressing the spring), and water can pass the plunger into the fountain.
- Once the water level has reached the bottom of the nozzle, no more air can enter the bottle. Therefore, the water

stops flowing (like a drinking-water bottle).
- The level of water in the fountain must drop under the nozzle so that air can enter the bottle and water can once again flow.
- Therefore, the level of water in the fountain varies--especially when the bottle is able to "gulp" air.
- The varying water level results in variations in water flow: **another major system flaw.**




Fountain solution recirculation system

- This optional system pumps water into the fountain and keeps the water height constant through the use of a stand-pipe.
- The recirculation system may also perform other functions such as refrigeration, filtration, and monitoring of solution chemical balance.
- The illustration at right shows how a system could be used to regulate the amount of isopropanol in the solution.
- Alcohol is a VOC and its use is now severely limited. Most systems now use alcohol substitutes.
- More about alcohol and alcohol substitutes later.

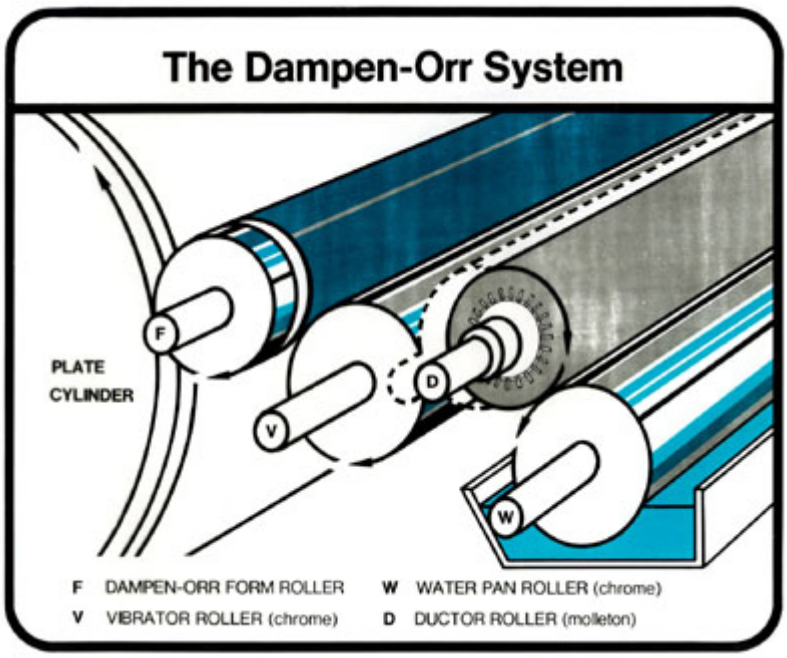



Variations of the conventional dampening system

- Over the years, several variations of the conventional dampening system were engineered to lessen many of the problems associated with that system
- The Dampen-Orr system attempted to eliminate the "gets-wet, stays-wet" problem by eliminating the molleton-covered form roller. To view a

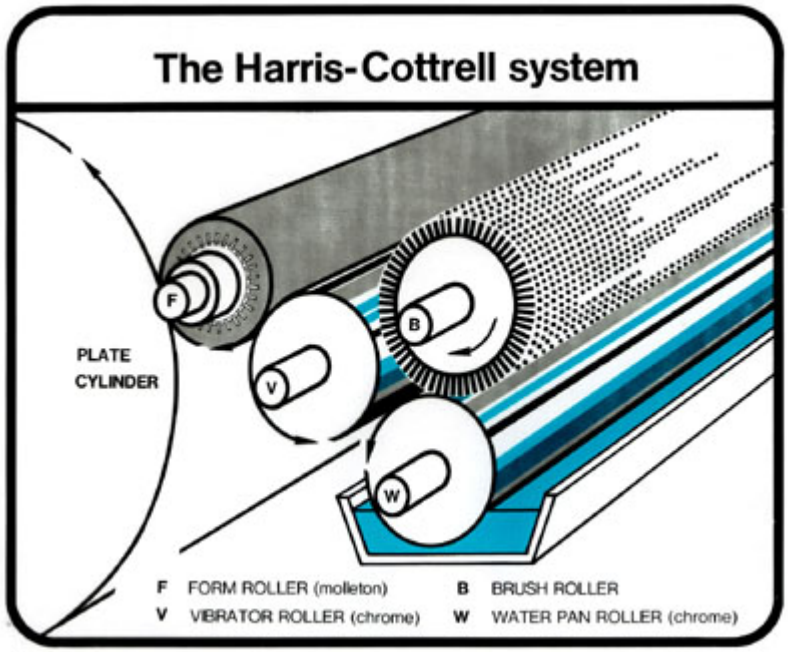
photograph of a bareback hydrophilic roller, click here.

- Because the form is "bare-back" changes to the water fountain roller speed or "swing" immediately impact the amount of water on the plate.
- At the end of the special form roller you can see a shiny ring. This ring is polished metal and is called a "bearer." It rides on a matching bearer on the plate cylinder. The result is there is no need to set water-form to plate pressure.
- The bareback form is easier to clean than molleton covered forms (no special washing machine is necessary).




The Harris-Cottrell System

- This system tried to eliminate the "feast or famine" problem by replacing the ductor with a "brush" roller that always contacts both the water fountain roller and the vibrator.
- The brush roller continuously "flicks" water onto the vibrator.
- The system doesn't solve the "gets-wet, stays-wet" problem.

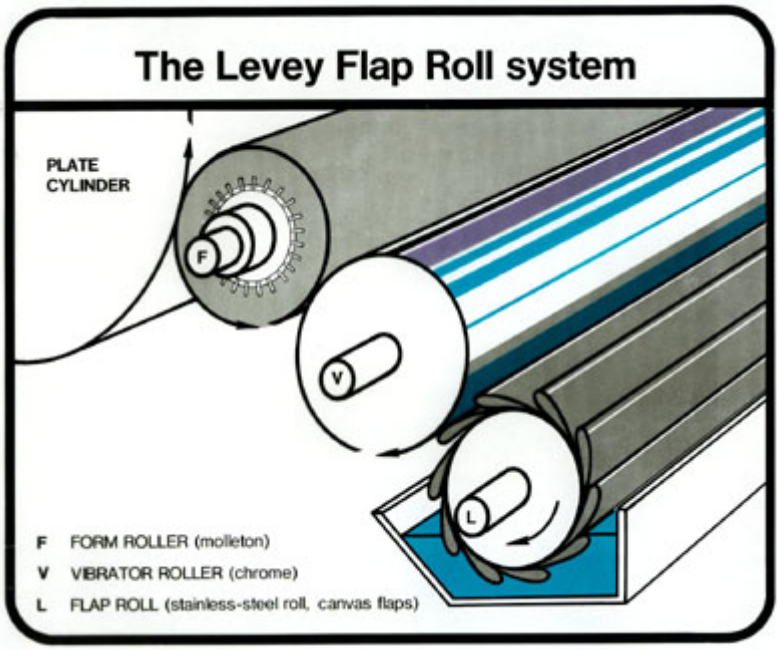



The Levey Flap Roll system

- Like the Harris-Cottrell system, this system attempted to eliminate the "feast or famine" problem.
- Canvas flaps attached to the water fountain roller "flick" dampening solution onto the vibrator.
- The amount of water fed into the system is controlled by the speed of the Levey roller.

The Spray system (not shown)

- Constantly sprays a fine mist of water directly onto the roller train.
- Nozzles must be extremely small to create a mist. Those holes plug-up easily causing streaks of non-dampened areas on the plate.



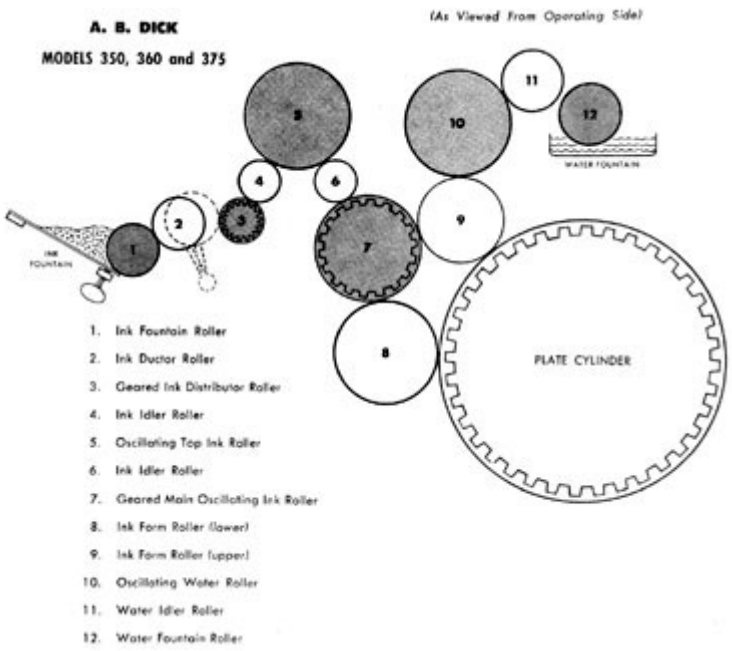

Integrated dampening systems:

- Integrated systems allow the ink and water to flow through the same system.
- Because ink and water do not mix, the water flows on top of the ink.
- All integrated dampening systems require the use of a surface-tension-reducer (surfactant) to increase the wetting-ability of the water. This reduces the amount of water that must be fed onto the ink rollers.
- Early integrated dampening systems relied on isopropyl alcohol (isopropanol) as a surfactant. Today, because alcohol is a VOC and its use is severely restricted by the EPA, most printers use an alcohol substitute instead.
- These systems solve both the "gets-wet, stays-wet"problem and most solve the "feast or famine" problem.

A.B. Dick Systems

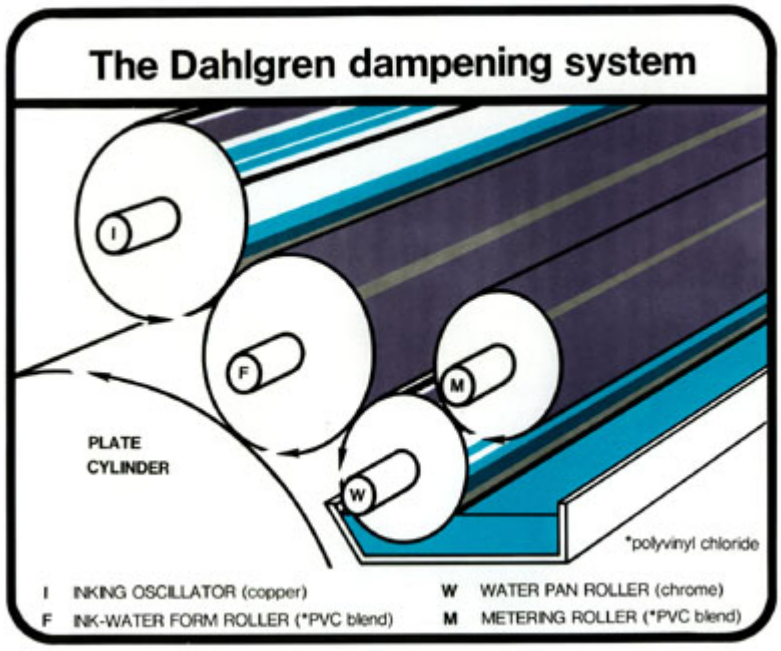
- The A.B. Dick system is a low-end integrated system.
- There are two variations: the "basic" A.B. Dick system has a copper-covered water fountain roller (#12). **It is made to be covered by ink.** Therefore, you must ink-up the

system before putting dampening solution in the fountain.
- The "Pro" A. B. Dick system has a chrome-covered "idler" roller (#11). **It is made to be covered by water.** Thus, you must **not** allow ink to touch that roller when it is dry. You can prevent the ink from touching the idler roller by turning off the Aquamatic Night Latch Handle until you are ready to print. You must also apply gum arabic to the "idler" and water fountain rollers in the "Pro" system after you wash up the press.
- The idler is really a ductor, so this problem doesn't solve the "feast or famine" problem.




The Dahlgren dampening system

- A "high-end" integrated dampening system
- This system, or a variation, is found on most modern full-sized presses today.
- A chrome-plated fountain roller directly touches a special inking-dampening form roller which deposits both ink and water on the plate. It must be in the #1 ink-form roller position.
- The amount of solution reaching the plate is controlled by a **metering** roller (both speed and pressure can be set).
- The water rides on top of the ink on the same form roller.
- The system solves both the "gets-wet, stays-wet" and "feast or famine" problems.




The Micro-Flo system

- A variation of the Dahlgren system found on many presses.
- The system solves both the "gets-wet, stays-wet" and "feast or famine" problems.

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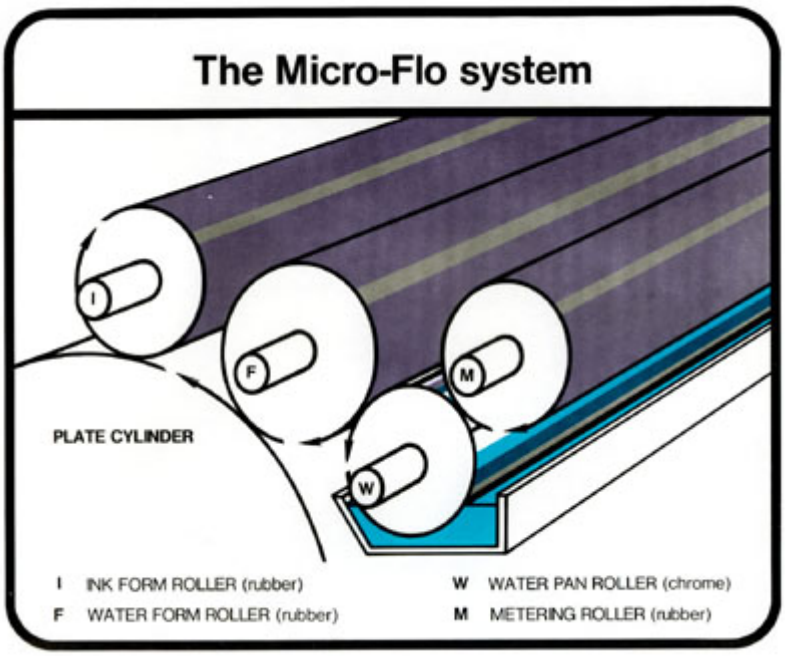
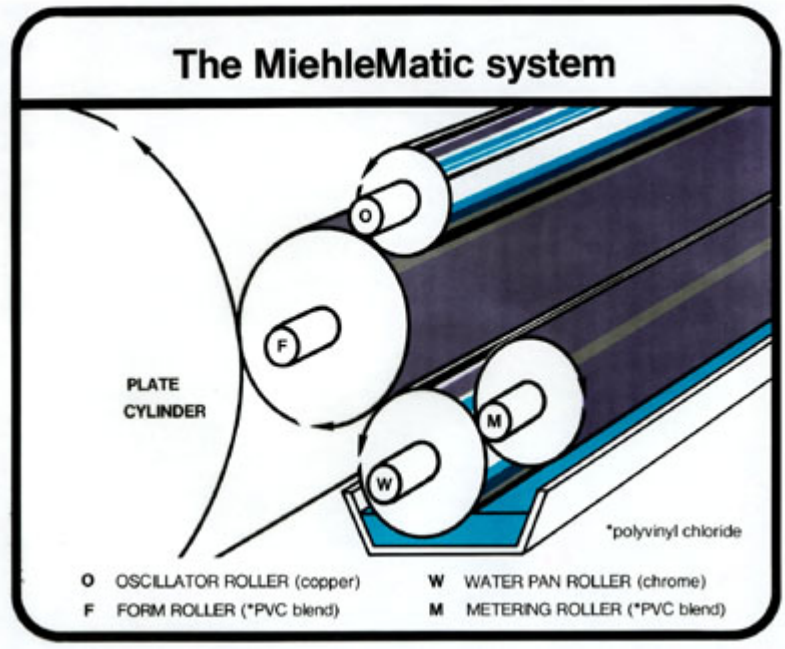
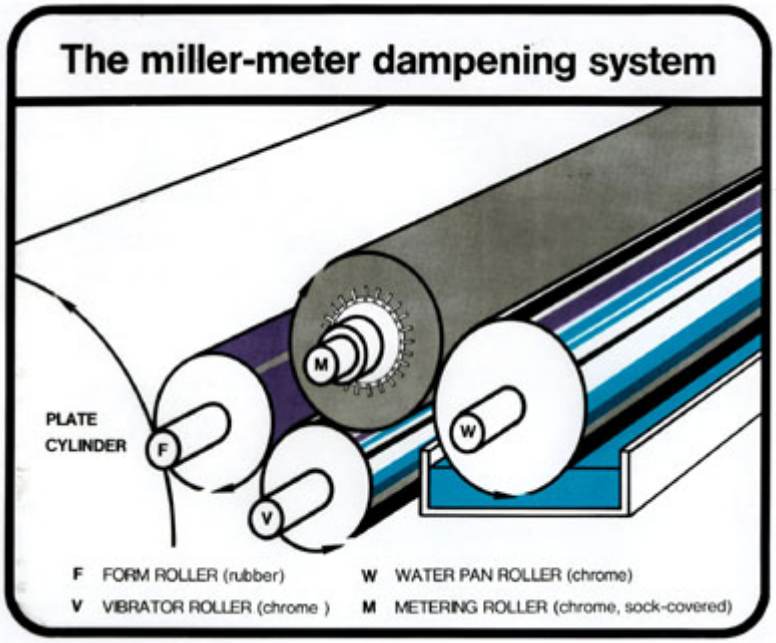
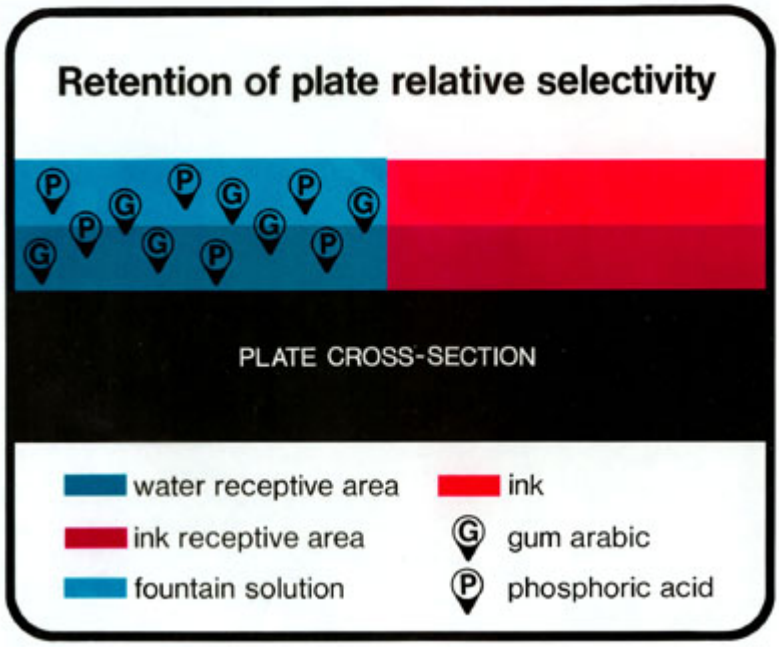
| |  |
| The MiehleMatic system<br>• A variation of the Dahlgren system found on Miehle (now MANRoland) presses.<br>• The system solves both the "gets-wet, stays-wet" and "feast or famine" problems. |  |
| The Miller-Meter system<br>• Similar to the conventional dampening system except it uses a bareback form and a metering roller instead of a ductor.<br>• Attempts to solve both "gets-wet, stays-wet" and "feast or famine" problems. | |




Need for chemicals in dampening solution besides water.

- As the plate runs, the non-image area begins to wear down.
- The worn-down area becomes hydrophobic and rejects water.
- The hydrophobic area must be returned to a hydrophilic state.




Components of fountain solution

- Water--should be **distilled** and **deionized** (the kind of water you'd buy for an iron).
- Desensitizing gum--gum arabic
- Acid
- Chemical salts
- Most press operators use "fountain concentrates" that contain all the ingredients listed above except the water. This concentrate is mixed into distilled/deionized water.

# WATER

# DESENSITIZING GUM

# ACID

# CHEMICAL SALTS

| | |
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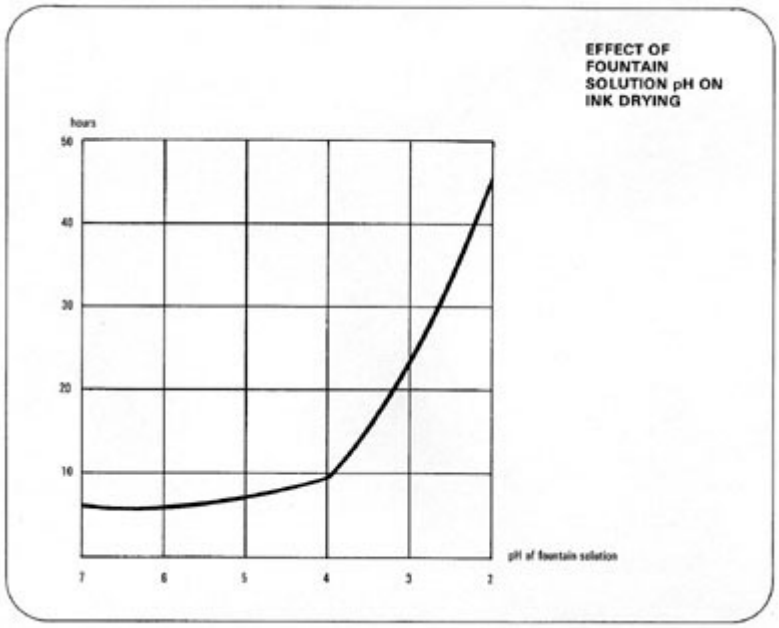
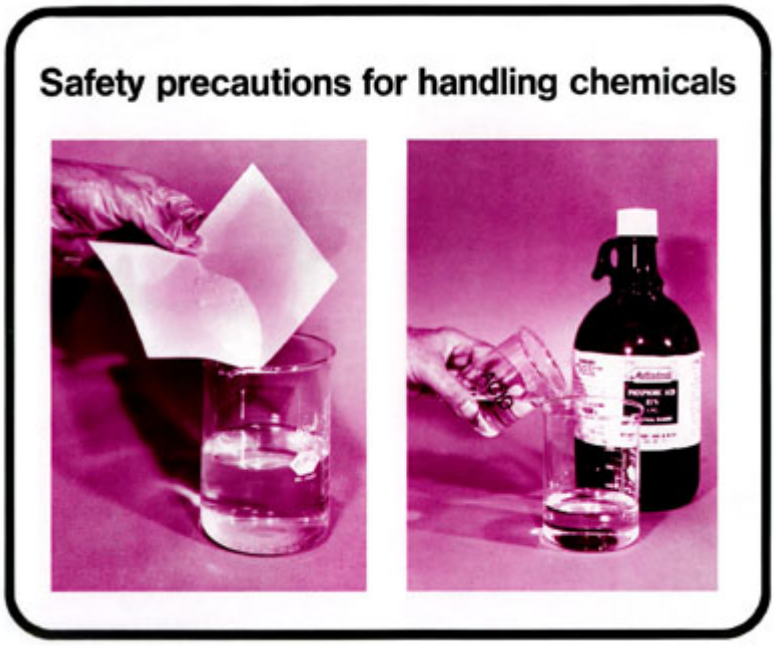
| Purpose of Gum<br><br>• Desensitizing agent--to replenish hydrophilic nature of plate material. | |
| Purpose of Acid<br><br>• To improve the adherence of gum arabic to the non-image areas of the plate.<br>• Converts the gum to "free acid" state so that it can bond better to the surface of the metal plate.<br>• In short, gum arabic does the desensitizing, but it won't work unless it is in an acidic solution. | |
| Purpose of Chemical Salts<br><br>• Inhibits the formation of corrosion<br>• Keeps the acid of the fountain solution from reacting chemically with the metal of the plate.<br>• Helps prevent stripping of metal rollers in the inking system. | |
| Importance of adding correct amounts of chemicals<br><br>• Too much gum causes roller stripping and makes deposits of gum on rollers and blankets (glaze).<br>• Too much acid **decreases the drying rate of ink and may prevent it from drying altogether.**<br>• The diagram at right shows how the strongest acid (furthest right) causes ink to take up to 45 hours to dry. |  |
| Chemical safety<br><br>• Always mix acid into water.<br>• Never add water to acid (chance for strong chemical reaction or even explosion). | |



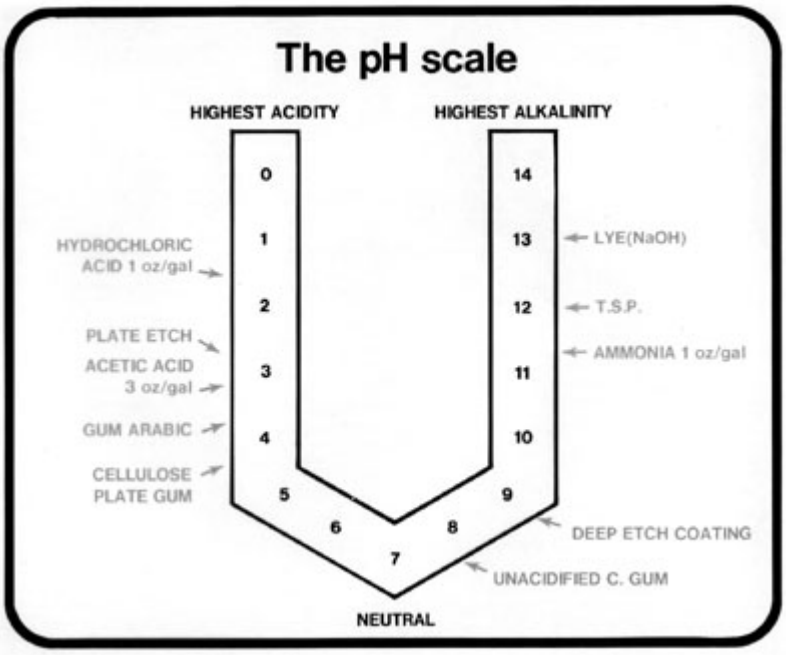

The pH scale

- Describes acidity or alkalinity (base) of a solution.
- 7 is neutral (distilled water)
- 0-6 are acidic
- 8-14 are basic (alkaline)

Scale is logarithmic

- 6 is weakest acid,
- 5 is 10 times stronger than 6.
- 4 is 10 times stronger than 5 and 100 times stronger than 6.
- Stronger acidic solutions have lower pH readings than weaker ones.

- Same holds true for bases.

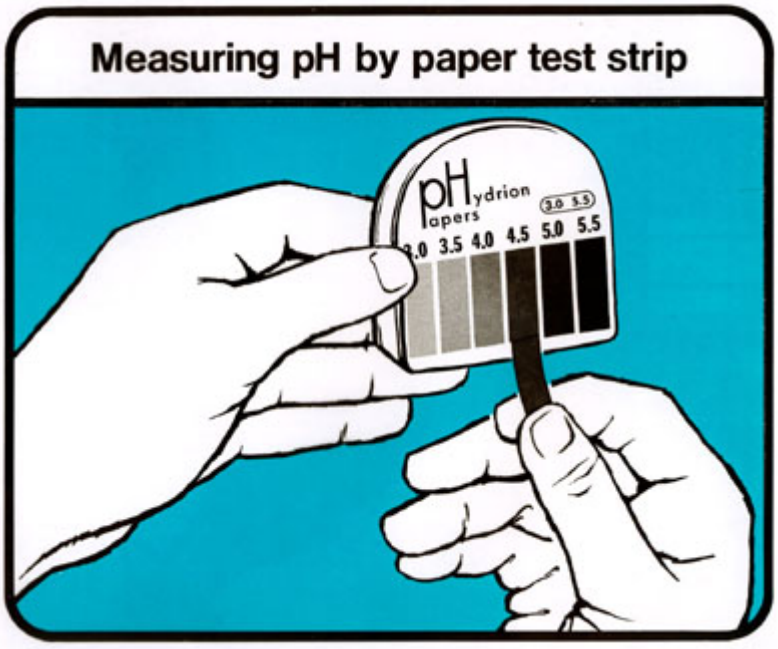



Measuring pH

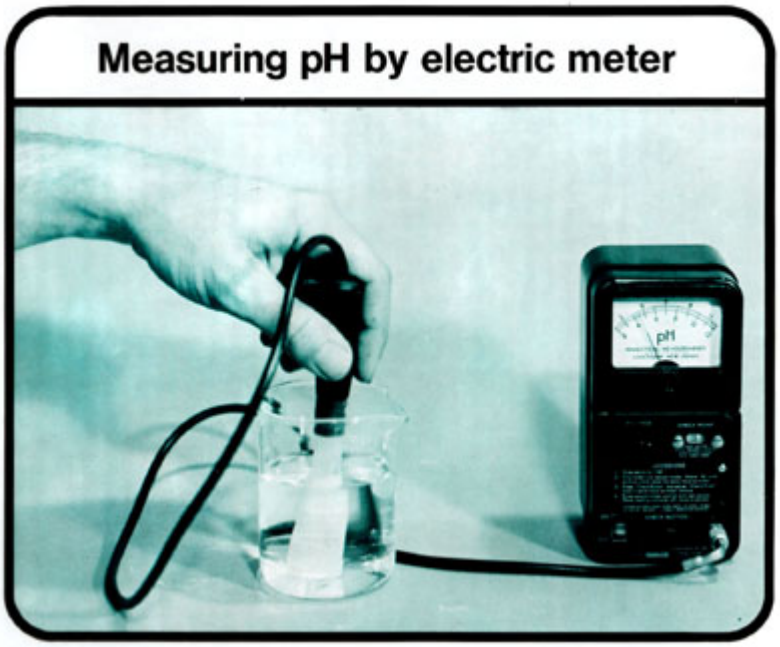
- Most fountain concentrate manufacturers recommend a pH level of about 4.5. You can measure pH with litmus paper.
- During the press run, water tends to evaporate while additives in the solution do not. **Thus, the pH level will drop as the proportion of acid to water increases.**
- Most modern fountain solutions contain a "buffer" chemical that prevents the pH reading from going

lower during the run. **However, the proportion of dissolved chemicals continues to increase even though the pH number does not indicate it.**

- Thus, press operators may also measure **conductivity,** which is the amount of electricity that a solution will conduct. The greater the percentage of added chemicals, the greater the conductivity. During the press run, the conductivity will increase as the water evaporates. Monitoring conductivity--and adding water when necessary--helps maintain a stable solution.




pH can also be measured by a meter.




Adding alcohol or alcohol substitutes to fountain solution:

- Thinner film of solution on plate because the alcohol or alcohol substitute reduces surface tension and allows beads of water to spread out.
- Prevents emulsification in integrated dampening systems--less water is required because the reduced surface tension causes the water to be wetter.
- Less solution on plate leads to less dimensional change to occur in paper.
- Less dampening solution results in faster ink-drying times.

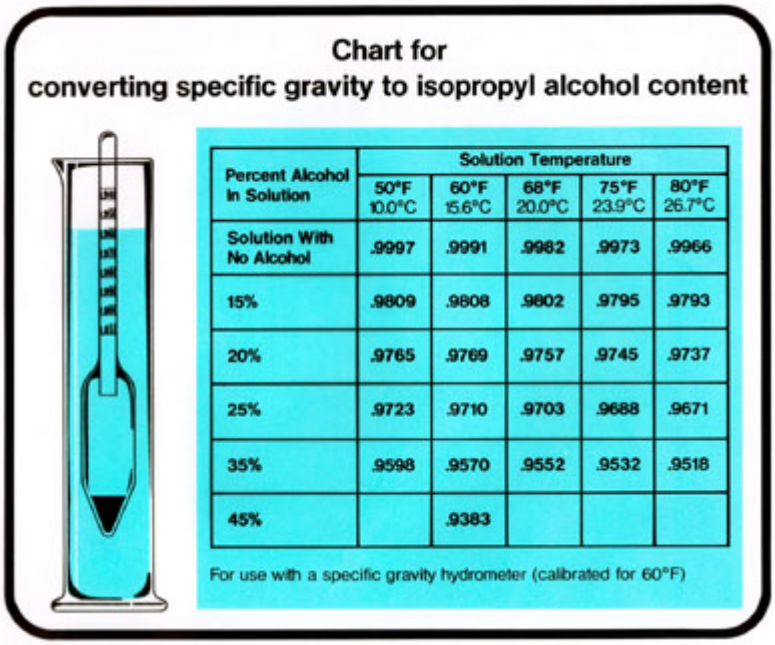
- Less dampening solution results in better, stronger ink colors.
- The proper amount of ink and water is easier to achieve.

Procedure for mixing fountain solution when alcohol is used.

- pH should always be checked before adding alcohol or alcohol substitute because those chemicals can "confuse" the pH reading.
- In the diagram at right, "fountain etch" refers to the acid.
- Remember that the water should be distilled and deionized.


Keeping track of the amount of alcohol in a solution.

- If alcohol is used in a solution, it changes the specific gravity of that solution.
- Alcohol is a VOC and evaporates faster than water. Thus, the percentage of alcohol in a solution decreases during the press run.
- The amount of alcohol in a solution can be measured by hand with a hydrometer. Alcohol can then be added manually until the desired percent is achieved.
- More realistically, alcohol levels are measured automatically as part of a fountain recirculation system's functions. Alcohol is added automatically by the system to maintain the desired concentration.

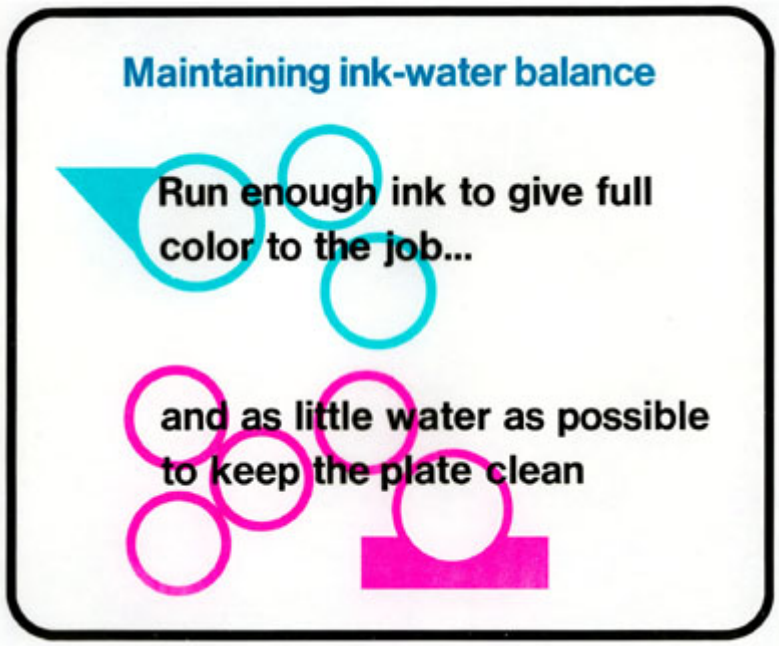



| Percent Alcohol In Solution | Solution Temperature | | | | |
|---|---|---|---|---|---|
| | 50°F 10.0°C | 60°F 15.6°C | 68°F 20.0°C | 75°F 23.9°C | 80°F 26.7°C |
| Solution With No Alcohol | .9997 | .9991 | .9982 | .9973 | .9966 |
| 15% | .9809 | .9808 | .9802 | .9795 | .9793 |
| 20% | .9765 | .9769 | .9757 | .9745 | .9737 |
| 25% | .9723 | .9710 | .9703 | .9688 | .9671 |
| 35% | .9598 | .9570 | .9552 | .9532 | .9518 |
| 45% | | .9383 | | | |

Ink-water balance

- Use the minimum amount of water to keep the non-image clean.
- Excessive water causes paper curling, emulsified ink, blotchy ink, weak

colors, and ink-drying problems
- Run the right amount of ink to provide the specified ink density.

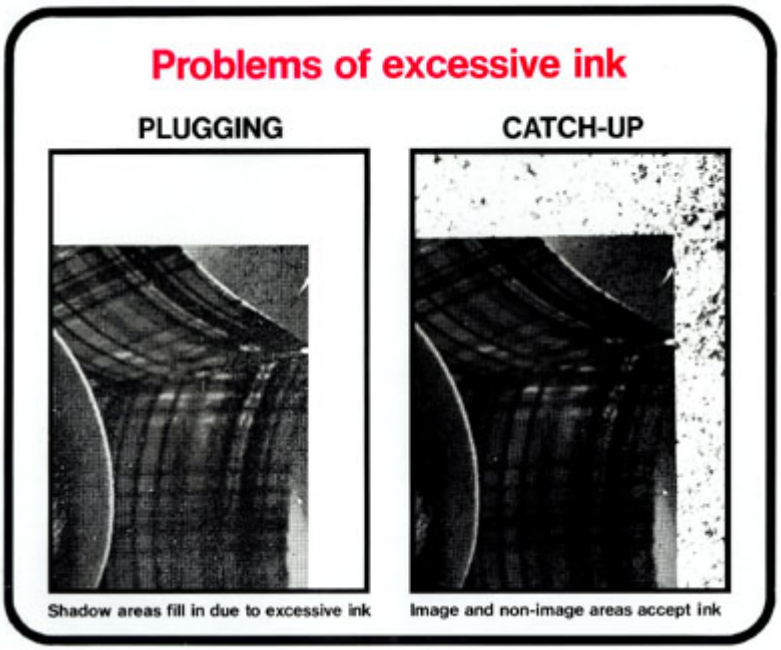



Ink-water problems

- Oftentimes, too little water and too much ink may look the same.
- Plugging is caused by too much ink (left illustration). So much ink is fed to the plate that it "oozes" off the image onto the non-image areas.
- Catch up (commonly called scum) is caused by too little water (right illustration). The non-image area is not wet enough to repel the ink from the ink form rollers.

Too much water--known as emulsification--(not illustrated) causes:

- build-up of water on the tail of the plate or blanket.
- broken "motley" areas in solids (full of tiny white specks caused by water, rather than ink, being laid onto the paper)
- beads of water floating on top of the ink in the inking system.
- dull-looking inked images




Analyzing press dampening problems

- Yes, the same process can be used to solve any problem (even dating problems!)

Emulsification

- Water-in-ink emulsification (water is worked into the ink): roller stripping, ink won't dry, snowflaky printing, chemical reaction with ink resulting in poor printing, weak ink colors.
- Ink-in-water emulsification (ink gets into the water). Too much ink fed to system, so it works its way into the dampening system. It causes the fountain solution to change color and that colored fountain solution will cause the non-image areas of the press sheet to appear lightly tinted.

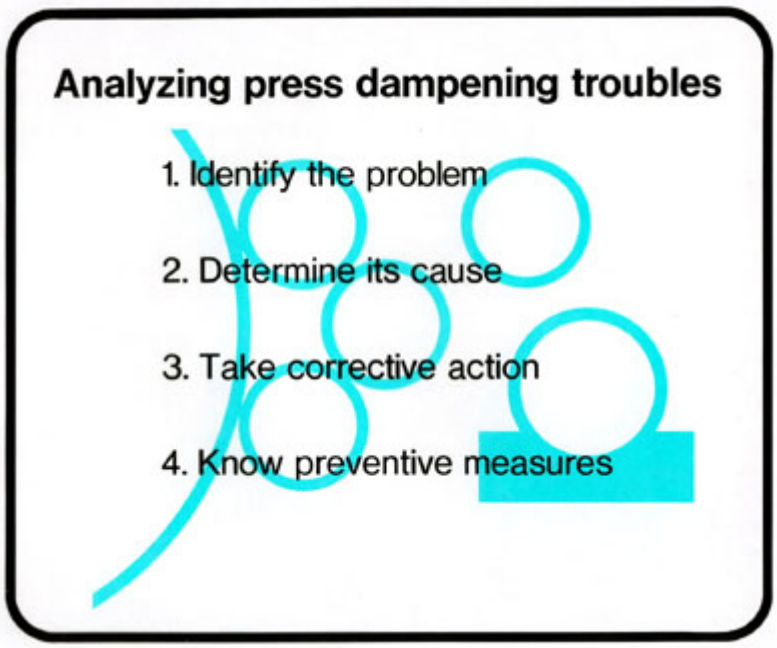



Plate scumming

- Caused by the non-image areas becoming ink receptive.
- Is a result of too little water fed to the plate.
- The ink bonds to the too-dry plate and is somewhat hard to remove unless a special plate cleaner is employed.
- Scumming will not return if the proper amount of water is fed.

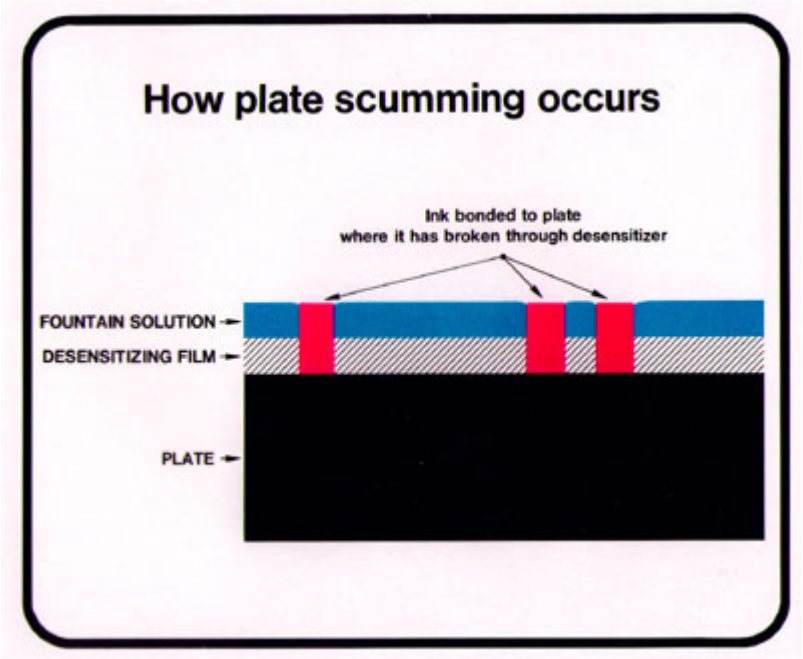
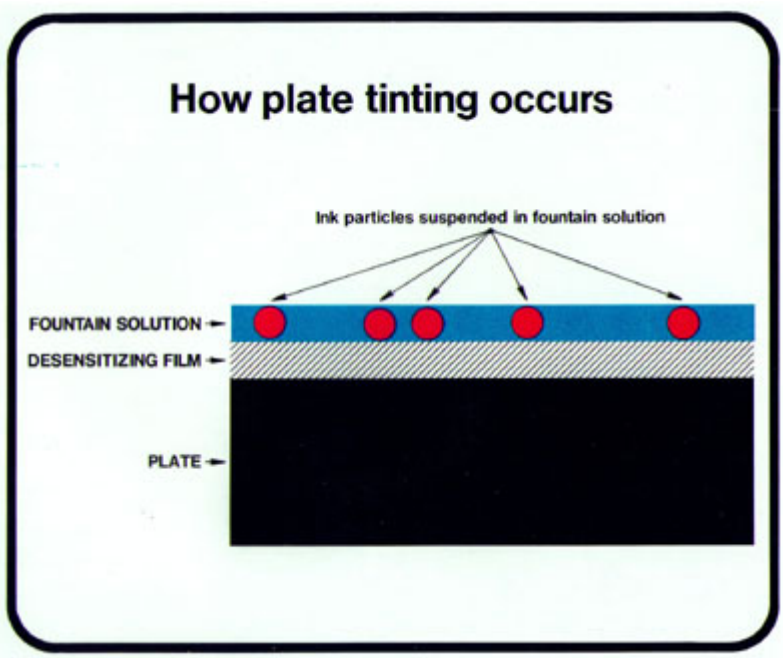



Plate tinting

- Caused by ink-in-water emulsification.
- Only remedy is to remove the fountain solution and make fresh.
- The ink, which is floating in the water, does not bond to the plate material.
- Tinting is easily removed from the plate with a damp sponge or wipe. It will come back immediately when the press is restarted.


How plate tinting occurs
Ink particles suspended in fountain solution
FOUNTAIN SOLUTION
DESENSITIZING FILM
PLATE