PRESS QUALITY CONTROL DEVICES

I. Categories of Quality Control Devices
   A. Dampening System devices
   B. Inking System devices
   C. Sheet Control System devices
   D. Printing Unit devices
   E. Paper QC devices
   F. Ink QC devices
   G. Print Quality QC Devices
   H. Devices to maintain QC in finishing

II. Dampening System devices
   A. Refrigerated circulator (deJidas page70)
      1. Cleans contaminants from system (ink, paper dust, and so on)
      2. Refrigerates liquid
         a. Maintains alcohol level (alcohol evaporates at a lower temperature than water) — automatically replenishes alcohol level to present percentage using built-in hydrometer.
         b. Helps prevent evaporation of water (evaporation leads to a stronger solution in terms of conductivity and pH.)
      3. Maintains constant fluid level in fountains
   B. pH meter (deJidas page 77)
   C. Conductivity meter (deJidas page 78)

III. Inking System Devices
   A. Durometer (deJidas page 63-64)
      1. measures 0–100˚. 100˚ would be an inflexible material such as cast iron
      2. Forms are softer (lower number) than distributer roller.
      3. A roller's durometer will increase about 10–15˚ during its lifetime
         a. commercial deglazing solution can often reduce a roller's durometer.
   B. Air Curtin
      1. A device that directs streams of low-pressure air against a strategically located roller to evaporate excess water.

IV. Sheet Control System Devices
   A. GATF Side-Guide Marks (deJidas page 277) (also use real example)
      1. Use for image-to-sheet registration checks
      2. Test of side-guide misregister (show on board)
      3. Test of front-stop misregister (show on board)
   B. Register marks
      1. Use for image-to-image registration check on multi-color press.
      2. Use for image-to-image registration check on single-color press.

V. Printing Unit devices
   A. Micrometer for measuring the thickness of paper, plates, and packing sheets.
   B. Paper micrometer
      1. has wider jaws to prevent crushing of paper that a machinist's micrometer can cause
   C. Cady gauge (deJidas page 150)
      1. Micrometer with wide throat for measuring the thickness of blankets other than at the edges
   D. Packing Gauge (deJidas page 151)
      1. Only give a brief overview—a major topic in Press II.
   E. Torque wrench (deJidas page 180)

1. To apply proper tension to blanket

VI. Paper QC devices

A. Likely to be found in pressrooms

1. Hygroscope (deJidas pages 208–209)
    a. Tests moisture content of the inside of a stack of paper.
2. Thermometer—check for consistent temperature in press room
3. RH meter
    a. to check humidity-level of room
    b. Refer to chart of page 210.
4. Antistatic bar
    a. Used in feeder or feedboard to decrease chance of static-charged paper from sticking to the feedboard.
    b. Used in delivery to neutralize static in paper that might cause sheets to stick to one another in the delivery exacerbating setoff.
    c. Can be combined with air blast or vacuum to clean dust particles from paper before sheets are printed.
5. Micrometer
    a. Special thickness gauge for paper and plates has a wider jaw than a machinist's micrometer to prevent compressing paper, blankets, plates, etc.
    b. Bench micrometers (also known as blanket thickness gauges) can be used to measure the thickness of paper in various places over the entire sheet.
    c. Some micrometers now have digital displays.

B. Devices found in paper manufacturers but not likely in a printing plant.

1. Brightness meters (IGC page 3)
    a. Brightness is the percentage of 457nm (blue) light that is reflected from a paper.
    b. Brightness is not whiteness, which is the equal reflection of red, green, and blue light.
    c. A paper that is bright does not appeared yellowed.
    d. Brightness should be uniform because it affects the contrast, color values and attractiveness of a printed product.
2. Colorimeter
    a. Measures the color of paper, ink and printed ink.
    b. Important test for uniformity of a paper's color from batch to batch and during production run.
    c. Results are given in the standard CIELAB color space (X,Y,Z; L, a, b) values where X,Y, and Z are standard colors combined to create other colors, L is the luminosity of a particular color, a is the amount of a red–green hue channel in a color, and b is the amount of blue–yellow hue channel.
3. Glossmeter
    a. Gloss is a measure of a sheet's shininess or lustrousness. When paper is very flat, the light rays reflecting from it are reflected as parallel rays—a mirror-like action called specular reflection.
    b. Gloss is the amount of light reflected from the paper when the angle of illumination equals the angle of reflection.
    c. Specular gloss is measured at 75˚ The paper is illuminated with light at a75˚ angle and measured at an angle of 75˚ by a photocell. Shiny papers reflect from 15%–75%.
    d. Contrast gloss is measured at 57.5˚ in the same way that specular gloss is measured. Contrast gloss measurements are used for low-gloss papers.
4. Opacimeter
    a. Opacity is the property of paper that obstructs light transmission and the show-through of printing.
    b. Insufficient opacity and the resultant excessive show-through reduce printing contrast and detract from printing quality.
    c. Light striking a sheet can:
        - reflect back

- absorb into
- pass through (transmitted)

d. If transmitted light is in the form of parallel rays, the paper is translucent
e. The more light that is absorbed or scattered, the higher the paper's opacity.
f. Factors influencing opacity are:
   - composition (ingredients)
   - brightness (the brighter the paper (more blue-white) the higher the opacity)
   - color
   - basis weight (thicker are more opaque)
   - coating increases opacity
g. Opacity is tested by placing a single sheet of paper over a highly reflective surface. Light is shined on the paper and the amount that passes through the sheet and is reflected back from the reflective sheet is measured. The more light that returns the less opaque the paper.
   - A sheet that allows 98% of the light to return is 2% opaque.
   - A completely opaque paper is 100% opaque and no light is reflected through it.
h. A quick visual check of a sheet's opacity can be done by printing a solid area on a sheet (perhaps done with an ink proof press) and inspecting the show-though on the reverse side.
i. Certain grades of paper tend to be more opaque than others (papers designed for book printing are more opaque than those designed for letterheads).
j. The addition of clay or other pigment into the paper increases opacity.

5. Spectrophotometer
   a. measures the color of paper by giving a wave-length by wavelength analysis of its reflected light.
   b. a curve depicting the paper's reflection of each individual wavelength of visible light is prepared
   c. reflectivity of each individual wavelength is expressed as a percentage ratio of the same wavelength reflected by an ideal white reflectance standard.
   d. These devices are similar to those employed by paint companies to color-match paints
   e. Inkmakers also use spectrophotometers.
6. Absorbency Testers
   a. Absorbency is the ability of paper to take up fluids
   b. inks must penetrate paper to properly adhere
   c. A Penetration Volumeter is used to check absorbency oil
      - liquid is allowed to penetrate into paper
      - as the liquid penetrates the paper, it drives out the air contained in the paper
      - the amount of air displaced is measured to give a measure of the absorbency
7. Densometer—Also Porosity Meters
   a. Measures how long a given volume of air takes to pass through the pores of the paper.
8. Expansimeter
   a. Measures dimensional stability
   b. No paper is completely dimensionally stable—they all will change size with changes in moisture content.
   c. Paper is designed to have best dimensional stability at 35–50% humidity. Humidity levels higher than 50% can cause the "built-in stresses" designed into the paper to relax, thus allowing dimensional change.
   d. A known length of paper is held under light tension at 50% humidity for a given length of time. The RH is changed to 65% and the elongation is measured.
   e. This test can also be used on materials other than paper, such as stripping base or film.
9. Coefficient-of-Friction Testers
   a. Friction is the resistance of a material to slide over itself.
   b. A paper's friction is not usually important during printing, but may be important for finished products such as paper bags or corrugated cartons (so they don't slide around easily).

c. The coefficient-of-friction is measured by determining the critical angle at which a sample slides down a plane.

10. Hydrostatic Testers
    a. Measure of water resistance of paper and paperboard.
    b. Some papers may need to resist water (such as a printed paper plate) while others may need to absorb water (such as paper used to print paper napkins)—mention Hallmark's gravure plant.
    c. The B.F. Perkins Hydrostatic Tester measures and indicates the resistance of materials to water penetration.
11. Linting Testers
    a. Lint originates from loosely bonded surface fibers of paper.
    b. Causes hickies and other print-quality defects.
    c. Do not confuse with picking, which is caused by excessive ink tack.
    d. Linting Testers determine the extent to which paper has a tendency to release dust, particles of coating, and paper fibers during printing.
12. Moisture Meters
    a. Determines moisture content of the paper
    b. Paper's moisture content is more important to the papermaker than the printer—the printer is more concerned about the balance between the sheet's moisture content and the RH of the pressroom.
    c. The printer uses a hygroscope to measure a paper's moisture content, while the papermaker uses a moisture meter.
    d. Changing the moisture content of paper affects other properties of the paper as well
        - bursting and tensile strength is low when paper is either too dry or too moist.
        - tear resistance is higher when paper is more moist.
        - fold strength is higher when paper is more moist.
        - elongation (deformation) increases when paper is more moist.
        - stiffness decreases when paper is more moist.
        - Paper with less than 35% humidity cannot dissipate static electricity and becomes "magnetic".
    e. Uneven distribution of moisture in paper causes wavy- or tight-edged paper.
13. Picking Testers
    a. Although picking is caused by the ink's tack, reducing tack results in less-sharp printed images or improper trap (when reducer is added to ink), or increased costs (if press is slowed down).
    b. Paper should be able to withstand the normal tack of the inks to be used on a given press.
    c. Surface strength is the ability of paper to withstand perpendicularly applied force without rupturing. High surface strength prevents picking.
    d. Surface strength is tested using a series of waxes, each with a progressively stronger adhesive power. The weakest wax to pull fibers out of a given stock demonstrates the pick-resistance of the paper.
14. Smoothness or Roughness Testers
    a. Smoothness affects the appearance of papers—smooth look shiny while rough look dull.
    b. Test by using a sheet of the given paper as somewhat of a "gasket." See how long it takes for a given amount of air to leak by the "gasket."
15. Adhesive Tester
    a. Ability of a paper to stick to itself or another surface by means of adhesives.
    b. Important for labels
    c. Instrument measures the amount of force required to peel-off a given paper bonded to surfaces using various adhesives.
16. Basis Weight Testers
    a. Measure a single sheet of basic size paper on a specially designed scale that is graduated in units relative to 500 sheets of the same paper stock (scale automatically measures the weight of one sheet by 500 to arrive at reading).

17. Bursting Strength Tester
    a. Bursting strength is the amount of pressure required to rupture paper when pressure is uniformly applied to one of its sides.
    b. Commonly measured with a Mullen Tester.
    c. Bursting strength is a general indicator of toughness and stamina for paper.
    d. Bursting strength is most important for cartons, which must comply with shipping standards.
18. Compression Testers
    a. Compressibility is a paper's capacity to be squeezed on a flat surface and return to its prior state.
    b. Printing with a blanket compresses the paper—it must be able to snap-back to its original width—known as resiliency.
    c. Soft paper does not rebound when compressed. Hard paper does.
    d. Hard papers resist indentation from a pen, pencil, type or printing plate (Letterpress prints better with soft paper—prints into the paper rather than onto it).
    e. Using a tool similar to a roughness or smoothness tester, air is allowed to leak out when a sheet of the paper is used as a seal. Softer paper will leak slower than harder paper because the paper compresses to form a better seal.
19. Folding Endurance Tester
    a. Folding endurance is the number of double folds that a paper will withstand before it breaks under specified conditions.
    b. Paper has a greater folding endurance when folded against the grain.
    c. A strip is clamped under tension between a spring-loaded jaw and an oscillating folding head. The paper is folded back and forth an exact number of degrees. The number of such folds the paper can endure is the folding endurance.
    d. Certain applications require a very high folding endurance (menus, reference books, maps, envelopes)
    e. For many applications, folding endurance should not decrease as paper ages (permanent records).
20. Puncture Testers
    a. Paper's resistance to perforation
    b. Force required to puncture a sheet of paper with a triangular pyramid point, under controlled conditions, is measured.
21. Stiffness Tester
    a. Stiffness is the ability of a sheet to support its own weight (important for file folders, index cards postcards, bank checks, and music paper that must be held without paper leaning over)
    b. Low stiffness is required for other printed products such as napkins and book paper (which needs to allow pages to be turned).
    c. The force required to bend a sheet of paper to a specified angle is measured. The higher the result, the stiffer the paper.
22. Tearing Strength Testers
    a. Internal tearing resistance is the amount of force required to tear paper through a fixed distance after the tear has already been started.
        • Important for durable papers used for maps, envelopes, and file folders.
        • Papers with high internal tearing resistance include cover, bristol, tag, kraft, wrapping and bond papers.
    b. Edge tearing resistance is the resistance of paper to tear from the edge.
        • Very important for papers subjected to high stress, such as those used for web presses.
    c. Tensile-strength testers are used to test tearing resistance. The amount of force needed to tear a given sheet is measured. In most cases, the tear is started before the test is applied.
23. Tensile strength testers
    a. Tensile strength is the amount of stress a paper will withstand **before** it breaks.
    b. Before breaking, paper elongates (stretches) before it breaks. The elongation is measured and

expressed as a percent of the sheet's original length.

c. Papers have greater tensile strength in the grain direction as compared to the across-the-grain direction.

d. A strip of paper is held in two jaws. One jaw is gradually moved away from the other under increasing force. The maximum elongation before the paper tears is an indicator of the tensile strength.

e. Tearing and tensile tests vary primarily in that tearing tests are done to papers in which a tear has already been started—tensile strength is done to untorn sheets.

f. A special type of tensile strength test is done after the paper has already been saturated with water. It is called the wet tensile breaking strength. Wet strength is the percent ratio of wet-to-dry tensile breaking strength.

VII. Ink QC devices

A. Colorimeters and Spectrophotometers (see paper)

B. Dispersion Testers

1. evaluate the dispersion attained in premixing of ink.
2. A measured sample of ink is drawn across a glass plate by a hard steel gauge. Eventually, scratches will appear in the ink film deposited on the glass (caused by the particles of pigment).
3. Note is made where 4 scratches appear and where 10 scratches appear. The greater the distance between these two points, the wider the range of coarse particles (and the poorer the ink has been dispersed)

C. Drying-time tester

1. Such tests are not completely accurate because they do not consider press variables such as amount of water fed or the pH of the dampening solution or paper.
2. A drying print is put into contact with clean paper at short time intervals. The drying time can be measured by the length of time it takes for no set-off to occur.

D. Ink-film applicators

1. Used to check the undertone of ink.
2. Thwing-Albert Quick Peek Tester applies a uniform drawdown of ink to a selected substrate.
3. Helps press operators check the color match of ink before it is placed into the fountain.
4. Also used to compare printed ink films with the test.

E. Ink Film Thickness Gauge

1. Helps press operator measure and control how much ink is being carried
2. Thicker films result in longer drying time
3. An indicator of the quality of the ink—the thicker the film of ink required to produce a given density, the less pigment.
4. A spherical, spring-loaded lens is forced through the wet layer of ink to contact the substrate. The ink leaves a circular spot on the lens. The diameter of the spot is measured and plotted on a chart to determine ink-film thickness.

F. Fineness of grind tester (similar to dispersion test, but performed after ink is ground on the mill)

1. Proper pigment dispersal (particles are ground down into very small particles) results in better press performance.
2. Poor grinding results in piling, weaker colors, streaking, plate fill-in, scumming, and unnecessary wearing of plates and rollers.
3. A fineness of grind gauge is a flat steel block that has two flat-bottomed grooves in its surface that vary in depth from near zero at one end to maximum at the other end of the block.
4. To make the test, place a small amount of ink in the deep end of the grooves and drawn the sample toward the shallower end using a straight-edge scraper.
5. Eventually furrows or scratches will appear in the grooves (caused by particles).
6. The closer to the shallow end of the groove the that furrows or scratches appear, the better the ink has been ground.

G. Mixing Scales

1. Required to properly mix PANTONE colors.

2. Available in either balance-beam or electronic versions.

H. Tack Testers (Inkometer)
   1. Tack is the resistance of a thin film of ink to split (stickiness).
   2. Tack must be controlled to prevent picking and also to achieve proper trap.

I. Viscometers (many types of tests available)
   1. Resistance to flow
   2. Paste inks have high viscosity (offset/letterpress) while fluid inks have low viscosity (gravure, flexography)
   3. In one test, a rod is coated with ink. The rod is positioned to slide through an opening of slightly larger diameter than the rod. The length of time it takes for the rod to move a specified distance is proportional to the viscosity of the ink (the longer it takes, the higher the viscosity).
   4. Fluid ink viscosity is measured using a Zahn cup. The length of time that a premeasured amount of ink takes to flow though an orifice (various diameters of orifices are available) the higher its viscosity.

J. Abrasion (scuff) testers
   1. Can the printed ink film resist scuffing?
   2. A weighted strip of unprinted paper is moved over a printed test specimen of the same paper through a specified arc for a predetermined number of strokes.
   3. Both surfaces are examined for ink rub (smear).

K. Exposure Resistance Testers
   1. Tests printed ink film's resistance to light and weather conditions.
   2. Sample is placed into controlled atmosphere and tested with regard to fading, dissolving, and other weather-related conditions.

VIII. Print-Quality QC Devices

A. Color Control Bars (refer to page 290 of deJidas)
   1. Patches for solid layers of each process color (the six-color also has space for 2 spot colors)
   2. Patches of overprints of each of the process colors (y+m=r; y+c=g; m+c=b) to evaluate trap.
   3. Patches of specified-size screen tints to evaluate dot gain
   4. Star Targets to evaluate doubling and slur (briefly describe)
   5. Overprints of specified-size screen tints to evaluate gray balance.
   6. Press manufacturers often supply their own color bars that match ink key/wedge configuration for a specific press.

B. Magnifiers
   1. Need about a 20X magnifier for checking registration
   2. Need 50X or above for checking dot shape and size.

C. The GATF QC strip (refer to page 290 of deJidas)
   1. A solid stripe of each process color with a patch of alternating printed and blank diagonal lines.
   2. The strip on the OK sheet is placed adjacent to the same strip on the current press sheet. The stripe provides a check for:
      a. ink film thickness (lines grow fatter if there is too much ink)
      b. ink-water balance (scum shows up readily)
      c. image quality (sharpness of diagonal lines and intersection between solid area and lines)

D. The GATF Dot Gain and Slur Gauge (refer to page 290 of deJidas)
   1. Dot gain is checked by a series of numbers created by finely spaced horizontal lines of differing thicknesses on a coarse-dot background.
      a. A change in which the position that the number blends into the background indicates dot gain or sharpening.
   2. Slur target is the word "slur" spelled-out using horizontal lines on a background of vertical lines of the same width.
      a. Slur only affects around-the-cylinder size of dots/lines
      b. Thus, slur will cause the horizontal lines to thicken, but not the vertical ones.

c. Result is the word “slur” standing-out from the background.

E. The GATF Midtone Dot Scale (refer to page 291 of deJidas)
   1. A minor change in dot size in the mid-tone portions of a printed halftone causes a marked effect on the perceived tonal range of the halftone.
   2. The target consists of several crosses with 5 dots (one in the center and one in each cell formed by the cross). A number is printed below each cross.
   3. If the press gains 1%, the dots and the cross touch at the 1% location; if the press gains 10%, the dots and corss touch at the 10% position.

F. Reflection Densitometer
   1. The basic QC device in the pressroom. Depending on model it may measure:
      a. Reflection density of each of the process colors.
      b. Dot area
      c. Trap
      d. Hue error and grayness
   2. Reflection density
      a. The target density and acceptable tolerance range should be established for each job based upon the quality level (basic, good, premium and showcase) and the accepted color OK’d on the OK sheet.
      b. Density numbers are *not* fixed numbers, but may vary due to inks, paper, and image.
      c. Typical targets might be: K=1.60; C & M=1.40; Y=0.90.
      d. Density, as read in the color bars, must remain consistent across the press sheet and throughout the press run within tolerances specified in 2a above.
   3. Dot area
      a. Too much or too little ink or pressure cause printed dot sizes to vary from the dot sizes recorded on the film and plate.
      b. All presses gain to some extent due to the rubber blanket.
      c. Plus or minus tolerances must be specified in advance.
   4. Trap
      a. The amount of ink transferred to a previously printed ink film can be equal to or greater than that transferred to paper. The amount of transfer is referred to as Trap.
      b. The percent trap is calculated as follows:

$$\text{Percent trap} = \frac{D_{OP} - D_1}{D_2} \times 100$$

Where D_1 is the reflection density of the first down ink, D_2 is the density of the second-down ink, and D_{OP} is the density of the overprint.

      b. Our densitometer calculates this value automatically (give demo)
      c. Wet trap seldom exceeds 90% (as calculated with the above equation) for red and blue, but values above 90% are possible with green
         - 80–90% are most common
         - Less than 75% trap is unacceptable
      d. High trap is important, but not as important as the printed sheet matching the OK’d sheet.
   5. Hue error and grayness
      a. Hue error is the departure of a process ink from its ideal hue.
      b. Hue error is calculated by measuring the density reading of a given patch of the color in question using red, green, and blue filters.
      c. Hue error is calculated as follows:

$$\text{Hue error} = \frac{M - L}{H - L}$$

Where M is the medium density reading, L is the lowest density reading, and H is the highest density reading.

d. Grayness is the freedom of a process color from gray.

e. Grayness is calculated as follows:

$$\text{Grayness} = \frac{L}{H}$$

f. The lower the grayness of a process color, the higher is purity.

6. Print contrast ratio

a. High print contrast is an indication of good shadow contrast in a reproduction. Higher print contrast is related to higher print quality.

b. Print contrast is calculated as follows:

$$\text{Print contrast} = \frac{D_S - D_{75}}{D_S} \times 100$$

where D_S is the density of a solid (including paper) and D_{75} is the density of a 75% tint (including paper).

G. Color Viewing booth (can be part of press console)

1. To prevent misunderstandings
2. Press and area where press check is OK'd must have the same lighting
3. Standard color viewing conditions:
   a. Color temperature of 5,000˚K
   b. Color rendering index of 90–100 (how well a light source simulates daylight)
   c. Level of print illumination 204.4±43.6 footcandles (measured with a light meter)
   d. Geometry of print illumination — no glare (10–15K˚ different than viewing plane)
   e. Surround—matte, neutral gray (Munsell N8)
4. Lamps need to warm up for 15–30 minutes before an accurate reading is possible.
5. Lamps and surrounding area need to be cleaned frequently
6. Lamps last only a specified number of hours before color temperature begins to change.
7. Extraneous light can alter the controlled lighting of the booth. Install 5000˚ lamps in all light fixtures in the color viewing room and fixtures near the color console of a press.

H. Automated Process Control devices

1. Press consoles (deJidas page 295)
2. Plate scanners — scans plate to preset fountains (deJidas page 298)
3. Scanning Densitometer — scans printed sheet to measure and analyze color control bars. Each control patch is compared to tolerances. Ink-key adjustments can then be made. (deJidas page 298)

IX. Devices to maintain QC in finishing department

A. Fold marks

B. Trim Marks

C. Signature collating marks

D. Bar code (UPC Code) check

E. MICR check