Precision Automated Technology I:1966
STANDARDS FOR CUP MANUFACTURE AND MEASUREMENT

1. CUP MANUFACTURE STANDARDS

Technology for quality cup manufacturing is well established and distributed throughout the worldwide wholesale baking industry. Individual baking cups are a “low tech” item in the scope of a baking process, but the quality and reliability of cups in any automated process is critical. When cups are denested and placed by hand, the requirements are minimal. In automated denesting system, the following requirements are critical:

a. Paper media consistency
The paper thickness, finish, and moisture content must be consistent and repeatable from lot to lot. Paper rollstock should be received from the same mill, and be inspected upon arrival for the characteristics referenced above. The paper must be nonporous: 24 in/hg vacuum will not pass through one layer.

b. Outer circumference cleanly cut
Rollstock is slit and rewound into smaller rolls for mounting in an array that enables multiple sheets to be fed and presented to a 2-stage die. The sheets must be guided to prevent “wander” from side to side, resulting in miscuts. The first die stage which cuts the circumference of the paper sheets must be regularly inspected for sharpness to assure that the cut is clean and the paper layers are not ragged or crimped. Sharp dies will also reduce cup dust particulates.

c. Paper basis weight
The basis weight of the paper media (grams/sq meter) has some effect on reliable mechanical denesting as cups are larger or smaller than standard. A “standard” cup is designated at 2.00” base x 1.25” sidewall (51mm x 32mm). Standard basis weight is 39 gsm. The plant and cup manufacturer must be willing to substitute different weight papers, if testing can prove increased reliability with heavier or lighter paper.

d. Paper type
Dry wax paper has been largely replaced by “greaseproof”, “Candor”, or “slip-easy”. All current finishes applied in a consistent manner lot to lot have been proven reliable in mechanical denesting. In some cases, a request for a different paper or finish may be made.

e. Cups per nest
18 to 24 sheets per nest have been found satisfactory. Over 24 sheets generally result in reduced reliability for single-cup separation. More sheets per nest cause the flutes to be irregularly formed and crushed or crimped. The forming dies must be properly adjusted for the total paper thickness in the nest. This is not to be confused with “Nest count”, paragraph g below.

f. Flutes formed with minimal wrinkling
Adjustment and finish of the forming dies is critical to eliminate wrinkling in the flutes. Excessive wrinkling causes individual layers of paper to stick together, reducing the reliability of mechanical separation. It is impossible to eliminate all wrinkling along the cup flutes, but is should be minimized for highest reliability.

g. Nest count
This is the number of nests in a 6" (152mm) vertical stack of cups. The higher the nest count, the reliability of mechanical separation is enhanced. Nest counts lower than15 denest with decreased reliability, due to the steeper sidewall and the resulting "air gap" between the horizontal bottom layers of each nest – this results in the last 2 or 3 cups in each nest collapsing from the weight of the stack above. Nest counts greater than 18 exhibit higher single-cup separation

h. Sidewall angle
The minimum sidewall angle (from vertical) is 15º. 18º is preferred, and 20º is optimal. The greater sidewall angle reduces the force required to separate each layer. The angle should be as large as will enable the cups to be spaced across the pan, and fit in the pan cavities. Precision requires a 0.20" (5mm) spacing between the top diameters of each cup to allow for support and separation mechanism.

i. Sidewall height to base diameter ratio
Divide the sidewall height by the base diameter. Any ratio over 0.70 is more challenging to denest, due to the length of flutes that must be separated. As the ratio exceeds 0.85, mechanical denesting becomes nearly impossible.

j. Overall cup dimensions
Mechanical denesting is nearly impossible on any sidewall height over 1.75" (44mm). If the base diameter exceeds 3.00" (76mm), the cups become flimsy and unstable.

k. Rectangular, square, or oval cups
Any cup form other than round is fraught with problems. Only limited success in denesting these shapes has been achieved. Samples are evaluated on an individual basis.

l. Flute profiles
Cup manufacturers provide various flute forms: sharp, rounded, reverse, etc. Evaluation on our in-house test system can evaluate the denesting reliability of each form to determine any purported advantages. Innovation and improvements in cup forming are always welcomed.

m. Top flare diameter
The top diameter or flare of the cups is one of the more critical factors in reliable mechanical denesting. The Precision Automated Technology Standard for cup flare measurement is well established and enables Precision, cup manufacturers, and plants to use one consistent method. The measurement procedure is detailed below as "Precision Standard Cup Measurement Method ". Flare must be maintained within +/-1.0mm for reliable mechanical denesting.

n. Heat tube set
The temperature and time in the heat tube must be consistent from lot to lot. Any discoloration or scorching on the upper flutes is indicative of too high a temperature. In extreme cases, the cups are brittle and will crack along the flutes. Inconsistent heat tube set will cause erratic separation within each nest.

o. Mechanical wrapping
To assure that the cups are consistently wrapped, resulting in a cylinder rather than a cone, mechanical wrapping is required. The glue or adhesive must be strong enough to hold without slipping. There is no preference as to the wrapping material (heavy paper or cardstock) as long as the above criteria are met. Poly or film wraps are not reliable unless custom sized to maintain flare.

p. Tear strip
A tear strip is required to enable the wrapper to be "unzipped" and removed after a stack of cups are inserted into the denester magazine. The tear strip itself is usually a narrow width of reinforced tape on the inside of the wrapper that will separate the wrapper completely when pulled through.

q. Printing, finishing
Any printing, surface coloration, or unusual finish on the paper will diminish reliability of mechanical denesting. Printed cups with less than 20% print area over the total surface generally denest to the same standards as plain surfaces. Some inks and dyes will fuse or melt while in the heat tube, essentially gluing the cups together.

r. Reliable separation
The objective of mechanical denesting is reliable, single cup separation approaching 100% reliability. It must be acknowledged that the paper media itself exhibits varying properties, the forming process has its own variables, and plant conditions (temperature, humidity, maintenance) are challenges. All of the factors above, combined with the operating quality of the denester determine the actual reliability. If the proper level of importance is attached to each of these items, it is reasonable to expect reliability in excess of 98% in ongoing operation. Performance may be increased under optimal conditions, and unfortunately decreased when any of these factors goes out of specification.

2. PRECISION STANDARD CUP MEASUREMENT METHOD
This is the standard, uniform method of measurement which must be used by all parties to assure consistent sizing of paper cups.

a. Discard the 1st nest in the stack, which will be undersize anyway. Unwrap 1 tube of cups and place it upside down on a flat surface.

b. Place a 2nd tube of cups on top (does not need to be unwrapped) to simulate the weight of a full magazine.

c. Measure the largest diameter near the bottom, either with a scale placed under the stack, or with calipers as shown.

d. The largest diameter will be about 3 - 4 nests up from the bottom. THIS IS THE TOP FLARE DIAMETER.

e. Place a 6" scale or rule alongside the vertical stack. Count the number of nests in this height. THIS IS THE NEST COUNT