

Tech Tip 17

Measuring Ink Viscosity

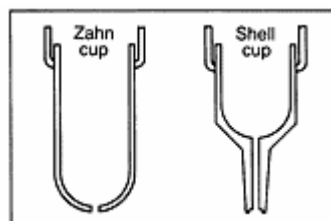
Ink viscosity is a measure of internal resistance to flow. It affects ink properties such as mileage, color strength, trapping, drying rate and fill-in. Low viscosity inks are extremely mobile and tend to flow on the printed substrate. Too low a viscosity can cause fill-in of fine reverses and growth in size of halftone dots. Too high a viscosity can cause plugging in fine reverses and excessive ink consumption.

The ideal ink viscosity varies with the job and the press. Determining and maintaining this viscosity is dependent on the skill and knowledge of the press operator. This Tech Tip discusses factors affecting ink viscosity and recommends an approach to accurately measuring and maintaining it.

Efflux Measuring Cups

Ink viscosity is measured during press run using efflux cups. An efflux cup is a container that holds an established amount of ink and has an accurately sized and shaped hole in its bottom. The time (measured in seconds) required for the ink to drain through the hole gives a measure of ink viscosity.

Two types of efflux cups are used with flexographic inks: the Zahn cup and the Shell cup (see figure below). The Zahn cup is a simple container with a circular hole of precise dimensions in its bottom. In the Shell cup, a 1" tube is attached to the drain hole. The size and shape of the cups and the drain openings are critical.



Efflux Cups

Shell cups are more accurate than Zahn cups and can detect smaller changes in viscosity. Shell cups are also slightly easier to use, as the moment at which ink flow stops is usually



clearly apparent.

Both Shell and Zahn cups are manufactured in a number of sizes. Cups should be selected that will empty within 20-40 seconds. Commonly used sizes for flexo inks are Zahn No. 2, Shell No. 3, and recently, the DIN No. 4.

Accurate Viscosity Testing

Ink is usually purchased in a concentrated form and diluted at the press with either a solvent mixture or water. Always use the diluent recommended by the ink supplier.

- Ink viscosity drops rapidly with increasing temperature. Make sure the ink is at working temperature before measuring viscosity.
- Some inks are thixotropic, or have “false body.” Make sure all inks are recirculated for at least 10 minutes before making viscosity adjustments.
- For consistent results, always use the same cup for all measurements of a color as there can be small variations between cups of the same design.
- Be sure the cup is clean and in good condition. Dirty or damaged cups will result in inaccurate measurements.
- Tests should be timed with an accurate stopwatch.
- The viscosity of a solvent-based ink can change quickly during a press run due to evaporation of the solvent. Ink viscosity should be checked at least every 30 minutes and adjusted if necessary. Water-based inks are less susceptible to evaporation so viscosity can be checked on a less frequent, though regular, schedule.

Viscosity Test Procedure

1. Use a clean efflux cup of appropriate size and an accurate stopwatch.
2. Be sure ink is warmed to working temperature.
3. Stir ink well, or circulate ink through the delivery system.
4. Lower the cup into the ink at an angle, allowing the cup to fill without trapping ink.
5. Hold the submerged cup in one hand and the timer in the other. Simultaneously, lift the cup vertically out of the ink and start the timer.
6. Watch the ink flow out of the bottom of the cup. When a break occurs in the stream of ink, stop the timer.
7. Read and record the elapsed time in seconds.
8. Clean the cup.
9. If the ink viscosity needs adjustment, add fresh ink to raise viscosity or diluent to lower viscosity. Add slowly and in small amounts. Allow sufficient mixing time before testing viscosity again to confirm that it is correct.

Efflux Cup/Viscosity Cross Reference

Chart figures are Efflux Time in seconds. Typical flexo printing viscosities are shown in red.



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Efflux Cup	Viscosity (in Centipoise)																	
	2000	1750	1500	1250	1000	900	800	700	600	500	400	300	250	200	150	100	75	50
Zahn #1									68	60	52	45	42	38	35	32		
Zahn #2		72	63	53	43	33	30	28	25	22	20	19	18					
Zahn #3	27	24	22	19	17													
Zahn #4	18	17																
Shell #1															70	57	46	37
Shell #2													75	39	29	21	18	15
Shell #3					70	64	55	46	36	29	22	18	15	11	8			
Shell #4	71	67	56	35	32	29	27	23	20	17	14	11						
DIN #4				37	34	30	26	22	21	18	16	11	5					

