Coating Technology for Flexible Packaging

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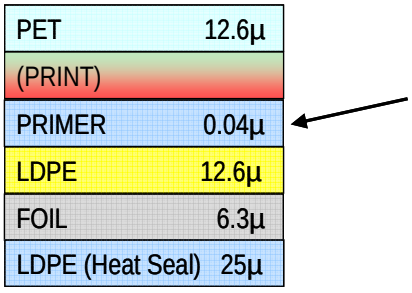
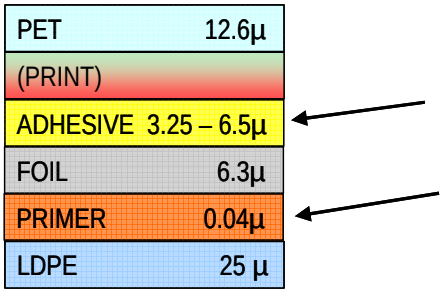
Flexible Packaging is widely used in today's world. It is used to package a multitude of products such as: processed meat, processed cheese, fresh red meat, bulk liquids, cereals, cake mix, coffee, medical device films, snacks and many others. There are many different substrates and coatings used to create these packages to produce the various levels of barrier protection. *see chart*

SUBSTRATES		COATINGS	
PET	1 – 10 mil	Primers	0.04 – 0.4 gsm
PE	1 – 8 mil	Adhesives	3.25 – 6.5 gsm
Al Foil	20 – 60 µ	PVDC	1.6 – 6.5 gsm
BOPP/OPP	0.4 – 2 mil	Wash-coats	0.8 – 1.5 gsm
CPP	1 – 4 mil	PVOH	0.5 gsm
Nylon	0.4 – 2 mil	Lacquers	5.0 gsm
MetPET	1 – 10 mil	Varnishes	0.02 – 0.04 gsm
Cellophane	0.8 – 1 mil	Acrylic Polyurethanes	0.3 gsm

A typical package may be constructed of several layers of substrates and coatings. Two typical constructions are illustrated below. The beverage package is constructed with PET/Printed/Primer coating/LDPE/Foil/LDPE(heatseal). The Retort Package is a different construction requiring two coatings, PET/Printed/Adhesive coating/Foil/Primer coating/LDPE. The foil is a barrier layer and may be substituted with Metalized PET, Nylon, or EVOH depending on the amount or type of barrier required. *see illustration*



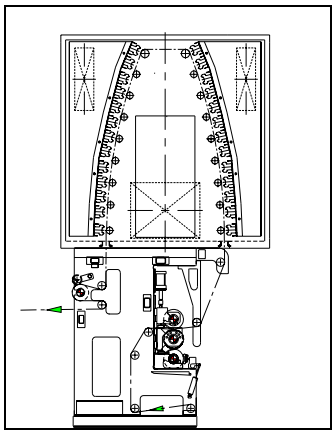
Beverage Package



Retort Package

The constructions incorporate the use of solution coating(s) to enhance either the barrier and/or the adhesion properties. The focus of this paper is to discuss how these coatings are applied.

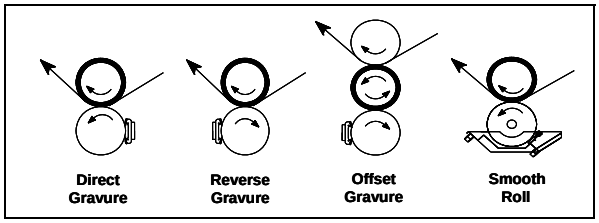
A solution coating is a liquid with solids dispersed in the liquid to assist the wetting of the substrate it is applied to. The liquid can be a combination of solvents or water determined by its ability to maintain the dispersion of the solids. The solution coating is applied to a continuous web with a Coater and then passed through a Dryer to remove the liquid leaving a thin layer of solids on the substrate. The coater will be either a gravure type or a smooth roll type. The dryers are normally a roll support design or a floatation design. The roll support dryer consist of rolls supporting the web with opposing impingement nozzles drying the web. The floatation dryer consist of nozzles on both sides of the web creating a sign wave affect to float the web.



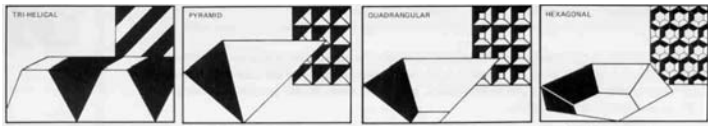
Coating heads have a variety of applications, strengths and weaknesses. How do you objectively select the right coating head? There are 50 plus coater configurations available to apply an infinite number of coating solutions. To select the coater for your needs you first need to know your coating and substrate's properties, then match these properties with the coater's abilities/limitations.

Coating	Substrate	Coater
% Solids	Absorbency	Speed Range
Viscosity	Surface Tension	Coat Weight Range
pH	Tear Strength	Solids Range
Shear Stability	Smoothness	Viscosity Range
Density	Caliper	Appearance
Solvent/Water Based	Melt Point	

There are four main coater configurations used in the Flex Package construction. The four types are Direct Gravure, Reverse Gravure, Offset Gravure and Smooth Roll. The gravure coaters utilize steel rolls with patterns engraved into the face of the roll. This pattern determines how much coating is carried to the web. The coating is applied to the gravure, metered off the surface, leaving coating only in the engraved pattern, then transferred to the web that is supported by the rubber covered back-up roll. The smooth roll coater applies the coating from an open pan, picking up the coating with a smooth steel roll partially immersed into the pan, then the web is pressed against the steel roll with the rubber covered back-up roll. The speed of the steel roll and amount of pressure against the steel roll combine to control the amount of coating applied to the web.



The gravure roll is a steel roll with a precise pattern engraved into the surface of the roll. There are several gravure vendors, each with their own names for these patterns. The picture shows one vendor's patterns and the names associated with them. The patterns are called from left to right; Tri-Helical, Pyramid, Quadrangular, and Hexagonal. The amount of coating in each cell (pattern) is measured and referred to as Billion Cubic Microns (BCM). To select the correct gravure pattern for your application, you need to reference a coat weight chart provided by most gravure vendors. On this chart locate your coat weight under the percent solids column that matches your formulation. Then follow the row to the left and it determines the volume required to deliver the desired coating to the substrate.



This chart is setup for the Direct Gravure method. The Reverse Gravure method will need to add approximately 20% to the desired coat weight and for Offset Gravure method add approximately 75%. This will be explained as we discuss each type of coater and their operating parameters.

MACHINE ENGRAVING COATING CHART

WEIGHT IN POUNDS DRY SOLIDS PER REAM - 432,000 SQUARE INCHES
WEIGHT OF MATERIAL 8 LBS. PER GALLON IN SOLUTION

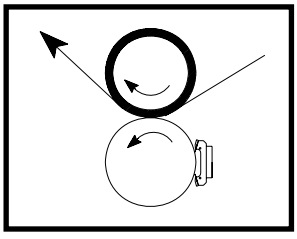
PYRAMID CELL				
Vol.	15% Solids	25% Solids	35% Solids	45% Solids
2.6	.26	.32	.47	.70
3.2	.29	.36	.53	.79
3.4	.32	.40	.59	.88
7.5	.64	.80	1.18	1.75
8.2	.70	.88	1.30	1.92
9.7	.80	1.00	1.48	2.19
11	.96	1.20	1.78	2.63
11.9	1.02	1.28	1.89	2.80
12.2	1.06	1.32	1.95	2.89
13.9	1.20	1.40	2.07	3.07
16	1.22	1.52	2.25	3.33
17.3	1.28	1.60	2.37	3.50
18	1.44	1.80	2.66	3.94
20.4	1.60	2.00	2.96	4.38
24.4	1.86	2.32	3.43	5.08
26.6	1.98	2.48	3.67	5.43
33.7	2.42	3.02	4.47	6.61
41	2.88	3.60	5.33	7.88
48	3.33	4.16	6.15	9.11

TRI-HELICAL CELL				
Vol.	25% Solids	35% Solids	45% Solids	50% Solids
18	1.40	2.07	3.07	3.80
20.3	1.60	2.37	3.51	4.35
26.2	2.05	3.03	4.49	5.57
28.8	2.25	3.33	4.93	6.11
32.3	2.50	3.70	5.48	6.79
32.7	2.58	3.81	5.64	6.99
36.8	2.88	4.26	6.30	7.81
41.8	3.28	4.85	7.18	8.89
45	3.53	5.22	7.73	9.57
49	3.85	5.70	8.44	10.46
53.3	4.18	6.18	9.15	11.34
59.6	4.68	6.92	10.25	12.70
61.5	4.80	7.10	10.52	13.04
73.5	5.78	8.55	12.66	15.68
76	5.98	8.74	13.10	16.23
78.2	6.15	9.10	13.48	16.70
90	7.05	10.43	15.45	19.15
106.5	8.33	12.32	18.25	22.61
115	8.95	13.24	19.62	24.31

QUADRANGULAR CELL				
Vol.	25% Solids	35% Solids	45% Solids	50% Solids
5.7	.48	.71	1.05	1.31
7.5	.60	.89	1.31	1.63
9.4	.72	1.07	1.58	1.96
10.9	.80	1.30	1.93	2.39
13.3	1.00	1.48	2.19	2.72
15	1.12	1.66	2.45	3.05
16	1.20	1.78	2.63	3.26
17.2	1.28	1.89	2.80	3.48
21.4	1.56	2.31	3.42	4.24
26.3	1.76	2.61	3.85	4.79
30	1.96	2.90	4.29	5.33
32	2.16	3.20	4.73	5.88
35.4	2.40	3.55	5.26	6.53
40.4	2.60	3.85	5.69	7.07
44.5	2.72	4.03	5.96	7.40
46.6	2.80	4.14	6.13	7.62
58.7	3.60	5.33	7.88	9.79
81	4.80	7.10	10.51	13.06
117	6.80	10.06	14.89	16.30

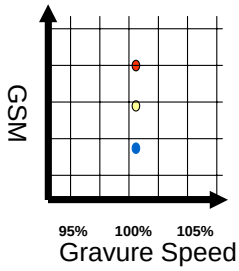
The chart is only a starting point to get you close to your target. A large amount of the time the gravure pattern will need to be adjusted to achieve the correct coat weight due to the different coating and/or substrate characteristics.

Direct Gravure Coater:

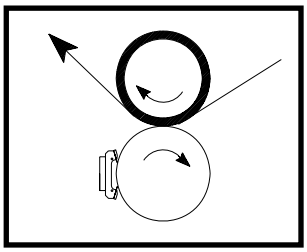


The **Direct Gravure Coater** consists of a rubber covered back-up roll, a gravure roll, and a coating applicator. The back-up roll is covered with a rubber compound and is used to transport the web through the coating process. The back-up roll is pressed against the gravure roll creating a slight nip which pulls the coating out of the gravure cells and deposits the coating onto the web. The gravure roll is a steel roll with a pattern engraved into the face of the roll. These cells are filled with the coating and doctored of the surface of the roll

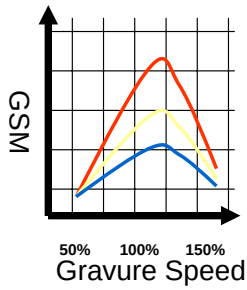
leaving a precise amount of coating on the gravure roll. The roll then transports the coating to the nip where it is transferred to the web. The coating applicator is either an enclosed chamber with two doctor blades or an open pan with a doctor blade assembly to remove the excess coating. In the Direct Gravure mode the gravure roll and the web are moving in the same direction at the point of contact. The speed of the gravure roll is usually the same as the web but it may be adjusted to ∓10% of the web speed. The coat weight is determined by the gravure volume and the coating solids.



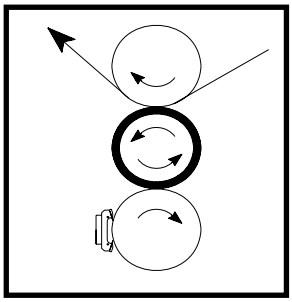
Reverse Gravure Coater:



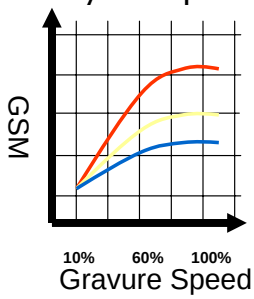
The **Reverse Gravure Coater** consists of the same equipment as the Direct Gravure coater. In this method the gravure roll runs in the opposite direction to the web and varies in speed from 50% to 150% of web speed. The most common operating speed is 110% to 120%. The coat weight in this mode when plotted will create a bell shaped curved by running the gravure roll from 50 to 150% of web speed measuring the coat weight every 10%. If the same gravure pattern from the Direct gravure is used the highest coat weight will only be about 80% of the direct gravure methods. The coat weight is determined by the gravure pattern, the coating solids, and by the speed of the gravure roll. This method will lay the coating down with a smoother appearance because of the shearing action created at the nip. The appearance created by the direct gravure method is a rougher texture because at matched speeds and in the same direction you are virtually printing the pattern onto the web.



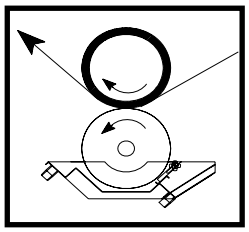
Offset Gravure Coater:



The **Offset Gravure Coat**er consist of a steel back-up roll, a rubber covered applicator roll, a gravure roll, and a coating applicator. The back-up roll is chrome plated steel roll used to transport the web through the coating process and create the nip between the web and the applicator roll. The Applicator roll is a rubber covered roll used to transfer the coating from the gravure roll to applicator roll, to the web. The gravure roll is a steel roll with a pattern engraved into its surface. The coating applicator is either an enclosed chamber with two doctor blades to an open pan with a doctor blade assembly to remove the excess coating. In this method all the rolls are turning in the same direction at the point of contact at each nip. The back-up roll is operating at line speed, the applicator roll most usually is operating at 98% of line speed (∓5%), and the gravure roll operates at 25 to 35% of line speed. With this method the coat weight curve when plotted would be a steady incline then level off to a fairly straight plain. The curve would be generated by varying the speed of the gravure roll from 5% to 100 % in increments of 5%. The coat weight usually levels off when the gravure roll reaches about the 60% of line speed. The shearing action created by the differential speeds and the two nip points generally apply a smooth coating.

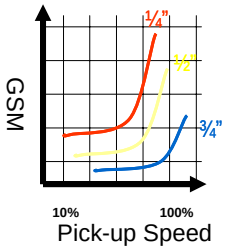


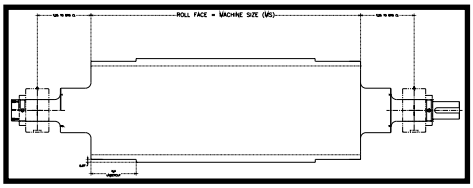
Smooth Roll Coater:



The **Smooth Roll Coater** consist of a rubber covered back-up roll, a steel chrome plated pick-up roll, sling guards and a coating pan. The back-up roll is covered with a rubber compound and is used to transport the web through the coating process. The back-up roll is pressed against the pick-up roll creating a slight nip. The pick-up roll is immersed into the coating pan and transports the coating to the nip between the web and the pick-up roll. The coating is applied to the web

at this nip point. The amount of coating applied is dependent on the hydraulic forces at the coater nip created by the speed of the pick-up roll and the nip force. The coating pan is filled with a solution coating and in most cases it has an overflow weir so the coating may be recirculated. The rubber compound selected has to consider several operational conditions. The parameters consist of the durometer, surface tension, resilience, tear resistance. The durometer needs to be based on the speed of the machine line and the viscosity of the coating. With this method the coat weight increases with higher speed and higher viscosity. The surface tension is selected based on the compound of the rubber. This method requires the rubber to repel the coating, so only the web will be coated. The resilience and tear strength are required due to the high forces and different web widths. The coat weight is determined by the nip width and the pick-up roll speed and the curve will be a line with a slow incline and then when the hydraulic forces overcome the nip the line transitions into a steep incline. The wider the nip the lower on the graph the curve is generated.

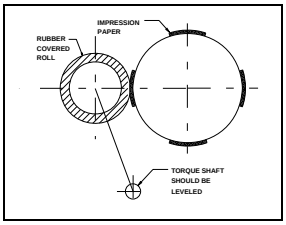




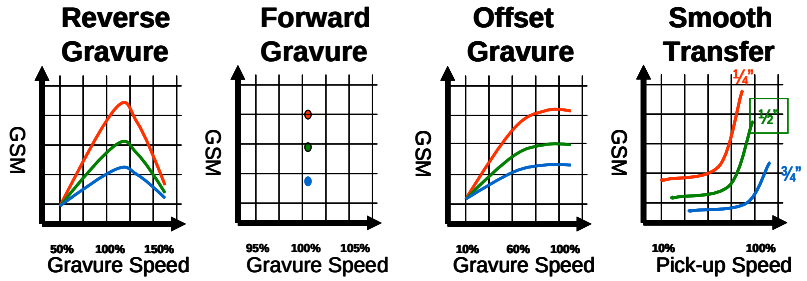
The gravure coater requires the rubber rolls to be undercut slightly narrower than the web width whereas in the smooth roll method the rubber rolls are full width. When the coating is transferred to the web or applicator roll from the gravure cells it only needs to be transferred at the width of the web. If the rubber is not undercut the coating would form a flooded nip outside the area of the web and gradually move into the web area, creating a hydraulic force that would increase the coat weight to unacceptable levels in these areas. If the rubber was undercut, the area outside the width of the web would continue to travel around and back into the coating applicator. The smooth roll coater requires a full width rubber roll to create the flooded nip. If the nip was not flooded across the entire web, some areas would

have either too little coating or none at all. This flooded nip also requires sling guards at the end of the rolls to catch and return into the pan any of the slinging coating.

A nip is required between the coating rolls in all of the methods listed above. What is a nip? A nip is the amount of contact that is generated between the rolls when they are pressed together. The softer the rubber durometer, the wider the nip will be with the same pressure. As the pressure increases the nip width increases. How do you measure the nip width? There are several methods available using carbon nip paper, aluminum foil, liquid coating and piece of paper, a computerized nip blanket. What all these methods have in common is you must place something between the two rolls before you close them together.



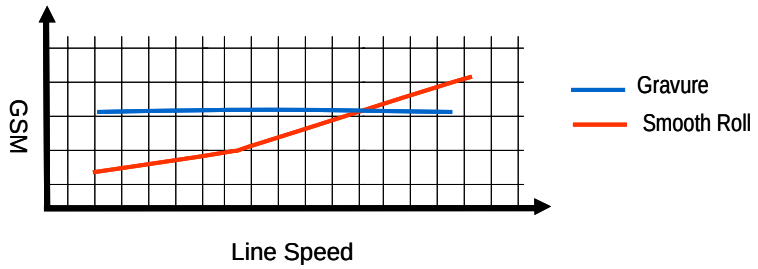
In review, the coat weight control of each coater as depicted in the charts show that the only coater that cannot adjust coat weight is the Direct Gravure (*shown as forward gravure in the illustration*).



The smooth roll coater can control coat weight until the hydraulic force over comes the coater nip and then the coat weight climbs dramatically.

The Gravure coaters offer excellent coat weight control and are stable through out all line speeds but require an undercut rubber roll for each web width. A sleeve system may be used in the rubber roll location. The sleeve system allows the rubber undercut sleeve to be changed in less than 15 minutes. This system still requires a sleeve for each web width. The smooth roll coater offers coat weight control but needs adjustment going from low to high line speeds. This is referred to as unstable, as

the line speed increases so does the amount of coating supplied. The result is much of the coated web during speed-up and slow down is waste. The advantage to the smooth roll coater is it only requires one rubber roll for all web widths.



The Direct Gravure coater is used primarily on substrates that are fragile, like metalized PET or printed webs. If the roll applying the coating to these two examples were operated in the reverse direction or at a differential speed, then that roll could damage the print layer or pick off the foil. Operating the roll in the forward direction with matched speeds will apply the coating without damage. The smooth roll coater can adjust coat weights and apply coatings without damage to the layers. The limit on this coater is the flooded nip. This application works well on films or coated papers, BUT on open face paper the coat weight cannot be controlled. Passing the open faced paper through the flooded nip will saturate the web and apply excessive coating.

Take all the parameters from this paper and create a chart, now you can select the correct coater for your process.

Coater Selection		Direct Gravure		Reverse Gravure		Offset Gravure		Smooth Roll
Ability to Adjust Coat Weight		No		Yes		Yes		Yes
Ability to Coat Paper		Yes		Yes		Yes		No
Ability to Coat Film		Yes		Yes		Yes		Yes
Stable at all Line Speeds		Yes		Yes		Yes		No
Requires Under Cut Rubber Roll		Yes		Yes		Yes		No
Ability to Coat Printed Film		Yes		No		Yes		Yes
Ability to Coat Foil		Yes		No		Yes		Yes

2006 PLACE Conference

September 17-21
Cincinnati, Ohio

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Typical Products

Product	Package Type
•Processed Meat	•Pouches, Vacuum Packages
•Processed Cheese	•Pouches, Wraps
•Fresh Red Meat	•Barrier, Shrink Bags
•Bulk Liquids	•Pouches, Bag in Box
•Cereal/Cake Mix	•Inner Liners
•Medical Devices Films	•Pouches, Thermal Formed
•Coffee	•Brick Packs, Pouches
•Fresh Produce	•Breathable Bags
•Snacks	•Bags

Flex-Pack Components

Substrates		Coatings	
•PET	1-10 mil	•Primers	0.04-0.4 gsm
•PE	1-8 mil	•Adhesives	3.25-6.5 gsm
•Al foil	20-60 µ	•PVDC	1.6-6.5 gsm
•BOPP/OPP	0.4-2 mil	•Wash-coats	0.8-1.5 gsm
•CPP	1-4 mil	• PVOH	0.5 gsm
•Nylon	0.4-2 mil	•Lacquer	5.0 gsm
•METPET	1-10 mil	•Acrylic Polyurethane	0.3 gsm
•Cellophane	0.8-1 mil	•Varnish	0.02 – 0.04 gsm

Typical Product Structures

PET	12.6µ
(PRINT)	
PRIMER	0.04µ
LDPE	12.6µ
FOIL	6.3µ
LDPE (Heat Seal)	25µ

Beverage Package

PET	12.6µ
(PRINT)	
ADHESIVE	3.25 – 6.5µ
FOIL	6.3µ
PRIMER	0.04µ
LDPE	25 µ

Retort Package

Note: The foil is a barrier layer and may be substituted with METPET, Nylon, or EVOH depending on the amount or type of barrier layer needed.

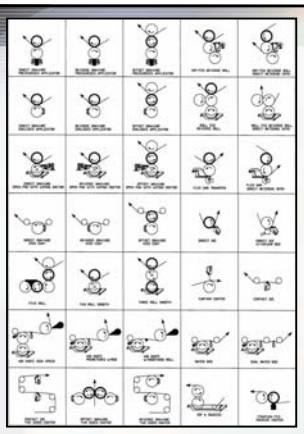
COATER/DRYER

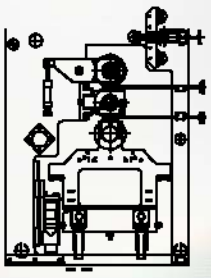
Coater

- **Smooth roll**
  - **Backing Roll not Undercut**
  - **Pan Fed**
- **Direct Gravure**
  - **Backing Roll Undercut Sleeve**
  - **Pan Fed**
  - **Enclosed Applicator**

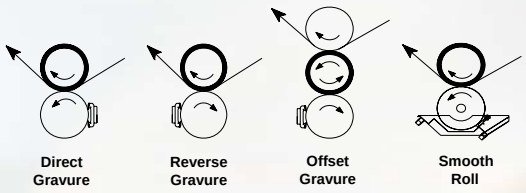
Dryer

- **Air Floatation Nozzles**
- **Roll Support**



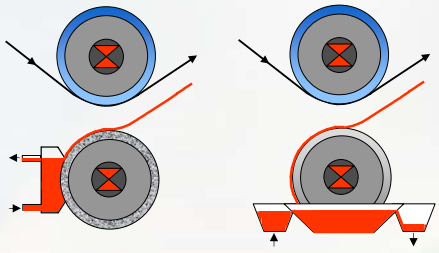


FLEX-PACK COATERS



Direct Gravure | Reverse Gravure | Offset Gravure | Smooth Roll

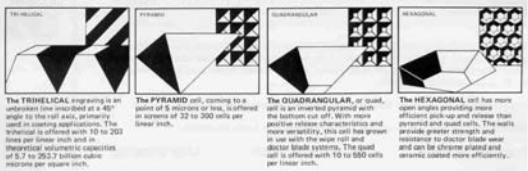
Methodology of Application



Gravure Coater

Smooth Roll Coater

Gravure Engraved Patterns



The TRIHELICAL engraving is an unbroken line inscribed at a 45° angle to the roll axis, primarily used in coating applications. The trihelical is offered with 10 to 203 lines per linear inch and in theoretical volumetric capacities of 9.7 to 253.7 billion cubic microns per square inch.

The PYRAMID cell, coming to a point of 5 microns or less, is offered in screens of 32 to 300 cells per linear inch.

The QUADRANGULAR, or quad, cell is an inverted pyramid with the bottom cut off. With more positive release characteristics and more versatility, this cell has grown in use with the wipe roll and doctor blade systems. The quad cell is offered with 10 to 550 cells per linear inch.

The HEXAGONAL cell has more open angles providing more efficient pick-up and release than pyramid and quad cells. The walls provide greater strength and resistance to doctor blade wear and can be chrome plated and ceramic coated more efficiently.

CONSOLIDATED'S LATEST INNOVATION...QCH *

The QCH Screen was originally developed for the new high solid/low solvent and water based inks being developed to meet present and future EPA emission requirements. QCH has solved many metering and starvation problems even at high press speeds. This configuration is especially effective in doctor blade systems.

Because QCH Screens have the same wall support at every position of the roll, it has no wear points . . . this extends roll life.

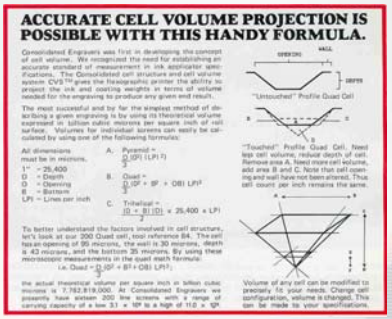
*QCH is our trade name for our patented fluid metering roller, U.S. Patent No. 4,301,583.

Volume

"BCM"

Billion Cubic Microns

The formula is based on ink technology. Many of today's coatings are of an unique composition. Use this formula for a better understanding of how the cell volumes are achieved. Coat weights may vary when different coatings are applied with the same cell volume.



ACCURATE CELL VOLUME PROJECTION IS POSSIBLE WITH THIS HANDY FORMULA.

Consolidated Engravers was first in developing the concept of cell volume. We recognized the need for establishing an accurate standard of measurement in ink applicator specifications. The Consolidated cell structure and cell volume system CVS™ gives the Helioaphic printer the ability to project the ink and coating weights in terms of volume needed for the engraving to produce any given end result.

The most successful and by far the simplest method of describing a given engraving is by using its theoretical volume expressed in billion cubic microns per square inch of cell surface. Volumes for individual screens can easily be calculated by using one of the following formulas:

All dimensions must be in microns.
1" = 25,400
D = Depth
O = Opening
B = Bottom
LPI = Lines per inch

A. Pyramid = $\frac{D}{3}(O)\,(LPI^2)$

B. Quad = $\frac{D}{3}(O^2 + B^2 + OB)\,LPI^2$

C. Trihelical = $\frac{(O + B)\,(O)}{2} \times 25{,}400 \times LPI$

To better understand the factors involved in cell structure, let's look at our 200 Quad cell, tool reference B4. The cell has an opening of 95 microns, the wall is 30 microns, depth is 43 microns, and the bottom 35 microns. By using these microscopic measurements in the quad math formula:

i.e. Quad = $\frac{D}{3}(O^2 + B^2 + OB)\,LPI^2$;

the actual theoretical volume per square inch in billion cubic microns is 7,782,819,000. At Consolidated Engravers we presently have sixteen 200 line screens with a range of carrying capacity of a low 3.1 × 10⁹ to a high of 11.0 × 10⁹.

"Untouched" Profile Quad Cell

"Touched" Profile Quad Cell. Need less cell volume, reduce depth of cell. Remove area A. Need more cell volume, add area B and C. Note that cell opening and wall have not been altered. Thus cell count per inch remains the same.

Volume of any cell can be modified to precisely fit your needs. Change cell configuration, volume is changed. This can be made to your specifications.

formula from Consolidated Engravers

MACHINE ENGRAVING COATING CHART

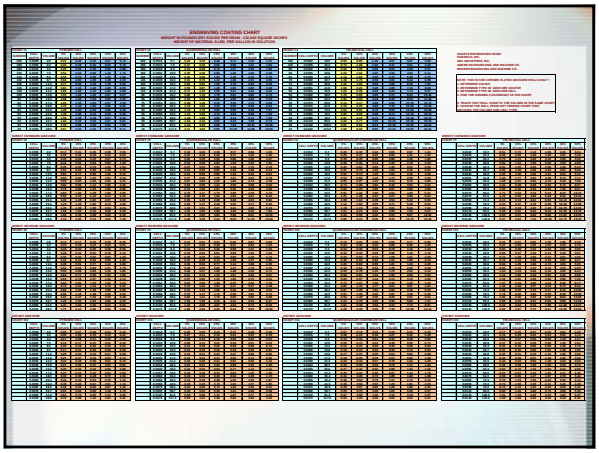
WEIGHT IN POUNDS DRY SOLIDS PER REAM - 432,000 SQUARE INCHES
WEIGHT OF MATERIAL 8 LBS. PER GALLON IN SOLUTION

PYRAMID CELL				
Vol.	15% Solids	25% Solids	35% Solids	45% Solids
2.6	.26	.32	.47	.70
3.2	.29	.36	.53	.79
3.4	.32	.40	.59	.88
7.5	.64	.80	1.18	1.75
8.2	.70	.88	1.30	1.92
9.7	.80	1.00	1.48	2.19
11	.96	1.20	1.78	2.63
11.9	1.02	1.28	1.89	2.80
12.2	1.06	1.32	1.95	2.89
13.9	1.20	1.40	2.07	3.07
16	1.22	1.52	2.25	3.33
17.3	1.28	1.60	2.37	3.50
18	1.44	1.80	2.66	3.94
20.4	1.60	2.00	2.96	4.38
24.4	1.86	2.32	3.43	5.08
26.6	1.98	2.48	3.67	5.43
33.7	2.42	3.02	4.47	6.61
41	2.88	3.60	5.33	7.88
48	3.33	4.16	6.15	9.11

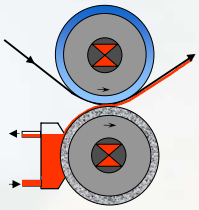
TRI-HELICAL CELL				
Vol.	25% Solids	35% Solids	45% Solids	50% Solids
18	1.40	2.07	3.07	3.80
20.3	1.60	2.37	3.51	4.35
26.2	2.05	3.03	4.49	5.57
28.8	2.25	3.33	4.93	6.11
32.3	2.50	3.70	5.48	6.79
32.7	2.58	3.81	5.64	6.99
36.8	2.88	4.26	6.30	7.81
41.8	3.28	4.85	7.18	8.89
45	3.53	5.22	7.73	9.57
49	3.85	5.70	8.44	10.46
53.3	4.18	6.18	9.15	11.34
59.6	4.68	6.92	10.25	12.70
61.5	4.80	7.10	10.52	13.04
73.5	5.78	8.55	12.66	15.68
76	5.98	8.74	13.10	16.23
78.2	6.15	9.10	13.48	16.70
90	7.05	10.43	15.45	19.15
106.5	8.33	12.32	18.25	22.61
115	8.95	13.24	19.62	24.31

QUADRANGULAR CELL				
Vol.	25% Solids	35% Solids	45% Solids	50% Solids
5.7	.48	.71	1.05	1.31
7.5	.60	.89	1.31	1.63
9.4	.72	1.07	1.58	1.96
10.9	.80	1.30	1.93	2.39
13.3	1.00	1.48	2.19	2.72
15	1.12	1.66	2.45	3.05
16	1.20	1.78	2.63	3.26
17.2	1.28	1.89	2.80	3.48
21.4	1.56	2.31	3.42	4.24
26.3	1.76	2.61	3.85	4.79
30	1.96	2.90	4.29	5.33
32	2.16	3.20	4.73	5.88
35.4	2.40	3.55	5.26	6.53
40.4	2.60	3.85	5.69	7.07
44.5	2.72	4.03	5.96	7.40
46.6	2.80	4.14	6.13	7.62
58.7	3.60	5.33	7.88	9.79
81	4.80	7.10	10.51	13.06
117	6.80	10.06	14.89	16.30

DIRECT GRAVURE: *is 80 % of what the chart displays*
REVERSE GRAVURE: *is generally 80% of Direct Gravure*
DIFFERENTIAL OFFSET GRAVURE: *is generally 25% of Direct Gravure*



DIRECT GRAVURE



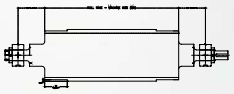
BACKING; LINESPEED
Undercut Required

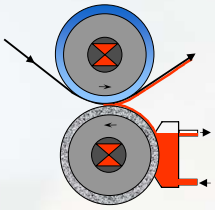
BACKING/GRAVURE = 3/8" NIP

GRAVURE; 90% to 110% LINESPEED

USUALLY REQUIRES POST SMOOTHING

REVERSE GRAVURE



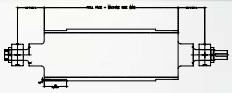


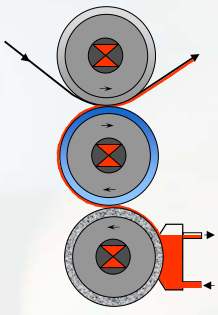
BACKING; LINESPEED
Undercut required

BACKING/GRAVURE = 3/8" NIP

GRAVURE; 50% to 150% OF LINESPEED

OFFSET GRAVURE





BACKING; LINESPEED

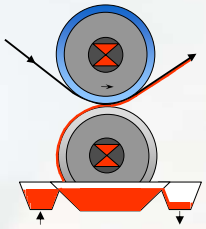
BACKING/OFFSET =3/8" NIP

OFFSET; 95% to 105% OF LINESPEED
Undercut Required

OFFSET/GRAVURE = 3/8" NIP

GRAVURE; 10% to 25% OF LINESPEED

SMOOTH ROLL



BACKING; LINESPEED

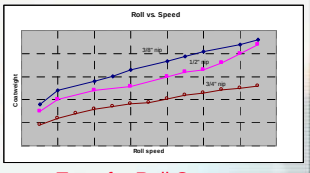
***NO* Undercut Required**

BACKING/PICKUP = VARY NIP

PICKUP;20% to 150% LINESPEED

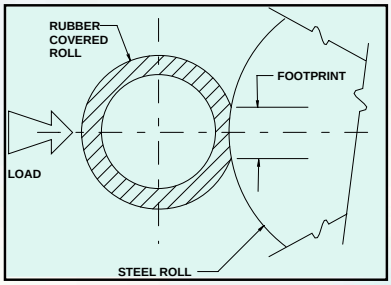
COAT WEIGHT
NIP WIDTH & ROLL SPEED

- **Coat weight control is dependent upon the relationship of linespeed vs. nip width and pickup roll speed**
- **By increasing pickup roll speed the coat weight increases**
- **By decreasing the pickup roll footprint the coat weight increases**
- **Other coat weight variables**
  - **–coating solids**
  - **–coating viscosity**

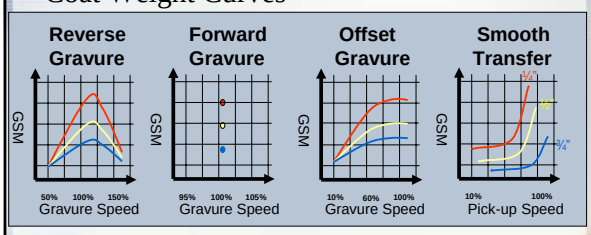


Transfer Roll Coater

CHECKING NIP IMPRESSIONS



Coat Weight Curves

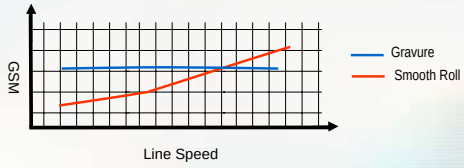


Factors That Affect Coat Weight

- **Gravure Volume**
- **Roll Speed**
- **Coating Solids**
- **Coating Viscosity**
- **Nip Width**

COAT WEIGHT STABILITY

- **Effects of speed on coatweight**
  - **Differential Offset Gravure - *STABLE***
  - **Direct/Reverse Gravure - *STABLE***
  - **Smooth Roll - *UNSTABLE***



Coater Selection	Direct Gravure	Reverse Gravure	Offset Gravure	Smooth Roll
Ability to Adjust Coat Weight	No	Yes	Yes	Yes
Ability to Coat Paper	Yes	Yes	Yes	No
Ability to Coat Film	Yes	Yes	Yes	Yes
Stable at All Line Speeds	Yes	Yes	Yes	No
Requires Undercut Rubber Roll	Yes	Yes	Yes	No
Ability to Coat Printed Film	Yes	No	Yes	Yes
Ability to Coat Foil	Yes	No	Yes	Yes

PRESENTED BY

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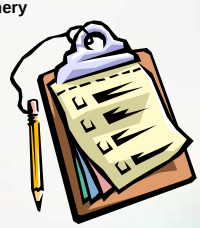

Please remember to turn in your evaluation sheet...