Relation between yarn dia & yarn numbering system

In the indirect system

$$\text{count } (N) \propto \frac{\text{length}}{\text{wt}}$$

$$N \propto \frac{1}{\text{wt}/\text{length}}$$

If the density is constant

$$N \propto \frac{1}{\text{cross sectional area}} \propto \frac{1}{A}$$

$$N \propto \frac{1}{A}$$

$$A = \frac{\pi}{4} d^2$$

$$N \propto \frac{1}{d^2}$$

$$d^2 \propto \frac{1}{N}$$

$$d \propto \frac{1}{\sqrt{N}}$$

In the direct method

$$N \propto \text{wt}/\text{length}$$

$$N \propto A \quad (\text{if density is constant}).$$

$$N \propto d^2$$

$$d \propto \sqrt{N}$$

$\frac{22}{30}$ 16 30/

General eqn for yarn diameter.

$$d = \frac{.990}{\sqrt{yd/lb \times Dm}}$$

yarn density = Dm

Following assumptions were taken

① The yarn is a cylinder with circular cross section

② Diameter of the circular cross section is the dia of the yarn.

③

Density = mass/volume.

* Mass = volume × density

1 lb of yarn = $(inch)^3 \times lb/(inch)^3$

volume = area × length

$= \frac{\pi}{4} d^2_{inch} \times yd/lb \times 36 \text{ (in)}$

$$\text{Density} = \frac{lb}{inch^3} = \frac{lb \times 453.6}{(inch)^3 \times (2.54)^3} = \frac{gm}{cc} \; Dm$$

$$\Rightarrow De \times \frac{453.6}{(2.54)^3} = Dm$$

$$\Rightarrow De = \frac{(2.54)^3 \times Dm}{453.6}$$

$$\Rightarrow \quad = .0361 \times Dm$$

Mass = volume × Density

$$1\,lb = \frac{\pi}{4} d^2 \times \frac{yds}{lb} \times 36 \times .0361 \times D_m$$

$$d^2 = \frac{4 \times lb \times}{\pi \times yds \times 36 \times .0361 \times D_m}$$

$$= \frac{.9797}{yds/lb \times D_m} = \frac{1.038}{28.98}$$

$$d = \frac{.990}{\sqrt{\frac{yds}{lb} \times D_m}} = \frac{.990 \times \sqrt{1.1}}{\sqrt{840 \times N}} = \frac{1}{28\sqrt{\ldots}}$$

$$d = \frac{Sdf\sqrt{V}}{\sqrt{N}}$$

system diametre factor

Cotton system $\frac{yds}{lb} = 840 \times N$

$$d = \frac{.990}{\sqrt{840 \times N \times D_m}} = \frac{.0342}{\sqrt{N \times D_m}}$$

$$d = Sdf \times \frac{1}{\sqrt{N \times D_m}} = \frac{Sdf\sqrt{V}}{\sqrt{N}}$$

worsted system $yds/lb = 560 \times N$

$$d = \frac{.990}{\sqrt{560 \times N \times D_m}} = \frac{.0418}{\sqrt{N \times D_m}}$$

For direct system

Denier system

$$\frac{gm}{N} \qquad \frac{m}{9000}$$

$$m/gm = \frac{9000}{N}$$

$$yds/gm = \frac{9000 \times}{N \times .9144} yds$$

$$yds/lb = \frac{9000 \times 453.6}{N \times .9144}$$

$$= \frac{4464566}{N}$$

✓

$$d = \frac{.990}{\sqrt{\frac{4464566}{N} \times Dm}}$$

$$= \frac{.000468 \sqrt{N}}{\sqrt{Dm}}$$

$$= \frac{\sqrt{N}}{2136 \sqrt{Dm}}$$

$$d = Sdf \sqrt{N} \sqrt{V}$$

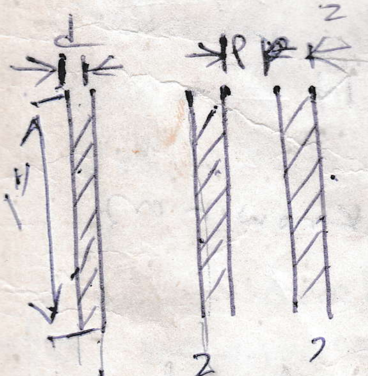
✓

COVER

Cover of a fabric is measure by the ratio of the projected area of the yarn in the fabric to the total area included within its out side boundaries. This ratio may be expressed as fractional coverage or percentage form. Projected area of fabric is equal to the projected area of warp + projected area of weft — approximate allowances for the fact the area at the cross over points is covered twice once by each yarn.

Warp & weft cover

For warp & weft cover let us consider a set of parallel yarns. having the area $= 1'' \times 1''$.



Projected area = yarns/inches $d \times 1''$

Fractional cover

$$= \frac{\text{Projected area}}{\text{Total area}}$$

$$= \frac{\text{Yarns/inch} \times d \times 1}{1 \times 1}$$

we have

$$d \propto \sqrt{\frac{N}{D}}$$

$$d \propto \frac{1}{\sqrt{ND}}$$

N = yarn count
D = Density factor

neglecting the density factor

$d \propto \sqrt{N} \rightarrow$ Direct system

$d \propto \frac{1}{\sqrt{N}}$ — Indirect system

Let n = yarns / inches

Fraction of cover = nd

or $d \propto \frac{1}{\sqrt{N}}$ — Indirect system

or $\propto \sqrt{N}$ — direct system

so fractional cover $\propto \frac{n}{\sqrt{N}}$

or

$\propto n\sqrt{N}$

Both expression can be known as cover factor K

$K = \frac{n}{\sqrt{N}}$ for indirect system

or

$K = n\sqrt{N}$ for direct system

Again we have

$$P = \frac{1}{n}$$

$$n = \frac{1}{P}$$

$$K = n\sqrt{N}$$

$$K = \frac{\sqrt{N}}{P}$$ for direct system

$$K = \frac{n}{\sqrt{N}}$$

$$K = \frac{1}{P\sqrt{N}}$$ for indirect system.

Actual fractional cover

cover factor calculated from the previous calculations is not recongnised ~~because~~ although it was based on the correct relationship between D & $\sqrt{N}$. It fails to recongnise because of the fact that $d \propto \sqrt{V}$ where V is the specific volume of yarn.

Another method ~~of~~ ~~means~~ is used to measure fractional cover which gives actual fractional value.

Actual Fractional coverage $= \frac{d \times 1}{P \times 1} = \frac{d}{P}$

Relation between K & d/P.

For direct system

$$d = Sdf \sqrt{NV}$$ (Sdf = system diameter factor)

we have

$$K = \frac{\sqrt{N}}{P}$$

$$P = \frac{\sqrt{N}}{K}$$

Hence $$\frac{d}{P} = \frac{Sdf \sqrt{NV}}{\frac{\sqrt{N}}{K}}$$

$$= Sdf\ K \sqrt{V}$$

For Indirect system

$$d = \frac{Sdf \sqrt{V}}{\sqrt{N}}$$

$$K = \frac{1}{P\sqrt{N}}$$

$$P = \frac{1}{K\sqrt{N}}$$

$$\frac{d}{P} = \frac{\frac{Sdf \sqrt{V}}{\sqrt{N}}}{\frac{1}{K\sqrt{N}}}$$

Fabric Cover

Fabric cover Kc is derived in terms of the cover provided by the warp & weft. It was assumed that dia of warp & weft is the same. Fabric cover can be expressed in the form of following exp

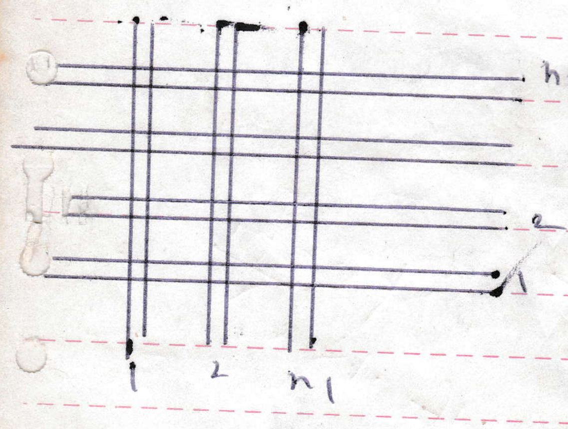
Kc = fraction of total area covered by warp yarn

+

fraction of total area covered by weft yarn

—

fraction of total area covered by either set



Let us consider that

n_1 = EPI

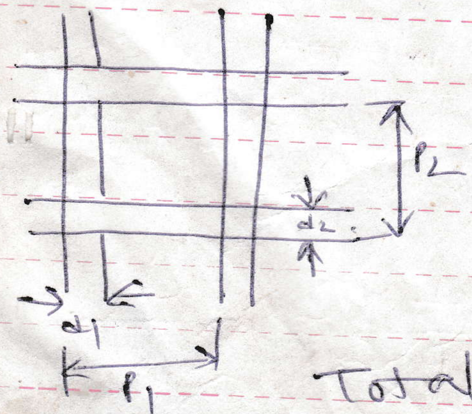
n_2 = PPI

d_1 = dia of wp

d_2 = dia of wf.

P_1 = warp spacing

P_2 = weft spacing



Total area covered by the fabric = 1" x 1"

Area covered by warp per inch

$= n_1 d_1 \times 1''$

area covered by wft $= n_2 d_2 \times 1''$
cross over area of each warp & weft $= n_1 n_2 d_1 d_2$

Total covered area

$= n_1 d_1 + n_2 d_2 - n_1 n_2 d_1 d_2$,

fractional cover

$$= \frac{n_1 d_1 + n_2 d_2 - n_1 n_2 d_1 d_2}{1 \times 1}.$$

$$= \frac{d_1}{p_1} + \frac{d_2}{p_2} - \frac{d_1}{p_1} \frac{d_2}{p_2}, \quad \left[p_1 = \frac{1}{n_1},\ n_1 = \frac{1}{p_1} \right]$$

from previous eqn

$$= S d f\, K_1 \sqrt{V_1} + S d f\, K_2 \sqrt{V_2} - S d f\, K_1 \sqrt{V_1} \cdot S d f\, K_2 \sqrt{V_2}$$

The value of K_1 & K_2 are different for diff numbering system

if both set of yarns are numbered in same system example cotton system then

$$K_c = .0342 \left(K_1 \sqrt{V_1} + K_2 \sqrt{V_2} \right) - (.0342)^2 K_1 K_2 \sqrt{V_1 V_2}$$

$$= \frac{K_1 \sqrt{V_1} + K_2 \sqrt{V_2}}{29.0} - \frac{K_1 K_2 \sqrt{V_1 V_2}}{(29.2)^2}$$

Assuming $N_1 = N_2$

weight of warp / yd^2

$$W = \frac{n_1 \times 36 \times (1+c_1)}{840 \times N_1} + \frac{n_2 \times 36 \times (1+c_2)}{N_1 \times 840}$$

$$W = \frac{n_1 \times 36 \times \left(1 + \frac{10}{100}\right)}{840 \times N_1} + \frac{n_2 \times 36 \left(1 + \frac{10}{100}\right)}{N_1 \times 840}$$

$$W = \frac{36 \times n_1(1+c_1\%)}{840 \times N_1} (n_1 + n_2)$$

weight of weft / yd

$$= \frac{n_2 \times 36 \times (1+c_2)}{840 \times N_2}$$

$$= \frac{n_2 \times 36 \times \left(1 + \frac{10}{100}\right)}{840 \times N_2}$$

$$= \frac{n_2 \times 36 \times (1 + c_2\%)}{840 \times N_2}.$$

For complete cover

$K_c = 1$.

$$1 = \frac{K_1 + K_2}{28} - \frac{K_1 K_2}{28^2}$$

Multiplying both sides by 28

$$28 = K_1 + K_2 - \frac{K_1 K_2}{28}$$

L.H. side of the eqn is set for 100% cover & R.H. side of the eqn is actual fabric cover which is equal to $\frac{K_c}{28}$ is called cloth cover factor K.

$$K = K_1 + K_2 - \frac{K_1 K_2}{28}$$

When purely relative measuring the cloth are required then cloth