Seri. J. Korea, Vol. 24(2), 1983

Secondary Report for Raw Silk Classification Method

<I.S.A. 發表論文 要約>

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生絲檢査 등급매기方法에 對한 第二次報告

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摘 要

本 報告는 1981年 國際絹絲協會가 佛蘭西리온에서 開催되었을 때 第一次 報告를 技術研究分科委員會議에서 發表된 바 있는데 當時의 反應이 좋았었고 同時에 新規로 生絲檢査方法을 委任받은바 있는 스위스側 代表로부터 第一次報告를 좀더 具體的으로 說明하여 달라는 要請을 받어 第二次 報告를 1982年 英國런던에서 開催된 바 있는 第15次 國際絹絲大會에서 再次發表하게 되었다.

本 報告는 複雜을 피하기 爲해 三角法에 의한 理論展開 代身 XY軸 直角座標數式으로 理論을 展開하여 더욱 明確하게 理解 할수 있도록 作成되었으며 스위스 代表도 이제는 確實히 알게되었다는 言及을 받게되었다. 한편 本 研究에 대한 考察部門은 韓國蠶絲學誌 第22卷 第2號 第22面을 參考하여 주기 바란다.

本 研究에서 얻어진 要約은 다음과 같다.

1. 本 研究에서 生絲檢査結果와 그들로 만들어진 絹織物 品位사이의 關係를 調査한 結果 楕圓形態의 二次曲線關係가 있음을 알았다.

2. 이러한 關係를 根據로하여 生絲檢査等級間의 級間値를 檢査項目別로 算出할 수 있는 標準罰點 parameter表를 作成하였으며 이것을 崔炳熙 標準罰點 parameter라 命名하였고 다음과 같은 parameter가 作成 되였다.

textile penalty parameter	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
raw silk penalty parameter	0.4358	0.6000	0.7141	0.8000	0.8661	0.9164	0.9539	0.9789	0.9944	1.000
raw silk grade	6A	5A	4A	3A	2A	A	B	C	D	E

3. 實際 生絲檢査 등급매기 表를 作成하는데는 다음과 같은 단계를 밟아서 이루어진다.

(A) 可及的 많은 生絲檢査荷口를 相對로 하여 E格부터 6A格에 이르기까지의 檢査結果를 利用하여 各檢査項目別로 平均値와 標準偏差를 正確하게 調査한다.

(B) 各 檢査項目에 對한 統計的 最大値와 最小値는 平均値에다 4倍量의 標準偏差 값을 加減하여 算出한다.

(C) 各 檢査項目에 對하여 統計的 開差(R)는 8倍量의 標準偏差로 하고 標準罰點의 算出에는 위에 提示한 parameter表 數値와 곱셈해서 얻는다. (R×parameter)

(D) 絲條斑 絲條斑劣等 大中節 및 小節劣等과 같이 百分率로 結果 表示되는 檢査項目에 對하여는 最大値에서 標準罰點을 控除한 것으로 表示한다.

(E) 生絲纖度偏差 및 最大偏差와 같이 實罰點으로 表示되는 檢査項目은 最小値에다 標準罰點을

加算해서 얻어진다.

4. 以上의 方法을 主要檢査 項目에 限해서 反復하므로서 生絲檢査等級 매기表가 完成된다.

I. Principles of the theoretical raw silk classification method

This study has been carried out from a principle that the number of sample skeins are based upon the sample test result may represent the whole silk from fundamentaly statistical distribution, another word, Normal Curve Distribution method. For instance, we always see the raw silk denier deviation distributions show such Normal Curve Distribution upon the testing results.

In order to make an international raw silk classification table, we have investigated the relationship between raw silk grade and the silk textile grade. After various anlysis for this matter, we have found

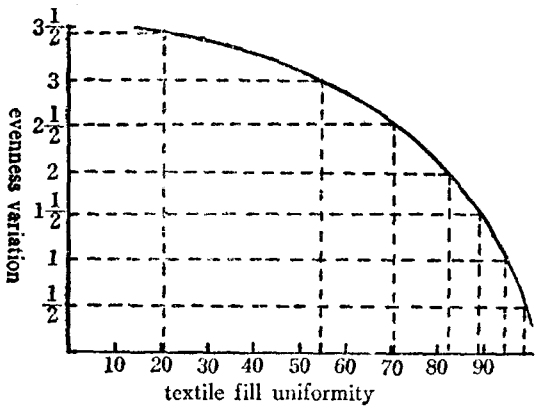

Fig. 1. Evenness variation against textile fill uniformity (%)

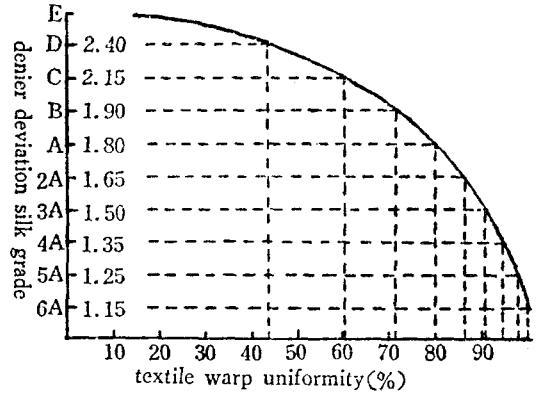

Fig. 2. Denier deviation against textile warp uniformity

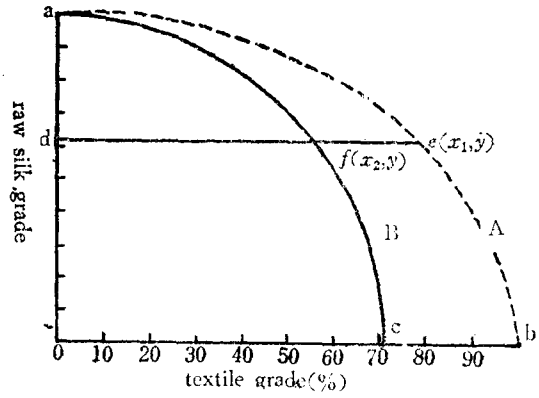

Fig. 3. Translation of ellipsoidal curve.

a secondary functional relationship between them which were similar with ellipsoidal curve as shown on Fig. 1 and Fig. 2. These ellipsoidal curves may be translated into a circular curve as shown on Fig. 3, because any empirical plot(e) may move along horizontaly to a circular curve in case transfer of the longer radius (ob to oc), for instance, at(f). It is known by geometry that normal ellipsoidal curve (A) or circular curve(B) may be shown as;

$$\frac{x_1^2}{(ob)^2}+\frac{y^2}{(oa)^2}=1 \cdots\cdots (A)$$

$$\frac{x_2^2}{(oc)^2}+\frac{y^2}{(oa)^2}=\frac{x_2^2}{(oa)^2}+\frac{y^2}{(oa)^2}=1 \cdots\cdots (B)$$

As shown in the above equation, an experimental plot x_1 will move to x_2 in case the ellipsoidal curve is transfered to the equiverent circular curve. Therefore, we may discuss the relationship between the raw silk grade penalty (or grade) and the silk textile grade refered with circular curve instead of ellpsoidal curve.

As all of us know, the testing results for Evenness, Neatness and Cleanness are shown as per cent which the results are shown deducting the test penalty from 100%. For instance, in case raw silk evenness shows 1/2 variation (Fig. 1), the rest of Y axis length (from 1/2 to 3 1/2) will replesent the grade of evenness.

On the other hand, raw silk denier deviation and winding test results show with actual penalty.

According to these graphs, the penalty intervals are ploted as uniform interval, but the corresponded silk textile grades are not uniform intervals each other as shown at Fig. 1 and Fig. 2 (See dotted lines). Such relationship was found after preparing many standard grades of silk textiles, then compared the textile grade from the corresponded raw silk graded ones. As all of us know, silk weavers pay more money for better grade of raw silk because they believe they can weave more better textile from it. So far, theoreticaly, there must be various textile grades markable from 10 to 100 as well as raw silk grade from E to 6A grade and each grade of textiles should be made from its corresponded material.

The final product of sericultural industry is of course silk textile, that is why, the grade of textile should be located as even interval like as shown at Fig. 4. This is a quite reversive consideration from the above observation by the vertical numbers up side down location and we will see the corresponded grades are distributed irregularly, which the better grade interval is, the wider interval shows.

Now, let us discuss the curve by mathematicaly. As the author said, the vertical axis may show either penalty or grade. The mathematical relationship of the variation is as following. When we represent R to be penalty (or grade) range for each testing item, the formula will be

$$(R-y)^2+x^2=R^2, \quad (R \geqq y)$$

$$x^2=R^2-(R-y)^2=2Ry-y^2$$

In order to induce a reasonable method to figure out the raw silk grade distribution for specific textile grade, we will try to devide the horizontal axis in ten uniform divisions as shown at Fig. 4, and the numerical numbers are shown as per cent unit, or (0.1, 0.2.....0.9, 1.0). R is desided by the investigation throughfull over various testing lots for each testing item, (evenness, neatness or cleanness etc), but here we can apply R to be 1, and we will get y value by such change of x, so far, we will get Table 1.

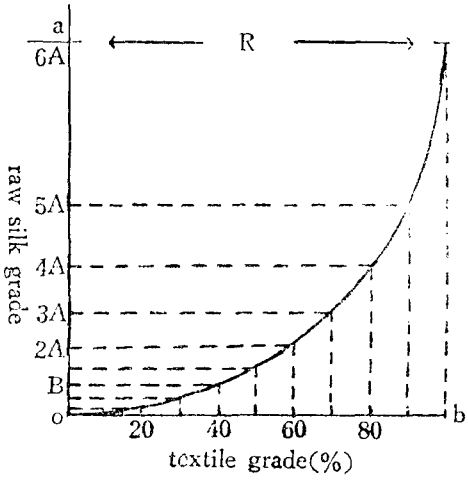

Fig. 4. Raw silk grade against textile grade.

The raw silk penalties of the below table for each grade are fundamental parameter or standard parameteter of each testing item, and this was named as "Choe's penalty parameter".

According to our investigation for the raw silk testing results covering over two hundred lots, the statistical range(R) on each testing item are listed as Table 2.

The above ranges are of course the difference between the statistical maximum value and the minimum value.

In case we compute the actual data for each raw silk grade for Evenness, Cleannes and Neatness, the actual penalty is obtained by deducting such standard penalty from the maximum value because 6A grade starts with specifying "Above" of the data.

According to our investigation for maximum value computed from which the mean value and standard deviation are as Table 3. (R)

For example, in case of Neatness of 20/22D, we have used 99.168 as maximum value and calculated the standard penalty for each grade (R×parameter). Then, the corresponded grade data were obtained by

Table 1. Choe's penalty parameter table

textile penalty $(1-x)$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
raw silk penalty $(1-y)$	0.4358	0.6000	0.7141	0.8000	0.8661	0.9164	0.9539	0.9789	0.9944	1.000
raw silk grade	6A	5A	4A	3A	2A	A	B	C	D	E

Table 2. Investigated ranges

Item	20/22D	27/29D
Evenness	12.040	13.304
Low evenness	22.656	16.816
Cleanness	18.629	17.560
Neatness	6.640	6.960
Low neatness	12.632	14.560
Denier deviation	1.704	1.984
Max. D. deviation	5.368	7.176

Table 3. Investigated max. value

Item	20/22D	27/29D
Evenness	95.244	97.978
Low evenness	94.771	94.540
Cleanness	103.695	103.859
Neatness	99.168	99.395
Low neatness	99.009	99.718

Table 4. Neatness classification table for 20/22D

Grade	Parameter	Actual penalty	Grade data	Current grade
6A	0.4358	2.89	96 above	95 above
5A	0.6000	3.98	95 above	94 above
4A	0.7141	4.72	94 above	93 above
3A	0.8000	5.31	94 above	92 above
2A	0.8661	5.75	93 above	90 above
A	0.9164	6.08	93 above	88 above
B	0.9539	6.33	93 above	86 above
C	0.9798	6.50	92 above	84 above
D	0.9944	6.60	92 above	82 above
E	1.0000	6.60	92 below	82 below

deducting the standard penalty from the maximum value. Following after the same principle, we can prepare Table 4 after all.

According to Table 4, the new grade data happened to be much higher than the current table and shows more difficulty to make better grade of raw silk than before. The neatness defects are understood to come from cocoon quality and this will call attention big careness for sericulture and silkworm breeding service.

In case we have to prepare Denier deviation or Maximum denier deviation classification table, the actual penalty must be figured out because the data are shown by penalty system rather than per cent system. The actual penalty can be found by the minimum value adding with the corresponded standard penalty. The reason of such adding is 6A grade starts with "Below" of data.

The minimum values for raw silk denier deviation and maximum denier deviation computed from the mean value and standard deviation were shown as Table 5..

By applying such data, we can prepare the denier deviation classification table as shown at Table 6.

Now, the following process will be the preparation method for raw silk grade classification table.

Table 5. Investigated denier deviation

Item	20/22D	27/29D
Denier deviation	0.554	0.540
Max. D. deviation	0.622	0.594

Table 6. Denier deviation classification table for 20/22D

Grade	Parameter	Standard penalty	Actual penalty	Grade data	Current grade
6A	0.4358	0.14	1.29	1.29 below	1.15 below
5A	0.6000	1.02	1.55	1.55 below	1.25 below
4A	0.7141	1.21	1.75	1.75 below	1.35 below
3A	0.8000	1.36	1.91	1.91 below	1.50 below
2A	0.8661	1.47	2.02	2.02 below	1.60 below
A	0.9164	1.56	2.11	2.11 below	1.80 below
B	0.9539	1.62	2.17	2.17 below	1.95 below
C	0.9798	1.67	2.22	2.22 below	2.15 below
D	0.9944	1.69	2.24	2.24 below	2.40 below
E	1.0000	1.69	2.24	2.24 above	2.40 above

(1) Investigate exact mean value and the standard deviation by using as many as raw silk testing lots covering from 6A grade to E grade.

(2) Then, figure out the maximum value and minimum value for each test item by means of adding four times of the obtained standard deviation or deducting the same amount from the mean value.

(3) Figure out eight times of the standard deviation to be use for the statistical range(R) (Table 2).

(4) The ranges are the basic number to find the standard penalty by multiplying with the corresponded Choe's parameter (Table 1).

(5) For Evenness, Low Evenness, Cleanness, Neatness and Low neatness, figure out the corresponded grade data by deducting the obtained standard penalty from the corresponded maximum value.

(6) For Denier deviation and Maximum denier deviation, figure out the corresponded grade data by adding the obtained standard penalty with the corresponded minimum values.

By repeats of such process, the theoretical raw silk grade classification tables for 20/22D size and 27/29D size are prepared as attached.

One thing should be cleared is that this study is just use for the Major test items and other test items are not discussed because they did not show the Normal Curve distribution upon the test results.

Theoretical Raw Silk Classification Table 20/22*D* (used 400 Lots)

Check \ Test item		Evenness	Low evenness	Cleanness	Neatness	Low neatness	Denier deviation	Max. D. deviation
Mean value ($\bar{X}$)		89.224	83.443	94.387	95.848	92.693	1.406	3.306
Standard deviation (σ)		1.505	2.832	2.327	0.830	1.571	0.213	0.671
Normal curve range (4σ)		6.022	11.328	9.308	3.320	6.316	0.852	2.684
Min. value.		83.204	72.115	85.079	92.528	86.377	0.554	0.622
Max. value.		95.244	94.771	103.695	99.168	99.009	2.258	5.990
Range (R)		12.040	22.656	18.629	6.640	12.632	1.704	5.368
Parameter		Standard penalty for each grade=(R×parameter)						
6A	0.4358	5.247	9.873	8.117	2.894	5.505	0.743	2.339
5A	0.6000	7.224	13.594	11.177	3.984	7.579	1.022	3.221
4A	0.7141	8.598	16.179	13.303	4.742	9.021	1.216	3.833
3A	0.8000	9.632	18.125	14.903	5.312	10.106	1.367	4.294
2A	0.8661	10429	19.622	16.135	5.751	10.941	1.476	4.649
A	0.9164	11.033	20.762	17.072	6.085	11.576	1.562	4.919
B	0.9539	11.485	21.612	17.770	6.334	12.050	1.625	5.121
C	0.9789	11.797	22.198	18.253	6.506	12.377	1.670	5.260
D	0.9944	11.973	22.529	18.525	6.603	12.561	1.694	5.338
E	1.0000	12.040	22.656	18.629	6.640	12.632	1.704	5.368
Classification		Maximum value — (R×parameter)					Actual penalty	
6A	math/curr	90/94 above	85/87 above	96/96 above	96/95 above	94/93 above	1.30/1.15 below	3.0/3.0 below
5A	math/curr	88/93 above	81/85 above	93/95 above	95/94 above	91/90 above	1.58/1.25 below	3.8/3.3 below
4A	math/curr	87/91 above	79/83 above	90/94 above	94/93 above	90/88 above	1.76/1.35 below	4.5/3.6 below
3A	math/curr	86/89 above	77/80 above	89/93 above	94/92 above	89/86 above	1.90/1.50 below	4.9/4.0 below
2A	math/curr	85/86 above	75/77 above	88/92 above	93/90 above	88/83 above	2.02/1.65 below	5.3/4.4 below
A	math/curr	84/84 above	74/75 above	87/90 above	93/88 above	87/79 above	2.11/1.80 below	5.5/4.8 below
B	math/curr	84/82 above	73/73 above	86/88 above	93/86 above	87/75 above	2.17/1.95 below	5.7/5.2 below
C	math/curr	83/80 above	73/70 above	85/85 above	92/84 above	87/70 above	2.22/2.15 below	5.8/5.7 below
D	math/curr	83/77 above	72/66 above	85/81 above	92/82 above	86/64 above	2.24/2.40 below	6.0/6.4 below
E	math/curr	83/77 below	72/66 below	85/81 below	92/82 below	86/64 below	2.24/2.40 above	6.0/6.4 above

Notice: Math.. Mathematical grade, Curr.. Current grade

Theoretical Raw Silk Classification Table 27/29*D* (used 200 Lots)

Test item / Check		Evenness	Low evenness	Cleanness	Neatness	Low neatness	Denier deviation	Max. D. deviation
Mean value ($\bar{X}$)		91.326	86.132	95.079	95.915	92.438	1.532	4.182
Standard deviation (σ)		1.663	2.102	2.195	0.870	1.820	0.248	0.897
Normal curve range (4σ)		6.652	8.408	8.780	3.480	7.280	0.992	3.588
Min. value.		84.674	77.724	86.299	92.435	85.158	0.540	0.594
Max. value.		97.978	94.540	103.859	99.395	99.718	2.524	7.770
Range (R)		13.304	16.816	17.560	6.960	14.560	1.984	7.176
	Parameter	Standard penalty for each grade=(R×parameter)						
6A	0.4358	5.798	7.328	3.635	3.033	6.345	0.865	3.363
5A	0.6000	7.982	10.090	10.536	4.176	8.736	1.190	4.306
4A	0.7141	9.500	12.008	12.540	4.970	10.397	1.417	5.124
3A	0.8000	10.643	13.543	14.048	5.568	11.648	1.587	5.741
2A	0.8661	11.523	14.564	15.290	6.028	12.610	1.718	6.215
A	0.9164	12.192	15.410	16.092	6.378	13.343	1.818	6.576
B	0.9539	12.690	16.041	16.750	6.639	13.889	1.893	6.845
C	0.9789	13.035	16.471	17.205	6.819	14,266	1.944	7.031
D	0.9944	13.229	16.722	17.462	6.921	14.478	1.973	7.136
E	1.0000	13.304	16.816	17.560	6.960	14.560	1.984	7.176
Classification		Max value — (R×parameter)					Actual penalty	
6A	math/curr	92/94 above	87/87 above	96/96 above	96/95 above	93/92 above	1.40/1.60 below	4.0/4.3 below
5A	math/curr	90/93 above	84/85 above	93/95 above	95/94 above	91/90 above	1.73/1.75 below	4.9/4.7 below
4A	math/curr	88/91 above	83/83 above	91/94 above	94/93 above	89/88 above	1.96/1.90 below	5.7/5.2 below
3A	math/curr	87/89 above	81/80 above	90/93 above	94/92 above	88/86 above	2.13/2.10 below	6.3/5.7 below
2A	math/curr	86/86 above	80/77 above	89/92 above	93/90 above	87/83 above	2.26/2.30 below	6.8/6.2 below
A	math/curr	86/84 above	79/75 above	88/90 above	93/88 above	86/79 above	2.36/2.50 below	7.2/6.7 below
B	math/curr	85/82 above	78/73 above	87/88 above	93/96 above	86/75 above	2.43/2.70 below	7.4/7.3 below
C	math/curr	85/80 above	78/70 above	86/85 above	93/84 above	85/70 above	2.48/2.95 below	7.6/8.0 below
D	math/curr	84/77 above	77/76 above	86/81 above	92/82 above	85/64 above	2.51/3.20 below	7.7/8.7 below
E	math/curr	84/77 below	77/66 below	86/81 below	92/82 below	85/64 below	2.51/3.20 above	7.7/8.7 above

Notice: Math.. Mathematical grade, Curr.. Current grade