

RAW SILK TESTING

1: Introduction

Silk weaving has reached a very high standard of industrial efficiency. In fact, today a number of varieties of silk fabrics are produced on handlooms and sophisticated power looms. This requires different qualities of raw silk. In order to assist the weaving industry in the selection of the required raw silk, it must be first tested and classified. Further, the raw silk reeling industry requires well-defined standards, which can only be achieved by silk testing. As the demand for silk is global and a number of countries compete in the trade of raw silk, it is necessary that there should be industry standards for raw silk quality so as to enable buyers to purchase raw silk at internationally accepted grades. This is the reason why all raw silk produced should be classified following testing.

The testing of raw silk is based on the procedure laid down by the International Silk Association (I.S.A.).

2: Quality test

2.1 Visual Inspection

This test is conducted on the whole lot of raw silk, which has to be classified. This is carried out in an inspection room, which is well illuminated. There are three main factors that have to be tested. These are:

2.2 Uniformity

In this test, the entire lot is inspected to assess the uniformity of colour, lustre and feel. The result is not recorded in the I.S.A. method, but is classified as good, fair and inferior under the Japanese method.

2.3 General finish

Here, considering the presence and degree of a number of defects assesses the general finish of the lot. These defects are:

- i. **Re-reeling.** Gummed skeins; gummed spots on skeins; double ends; irregular traverse and partial flack of traverse.
- ii. **Finish.** Tangled filament, defective lacing, filament out of place in skein (pulled filaments loose).
- iii. **Arrangement.** Lacing of booking card through skeins; non-uniform skeins; wrong twisting; raised filament; streaky filament; cut ends; discoloured skeins; foreign matter on skeins; irregular skeins on book; knots on skeins; skeins or books of different types.
- iv. **Damage.** Books of irregular shape; gummed books, soiled filaments; frayed skeins; insect attached skeins; musty skeins, etc.

The results are expressed in terms such as good, fair, poor or inferior. Outstanding defects are mentioned in the Test Certificate.

2.4 Nature

The degrees of Colour and Lustre and the Smoothness or Hand of the lot are inspected and indicated in the following manner:

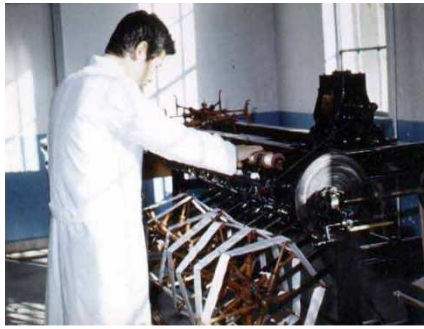
- i. Colour: light, medium or deep
- ii. Lustre : bright, medium or dull
- iii. Hand : smooth, medium or rough

3: Sample test

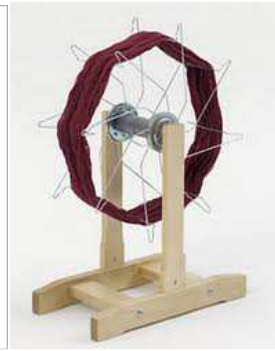
After completion of the test on the whole lot, the following tests have to be conducted. To conduct these tests, it is necessary to take out 50 skeins off the lot if the skeins weigh below 120 g. Alternatively, 25 skeins are taken if the skeins weight over 120 g. Having extracted the required number of skeins, the following test is carried out:

3.1 Winding test

Equipment required: 1. Winding frame 2. Wheels and bobbins



WINDING TESTER



Number of sample skeins drawn out for this test should be 40 skeins out of 50 skeins for a lot which weighs approximately 70 g each and 20 skeins out of 25 skeins drawn out for each skein weighing approximately 140 g.

When winding is started only the top half of the sample skeins should be wound. The winding should be carried out at a predetermined speed for a specific duration. The number of breaks that occur should be counted and noted. When breaks occur, it is necessary to note the cause of each break and this should be recorded.

Table 1. Average speed and winding period for winding test

Size under test	Preliminary winding	Average speed (meter/min.)	Winding period (minutes)	
			70 g skeins	140 g skeins
12 denier or finer	10	110	60	120
13-18	10	140	60	120
19-33	10	165	60	120
34-69	5	165	30	60
70 or coarse	5	165	20	40

The winding speed and duration of winding has also to be adjusted according to the denier of the raw silk being tested. For reference purposes, the different time and speed and other requirements are shown in Table 1.

3.2 Size deviation test

Equipment required:



Small skein sampler for size deviation test



- Sizing reel (1.125 meters in circumference)
- Balance
- Denier scale

Only a fixed length from each skein is taken for the testing. The highest degree of deviation is noted and compared with the average size deviation of the conditioned weight. When testing raw

silk of 33-denier or finer in size, 200 skeins of 450 meters each are taken out by picking out four skeins out of each of the 50 sampling skeins taken from the testing lot. In the case of 34-denier and over, 400 sizing skeins are extracted by picking eight skeins of 112.5 meters in length each from the 50 sample skeins (total length 45 000 meters).

Test: The entire lot of sizing skeins should be in ten separate lots.

Each sizing skein should be weighed on a quadrant scale in each lot separately. The total weight of all the skeins in each lot is therefore obtained. Table 2 indicates the size deviation of the skeins being tested. This table covers the number of skeins in a lot, the graduation in the scale for weighing each skein and all the skeins of a lot together.

Table 2. Number of skins in a lot and graduation in scale

Sizes	No. of skeins in a group	Accuracy of scale		Permissible range of denier
		For 1 skein	For group	
33 denier or finer	20	0.5 denier	0.5 denier	1.5 denier
33-49 denier	40	1.0 denier	2.0 denier	4.0 denier
50-99 denier	40	2.0 denier	2.0 denier	8.0 denier
100 denier or coarser	40	5.0 denier	2.0 denier	19.0 denier

If there is a difference in weight beyond the permissible denier indicated in the above table when the weight of the individual skeins are totaled and compared with the result obtained by weighing all the skeins together, the weighing operations both of single skein and the whole lot must then be repeated. The number of individual sizing skeins of each denier size should be noted in the table of frequency distribution.

3.3 Evenness test

The test is carried out with test samples of a fixed length using a Seriplane. These test samples represent fine passages and coarse ones, divided into 3 groups (Evenness Variation, I, II and III) according to the degree and frequency of size variations.

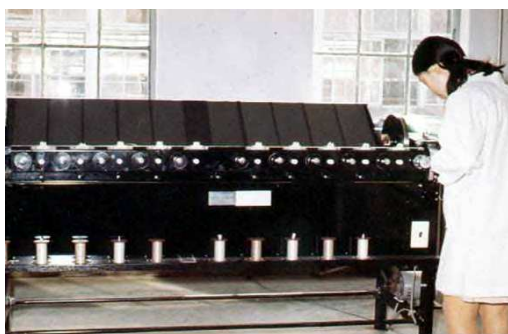
Evenness Variation I: The intensity of variation greater than the V_0 panel but does not exceed V_1 panel of the Standard Variation Photographs.

Evenness Variation II: The intensity of variation greater than the V_1 panel but does not exceed the V_2 panel of the Standard Variation Photographs.

Evenness Variation III: The intensity of variation, which includes all the variations greater than the V_2 panel of the Standard Variation Photographs.

Panel - A panel is a section of raw silk 127 mm wide by 457 mm long uniformly wound from a bobbin on to an inspection board.

Apparatus and equipment: Seriplane (127 x 457 mm), Standard Photographs and Illumination room.



Seriplane winder



Seriplane inspection for cleanness and neatness

Sample: The sample for the test consists of a total of one hundred panels from 50 test samples taken at the rate of two panels from each test sample.

The thread is spaced on the inspection panel according to the size under test as follows:

9 denier or finer	133 threads per	25.4 mm
10 to 12 denier	114	" "
13 to 16 denier	100	" "
17 to 26 denier	80	" "
27 to 36 denier	66	" "
37 to 48 denier	57	" "
49 to 68 denier	50	" "
69 to 104 denier	40	" "
105 to 149 denier	33	" "
150 to 197 denier	28	" "
198 denier or coarser	25	" "

Test: The test is conducted by the estimator from a position of about 2 meter distance directly in front of the inspection panels, which are placed in such a way that the panel receives the same intensity of light by indirect lighting, over the entire board. On any one side of the inspection board, each stripe found on each panel is carefully compared with the standard variation photographs and the intensity of variation is determined. The frequency of evenness Variation **I**, **II** and **III** found with the 100 panels is recorded separately. The record shows each total frequency of variations grouped in Evenness Variation **I**, **II** and **III**.

The evaluation of evenness in the Indian method (Table 41) is indicated by percentage. Percentage is indicated to the nearest 5 percent starting from 100 percent to 50 percent.

Below 50 percent, it is made to the nearest 10 percent. The record then shows the estimated evenness percentage of each panel, the average evenness percentage of a total of one hundred panels and the low evenness percentage of low panels corresponding to one-quarter of the total panels inspected.

3.4 Cleanness test

This test is conducted to ascertain Super Major Defects, Major Defects and Minor Defects. Each defect carries penalty points and the difference of the total penalty points from 100 gives the test result.

Definitions

Cleanness Defects: These are categorized into three general groups, viz., Super Major Defects, Major Defects and Minor Defects

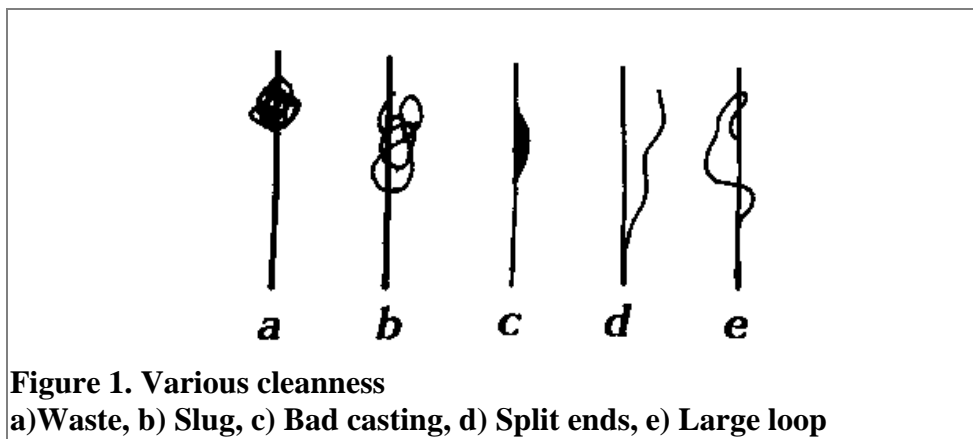
Super Major Defects: All major defects in length or size which are ten times larger than the minimum size of Major Defects are named Super Major Defects.

Major Defects: These are divided into five as follows:

- i. **Waste.** This is a mass of tangled cocoon filaments or fibers attached to the yarn.
- ii. **Large slugs.** These are somewhat thickened places in the thread 7 mm and above in length, or very badly thickened places shorter than 7 mm.
- iii. **Bad casts.** These appear as abruptly thickened places in the yarn due to the cocoon filaments not properly adhering to the raw silk yarn, or caused by feeding more than one cocoon filament at a time.
- iv. **Very long knots.** These are knots, which have loose ends, 10 mm and over, or those made by incorrect tying of threads.
- v. **Heavy corkscrews** are places in which one or more cocoon filaments are longer than the rest, and give the appearance of a very coarse and large spiral.

Minor Defects: The minor defects are subdivided into four as follows:

- a. **Small slugs,** which are considerably thickened places in the thread from 2 to less than 7 mm in length, or extremely thickened places less than 2 mm in length.
- b. **Long knots** are knots, which have loose ends below 10 and more than 3 mm in length.
- c. **Corkscrews** are places in which one or more cocoon filaments are longer than the remainder, and give the appearance of a thick spiral.
- d. **Long loops** or loose ends are loops or split ends, 10 mm and above in length, when measured along the filament.



Apparatus and equipment: Standard Photograph for cleanness, Seriplane and lighting equipment.

Sample: The same as given under Evenness test.

Test:In this test the inspector stands in a position of about 0.5 meters (2 feet) directly in front of the inspection panels, under the same conditions of lighting as for the cleanness test. The actual number of cleanness defects of each class and kind of defect described above, are counted on the yarns on both sides of the inspection panel, omitting the parts on its edges. The class and kind to which each defect belongs is determined by comparing it with the Standard Photographs for cleanness defects. The record should indicate the number of defects in 100 panels found by testing and also show the cleanness percentage, which is determined by deducting from 100 percent the total penalty calculated by penalizing each defect with the following rate:

For each super major defect 1.0 percent

For each major defect 0.4 percent

For each minor defect 0.1 percent

3.5 Neatness test

Neatness defects: Imperfection in raw silk yarn, which are smaller than those described as minor cleanness defects are known as neatness defects. Nibs are small thickened places or spots in the yarn less than 2 mm in length. Loops are small open places in the yarn caused by the excessive length of one or more cocoon filaments, less than 10 mm in length when measured along the filament. Hairiness and fuzziness are the conditions of yarn, which show small loose ends of less than 10 mm and fine particles of cocoon filaments protruding from the yarn. Small knots are knots, which have loose ends, less than 3 mm in length. Fine corkscrews are places in which one or more cocoon filaments are longer than the remainder and give the appearance of a spiral.

Apparatus and equipment: The Standard Photographs for neatness defects, Seriplane and lighting equipment.

Sample: The same as given in the Cleanness test.

Test:The test is conducted by the inspector, from a position of about 0.5 meters (2 feet) distance directly in front of the inspection panels, under the same conditions of lighting as for the neatness test. Each panel on any one side of the inspection board is carefully compared with the Standard Photographs for neatness defects and its neatness value is estimated in percentages. From 100 to 50 percent, the estimate should be to the nearest 5 percent. Below 50 percent, it should be made to the nearest 10 percent. The record should indicate the estimated neatness percentage of each panel, the average neatness percentage of a total of one hundred panels and the low neatness percentage represented by the average percentage of the low panels, i.e. on fifth (20 panels) of all panels examined. In the Japanese method, Cleanness and Neatness is represented as a mixed item by deducting the rate of Neatness results from the Cleanness percentage as shown in Table 37.

Table 3. Deducting points by Neatness results

Neatness	Deducting points	Neatness	Deducting points
Above 80	0		

75	0.25	50	1.5
70	0.5	40	2.0
65	0.75	30	2.5
60	1.0	20	3.0
55	1.25	10	3.5

3.6 Tenacity and elongation test

To test the strength of the raw silk, the breaking point (g per denier) and the degree of elongation (percentage) is carried out on the Serigraph. This test is conducted in a room, which is maintained at a standard temperature of 25°C and a humidity of 65 percent.

Apparatus: Serigraph, sizing reel and scale.



Tenacity and elongation tester

Sample: Ten test pieces taken out of 50 test pieces. From each one of these ten test pieces, ten sizing skeins shall be prepared for tenacity and elongation test.

Test: The sizing skeins to be tested are placed in a room, where standard humidity can be maintained, for a sufficient amount of time to allow them to become adjusted to standard conditions.

Each sizing skein is then tested for tenacity and elongation using the serigraph, which is placed in the room under the same standards of humidity. The tenacity is expressed in grams per denier, while the elongation is expressed in percentage of total stretch of the portion tested. The result is indicated by the average results of ten sizing skeins. The result of tenacity is calculated by omitting the figures after the second decimal.

3.7 Cohesion test

By means of the Duplan cohesion tester, the number of frictions required to split silk thread for the purpose of examining the state of cocoon filaments sticking together, can be counted. This test is conducted in a room kept at standard temperature and humidity.

Apparatus: Duplan cohesion tester.



Duplan type cohesion tester

Sample: the sample for the test should consist of 20 test pieces taken out of 50 test pieces. The yarn should be free from any cleanness defect or apparent evenness defect in the portion, which is to be tested.

Test: The test is performed in a room where standard humidity can be maintained during the test. The maximum speed of stroke should be 140 strokes per min. The machine should be stopped after every ten strokes and every single yarn inspected very carefully to see if there are any open places. As soon as ten different open spaces, 6 mm long and above are observed, they are recorded against

the number of strokes which should be considered as the strokes of the thread opened. The record of the test is the average number of strokes of 20 test pieces. The result of cohesion is recorded by omitting the decimal.

Table 4-ISA classification table for raw silk of category I (18 denier and finer)

Grade		4A	3A	2A	A	B
Major items						
Size	12 d. and below	0.80	0.95	1.10	1.35	above 1.35
Deviation (denier)	13 d. - 15 d	0.90	1.05	1.25	1.50	above 1.50
	16 d. - 18 d.	1.00	1.20	1.40	1.70	above 1.70
Evenness Variation I (count)		150	170	190	210	above 210
Evenness Variation II (count)		10	17	26	37	above 37
Cleanness (%)		97	95	93	88	below 88
Average Neatness (%)		94	92	90	87	below 87
Low Neatness (%)		90	87	83	77	below 77
Class		(1)	(2)	(3)	(4)	(5)
Auxiliary						
Maximum Deviation (denier)	12 d. and below	2.2	2.6	3.0	3.6	above 3.6
	13 d. - 15 d	2.4	2.8	3.3	4.1	above 4.1
	16 d. - 18 d.	2.7	3.2	3.8	4.6	above 4.6
Evenness Variation III (count)		0	1	2	6	above 6
Class		(1)	(2)		(3)	(4)
Auxiliary						
Winding (breaks)	12 d. and below	7	15		25	above 25
	13 d. - 18 d.	5	12		21	above 21
Class		(1)				(2)
Auxiliary						
Tenacity (grams)		3.7				below 3.7
Elongation (%)		18				below 18
Cohesion (strokes)		40				below 40

Table 5-ISA classification table for raw silk of category II

Grade		4A	3A	2A	A	B
Major items						
Size	19 d. - 22 d.	1.15	1.35	1.60	1.95	above 1.95
Deviation	23 d. - 25 d.	1.30	1.50	1.80	2.20	above 2.20
(denier)	26 d. - 29 d.	1.40	1.65	1.95	2.35	above 2.35
	20 d. - 33 d.	1.50	1.75	2.05	2.50	above 2.50
Evenness Variation I (count)		150	170	190	210	above 210
Evenness Variation II (count)		10	17	26	37	above 37
Cleansness (%)		97	95	93	88	below 88
Average Neatness (%)		94	92	90	87	below 87
Low Neatness (%)		90	87	83	77	below 77
Class		(1)	(2)	(3)	(4)	(5)
Auxiliary						
Maximum	19 d. - 22 d.	3.1	3.6	4.3	5.3	above 5.3
Deviation	23 d. - 25 d.	3.5	4.1	4.9	5.9	above 5.9
(denier)	26 d. - 29 d.	3.8	4.5	5.3	6.3	above 6.3
	30 d. - 33 d.	4.0	4.7	5.5	6.8	above 6.8
Evenness Variation III (count)		0	1	2	6	above 6
Class		(1)	(2)	(3)	(4)	
Auxiliary						
Winding (breaks)		4	10	18	above 18	
Class			(1)			(2)
Auxiliary						
Tenacity (grams)			3.7			below 3.7
Elongation (%)			18			below 18
Cohesion (strokes)			60			below 60

Table 6-ISA classification table for raw silk of category III (34 denier and coarser)

Grade		4A	3A	2A	A	B
Major items						
Size	34 d. - 49 d.	2.60	3.10	3.65	4.45	above 4.45
Deviation (denier)	50 d. - 69 d.	3.75	4.40	5.20	6.35	above 6.35
	70 d. and above	4.45	5.25	6.20	7.60	above 7.60
Maximum	34 d. - 49 d.	8.0	9.5	11.0	13.5	above 13.5
Deviation (denier)	50 d. - 69 d.	11.0	13.0	15.5	19.0	above 19.0
	70 d. and above	13.5	16.0	18.5	23.0	above 23.0
Evenness Variation I (count)		150	170	190	210	above 210
Evenness Variation II (count)		10	17	26	37	above 37
Cleanness (%)		97	95	93	88	below 88
Average Neatness (%)		94	92	90	87	below 87
Low Neatness (%)		90	87	83	77	below 77
Class		(1)	(2)	(3)	(4)	(5)
Auxiliary						
Evenness Variation III (count)		0	1	2	6	above 6
Class		(1)	(2)		(3)	(4)
Auxiliary						
Winding (breaks)	34 d. - 69 d.	1	6		13	above 13
	70 d. and above	0	4		10	above 10
Class		(1)				(2)
Auxiliary						
Tenacity (grams)				3.7		below 3.7
Elongation (%)				18		below 18

Table 7- Indian classification table for Class I raw silk (2.0 tex (or 18 denier) and finer)

Grade	6A	5A	4A	3A	2A	A	B	C	D	
Major stems										
Size Deviation, (tex or denier)										
1.3 tex (or 12d) (or 12d) and below	0.089 (0.80)	0.094 (0.85)	0.106 (0.95)	0.117 (1.05)	0.128 (1.15)	0.130 (1.25)	0.150 (1.35)	0.167 (1.50)	above 0.167 (above 1.50)	
1.4 to 1.7 tex (or 13 to 15d)	0.100 (0.90)	0.106 (0.95)	0.117 (1.05)	0.128 (1.15)	0.139 (1.25)	0.150 (1.35)	0.167 (1.50)	0.189 (1.70)	above 0.189 (above 1.70)	
1.8 to 2.0 tex (or 16 to 18d)	0.117 (1.05)	0.128 (1.15)	0.139 (1.25)	0.150 (1.35)	0.161 (1.45)	0.178 (1.60)	0.194 (1.75)	0.217 (1.95)	above 0.217 (above 1.95)	
Evenness (%)	94	93	91	89	86	84	82	80	below 80	
Low Evenness (%)	87	85	83	80	77	75	73	70	below 70	
Clearness (%)	96	95	94	93	92	90	88	85	below 85	
Neatness (%)	95	94	93	92	90	88	86	84	below 84	
Low Neatness (%)	92	90	88	86	83	79	75	70	below 70	
Auxiliary	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	
Maximum Deviation, (tex or denier)										
1.4 to 1.7 tex (or 12d) and below	0.23 (2.1)	0.26 (2.3)	0.28 (2.5)	0.30 (2.7)	0.33 (3.0)	0.37 (3.3)	0.40 (3.6)	0.44 (4.0)	above 0.44 (above 4.0)	
1.4 to 1.7 tex (or 13 to 15d)	0.27 (2.4)	0.28 (2.5)	0.30 (2.7)	0.33 (3.0)	0.37 (3.3)	0.40 (3.6)	0.44 (4.0)	0.50 (4.5)	above 0.50 (above 4.5)	
1.8 to 2.0 tex (or 16 to 18d)	0.31 (2.8)	0.33 (3.0)	0.37 (3.3)	0.40 (3.6)	0.43 (3.9)	0.47 (4.2)	0.51 (4.6)	0.58 (5.2)	above 0.58 (above 5.2)	
Auxiliary	(i)		(ii)		(iii)			(iv)		
Winding (breaks)										
1.3 tex (or 12d) and below	10		15		23			above 23		
1.4 to 2.0 tex (or 13 to 18d)	7		12		20			above 20		
Auxiliary	(i)			(ii)			(iii)			
Tenacity g/tex (or g/denier)	33 (3.7)			32 (3.6)			below 32 (below 3.6)			
Elongation (%)	19			18			(below 18)			
Cohesion (strokes) 1.4 to 2.0 tex (or 13 to 18d)	40			35			(below 35)			
Auxiliary	(i)					(ii)				
Cohesion (strokes) 1.3 tex (or 12d) and below	30					below 30				

Table 8- Indian classification table for Class I raw silk (2.1 to 3.7 tex or 19 to 33 denier)

Grade	6A	5A	4A	3A	2A	A	B	C	D	E
Major items										
Size Deviation tex (or denier)										
2.1 to 2.4 tex (or 19 to 22d)	0.128 (1.15)	0.139 (1.25)	0.150 (1.35)	0.167 (1.50)	0.183 (1.65)	0.200 (1.80)	0.217 (1.95)	0.239 (2.15)	0.267 (2.40)	above 0.267 (above 2.40)
2.6 to 3.0 tex (or 23 to 27d)	0.156 (1.40)	0.167 (1.50)	0.183 (1.65)	0.200 (1.80)	0.217 (1.95)	0.233 (2.10)	0.256 (2.30)	0.278 (2.50)	0.300 (2.70)	above 0.300 (above 2.70)
3.1 to 3.7 tex (or 28 to 33d)	0.178 (1.60)	0.194 (1.75)	0.211 (1.90)	0.233 (2.10)	0.256 (2.10)	0.278 (2.50)	0.300 (2.70)	0.328 (2.95)	0.356 (3.20)	above 0.356 (above 3.20)
Evenness (%)	94	93	91	89	86	84	82	80	77	below 77
Low Evenness (%)	87	85	83	80	77	75	73	70	66	below 66
Cleanness (%)	96	95	94	93	92	90	88	85	81	below 82
Neatness (%)	95	94	93	92	90	88	86	84	82	below 82
Low Neatness (%)	92	90	88	86	83	79	75	70	64	below 64
Auxiliary	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)
Maximum Deviation, tex (or denier)										
2.1 to 2.4 tex (or 19 to 22d)	0.33 (3.0)	0.37 (3.3)	0.40 (3.6)	0.44 (4.0)	0.49 (4.4)	0.53 (4.6)	0.58 (5.2)	0.63 (5.7)	0.71 (6.4)	above 0.71 (above 6.4)
2.6 to 3.0 tex (or 23 to 27d)	0.42 (3.8)	0.46 (4.1)	0.49 (4.4)	0.53 (4.8)	0.58 (5.2)	0.63 (5.7)	0.69 (6.2)	0.76 (6.8)	0.82 (7.4)	above 0.82 (above 7.4)
3.1 to 3.7 tex (or 28 to 33d)	0.48 (4.3)	0.52 (4.7)	0.58 (5.2)	0.63 (5.7)	0.69 (6.2)	0.74 (6.7)	0.81 (7.3)	0.89 (8.0)	0.97 (8.7)	above 0.97 (above 8.7)
Auxiliary	(I)		(II)			(III)				
Winding (breaks) above 20	6		10			15			20	
Auxiliary	(I)			(II)			(III)			
Tenacity g/tex (or g/denier)	33 (3.7)			32 (3.6)			below 32 (below 3.6)			
Elongation (%)	19			18			below 18			
Cohesion (strokes)	60			50			below 50			

Table 9- Indian classification table for Class I raw silk (3.8 tex or 34 denier and coarser)

Grade	4A	3A	2A	A	B	C	D	E	
Major items									
Size Deviation, tex (or denier)									
3.8 to 5.4 tex (or 34 to 49d)	0.344 (3.10)	0.389 (3.50)	0.433 (3.90)	0.489 (4.40)	0.556 (5.00)	0.656 (5.90)	0.778 (7.00)	above 0.778 (above 7.00)	
5.6 to 7.7 tex (or 50 to 69d)	0.456 (4.10)	0.511 (4.60)	0.578 (5.20)	0.644 (5.80)	0.744 (6.70)	0.878 (7.90)	1.033 (9.30)	above 1.033 (above 9.30)	
7.8 tex (or 70d) and above	0.567 (5.10)	0.633 (5.70)	0.700 (6.30)	0.789 (7.10)	0.911 (8.20)	1.078 (9.70)	1.267 (11.40)	above 1.267 (above 11.40)	
Maximum Deviation, tex or denier									
3.8 to 5.4 tex (or 34 to 49d)	1.00 (9.0)	1.11 (10.0)	1.22 (11.0)	1.44 (13.0)	1.67 (15.0)	2.00 (18.0)	2.33 (21.0)	above 2.33 (above 21.0)	
5.6 to 7.7 tex (or 50 to 69d)	1.33 (12.0)	1.56 (14.0)	1.78 (16.0)	2.00 (18.0)	2.33 (21.0)	2.67 (24.0)	3.11 (28.0)	above 3.11 (above 28.0)	
7.8 tex (or 70d) and above	1.67 (15.0)	1.89 (17.0)	2.11 (19.0)	2.44 (22.0)	2.78 (25.0)	3.22 (29.0)	3.78 (34.0)	above 3.78 (above 34.0)	
Evenness (%)	91	89	86	84	82	80	77	below 77	
Low Evenness (%)	83	80	77	75	73	70	66	below 66	
Cleanness (%)	94	92	90	87	83	79	75	below 75	
Neatness (%)	93	91	89	87	84	81	78	below 78	
Low Neatness (%)	87	85	82	78	74	68	62	below 62	
Auxiliary	(I)		(II)		(III)		(IV)		(V)
Winding (breaks)									
3.8 to 7.7 tex (or 34 to 69d)	3		6		10		15		above 15
7.8 tex (or 70d) and above	2		4		6		10		above 10
Auxiliary	(I)			(II)			(III)		
Tenacity									
h/tex (or g/denier)	33 (3.7)			32 (3.6)			below 32 (below 3.6)		
Elongation (%)	19			18			below 18		

Grades - For classification purposes, raw silk is divided into three categories according to their sizes:

SIZES	GRADES
18 D AND BELOW	6A, 5A, 4A, 3A, 2A, A, B, C, D
19 TO 33 D	6A, 5A, 4A, 3A, 2A, A, B, C, D, E
34 D AND ABOVE	4A, 3A, 2A, A, B, C, D, E

6: Miscellaneous tests

Quantitative test

4.1 Conditioned weight test

When weighing the gross weight and the dried weight of raw silk, the conditioned weight is calculated by adding 11 percent (International Standard Regain) to the dried weight.

The conditioned weight of raw silk is obtained as follows:

All skeins of raw silk for the test are put into a room with a constant temperature and humidity for 12 hours. 20 skeins are picked up for a test unit and are then weighed separately as the original weight.

Two skeins are selected from the sample for the conditioned weight test.

The sample skeins are dried in an oven one by one with the drying temperature at 140°C. The drying is continued until the different at every weighing (every 5 minutes) is within 0.1 g.

Moisture regain is calculated as follows:

If the different between both skeins in moisture regain is over 0.5%, another one is tested again.

$$\text{Moisture regain (\%)} = \frac{(\text{original weight} - \text{dry weight})}{\text{dry weight (g)}} \times 100$$

The total conditioned weight of the unit could be obtained from the total original weight multiplying by the following coefficient.

The coefficient of the conditioned weight is obtained by:

$$\text{Coefficient } t = \frac{1.11}{1 + \text{moisture regain (\%)}}$$

Notice:

$$\text{Moisture content (M.C.)} = \frac{W - W'}{W} \times 100$$

$$\text{Moisture regain (M.R.)} = \frac{W - W'}{W'} \times 100$$

Where, W is the original weight and W' is the dry weight.

5 Raw silk classification

5.1 Boil-off test for raw silk

a) United States Method

- **Object** – The purpose of the Boil-off test on raw silk is to determine the percentage of sericin and water-soluble substance which the silk contains.

- **Apparatus –a) Boil-off kettle** – A suitable receptacle for boiling off the silk.

b)Oven – Conditioning oven with forced ventilation efficient to dry the skeins within the time specified, positive value control, capable of drying the sample skeins at 140°C. The conditioning ovens should be equipped with a balance arranged to weigh

the skeins with an accuracy of one centigram while suspended within the drying chamber, the hold of the skeins to be of such type as to insure free access of the dry air to all skins.

- **Water** – The water used for all parts of the test should be zero hardness.
- **Soap** - The soap should be properly saponified "neutral" soap in chip or

Chemical requirements

Moisture and volatile matter at 105°C, max. percent10.0

Sum of free alkali or free acid, total insoluble matter in alcohol, and sodium chloride, max. percent4.0

Free acid calculated as oleic acid, max. percent0.2

Free alkali, calculated as NaOH, max. percent0.2

Insoluble matter in water, max. percent1.0

Titer of mixed fatty acids prepared from soap16 to 26°C

Anhydrous soap content, min. percent85.0

- **Samples** - Ten skeins, not more than one skein from one book, are taken to represent a five or ten bale lot. Approximately 10 g are removed from each skein. The silk removed from the original skeins is grouped into two parts of approximately 50 g each and marked, "part number one and part number two".
- **Dry weight before boiling** - Dry samples Part 1 and Part 2 separately in a conditioning oven at 140°C to constant weight as determined by successive weighings at five minute intervals. The first weighing is made at the expiration of the first fifteen (15) minutes of drying. The second weighing, made five minutes after the first weighing, is taken as the dry

weight provided that the loss between the successive weightings does not exceed one centigram.

- **Boiling** - The samples are boiled for 45 minutes in a one percent soap solution. The weight of the soap should be 25 percent of the weight of the sample and the water 100 times the weight of the soap.
- **Rinsing** = Rinsing should take place in two baths containing water at 60°C, the volume of which should not be less than 25 times the weight of the sample.
- **Boiling – Second boil** - The samples are boiled again for 30 minutes in 2.5 liters of water per 100 grams of silk, i.e. 25 times the original weight of the sample (no soap).
- **Rinsing** – Repeat the rinsing operation.
- **Centrifuge and dry at room temperature.**
- **Dry weight after boiling** – Dry and weigh the samples using the same procedure as described above.
- **Loss in boiling-off** – The difference between the dry weight of the combined weight (Parts 1 and 2) before boiling and the dry weight of the combined weight (Parts 1 and 2) after boiling is the loss in boiling-off. The percentage of loss in boiling-off should be calculated individually per Parts 1 and 2. If the percentage of loss for each of the two parts differs by more than 1 percent, the test should be repeated. The average results of the first test and the repeat test should be reported.

6: Exfoliation test for raw silk

- **Definition** – Exfoliation in raw silk is the undesirable property of the individual filaments of silk split into very fine fibrils. These fibrils initially do not absorb dye as readily as the main fibres and show up after dyeing as fine white fuzz on the surface of the silk yarn and fabric. The Exfoliation Test, as outlined below, is made on raw silk and the degree to which the raw silk tends to exfoliate can thereby be determined.
- **Sample** – The sample for the Exfoliation Tests consists of twenty original skeins drawn at random, an equal number from each bale of the lot, from different parts of the bale. Not more than one skein from any one book except in cases where the lot is composed of fewer than twenty books, and then more than one skein may be drawn from one book as is necessary to make up the twenty skein sample. The sample skeins are wound on regular winding bobbins for a period of twenty minutes.
- **Preparation of panels** – Twenty panels, one from each sample bobbin, is reeled on the metal frames on a specially modified seriplane equipped for this purpose. The size of the panels is 4 and three-quarters inches high and 3 and one-quarter inches wide. The threads are spaced at 25 threads per inch. Each frame is made to hold five panels, making a total of four frames of five panels each for each test. The specially modified seriplane is so constructed that the silk may be reeled on either one or on two frames at the same time. After the silk is reeled on the frames, the frames are placed in special racks for degumming and dyeing. The degumming and dyeing racks are made to hold eight frames or two lots each. Either four or eight frames (one or two lots) may be degummed and dyed at one time.
- **Degumming and dyeing** – The degumming and dyeing are done at the same time in a solution made up as follows:

Approximately twenty-four liters of water are put into the degumming and dyeing tank and the water is heated. Sixty g of sodium metasilicate are thoroughly dissolved in one liter of hot water and poured into the tank. Thirty g of dye are thoroughly dissolved in another liter of hot water and poured into the tank. The solution in the tank is then stirred thoroughly. A special dye known as United States Testing Company Sky blue S due is used. The thermometer should be left suspended in the solution at all times. When the temperature of the solution has risen to 195°-200°F, the racks holding the frames are placed in the solution and left there for 20 minutes. During the 20minute period, the temperature of the solution should be maintained between 195°-200°F. The same solution may be used a second time for one or two additional lots (four or eight frames). If the same bath is used a second time, ten g of dye are added to the solution, but no additional sodium

metasilicate is required. The added dye must be dissolved thoroughly in one-half (½) liter of water before being poured into the solution. Sufficient hot water should be added to the solution to maintain the level of the solution high enough to cover the frames. The same solution should not be used for more than two degumming and dyeing operations. It is necessary that the tank be drained and thoroughly rinsed at the end of every day even though the solution has been used for only one degumming and dyeing operation. After 20 minutes, the rack is removed from the degumming and dyeing solution and the frames are rinsed in the rinsing tank to remove excess dye. The rinsing tank is filled with warm water and rinsing is carried out by dipping the rack containing the frames up and down in the warm water three or four times. The silk on the frames is then dried thoroughly. The silk can be dried at room temperature or exposing the silk on the frames to a warm air blast or dried on the frames in a suitable warm oven. If the silk is dried in an oven, care must be taken not to scorch the silk.

- **Preparation of the panels for inspection** – It will be found that the silk threads on the frames will have a tendency to cling together in groups of three to six threads after the degumming and dyeing operation. After the silk has dried, the threads must be carefully separated before the silk is inspected. The separation of the threads can best be done while the frames are on the inspection racks. The threads can usually be separated by running a smooth glass rod, or similar instrument, horizontally across the threads near the top and bottom of the frame. In some cases, it may be necessary to separate some of the threads by means of a needle run vertically between the threads. These operations must be done on both the front and back surfaces of the frame. Extreme care must be taken in separating the threads in order to prevent breaking the filaments or threads. A limited amount of experience and practice will show the best way to separate the threads.
- **Inspection and grading of the panels** – The inspection and grading of the panels is done on the American Standard Inspection Rack. The two special holders are suspended over the top of the overhead light reflector so that the exfoliation frames can be placed in front of the light reflector, the top of the frame being approximately 1 and five-eighths inches below the forward edge of the reflector. A black seriplane board is placed in the upper brackets of the seriplane inspection rack behind the exfoliation frames. The seriplane board is inclined towards the inspection frames to an angle of approximately 40° from the vertical. The angle may be varied slightly so that the silk thread defects can be more easily observed. The exfoliation frames are maintained in a vertical position. Each of the twenty panels is given a rating by comparison with the standard photographs rated as follows: 90-80-70-60-50-30. Each panel is compared with the standard photographs and is given one of the following ratings in accordance with the standard: 100-95-90-85-80-75-70-65-60-50-40-30-20-10. If any filaments have been broken in the separation of the threads which have clung together after degumming and dyeing, care should be taken that the broken filaments are not mistaken for exfoliation and penalized. This difference can be detected after some experience in inspecting panels.
- **Calculation and rating reports** – The general average is obtained by calculating the average of the twenty individual ratings of the twenty panels. The penalty average is obtained by calculating the average of the lowest five panels.
- **The classification degree** is the average of the general average and the penalty average. The rating is based on the classification degree as follows:

Perfect	95 and higher
Excellent	85 to 94.99
Good	75 to 84.99
Fair	65 to 74.99
Poor	50 to 64.99
Very poor	10 to 49.99

Dye for exfoliation test, United States method

United States Testing Co., "Sky Blue S. Dye". This dye has the following formula:

	Class	Colour Index
Alphazurine A : 16 percent	Acid	714(NAC)
Wool Violet 4BN : 15 percent	acid	698(NAC)
Glauber Salt : 69 percent		

The two (2) dyes (Alphazurine A and Wool Violet 4BN) are strong colours. For this Exfoliation test, Glauber salt could be omitted and less dye required to obtain the desired colour for the test. In that case, the following proportions are suggested:

	Class	Colour Index
Wool Violet 4BN : 48 percent	acid	698(NAC)
Alphazurine A : 52 percent	acid	714(NAC)
