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SPECIFICATION FOR
WHITE SUGAR
(Second Revision)

SRI LANKA STANDARDS INSTITUTION

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SLS 191: 2017

(Corrigendum No.1 and No. 2 attached)

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SRI LANKA STANDARDS INSTITUTION
No, 17 , Victoria Place
ElvitigalaMawatha,
Colombo 08.
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Sri Lanka Standard
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FOREWORD

This Standard was approved by the Sectoral Committee on Food Products and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2017-12-04.

White sugar is manufactured from sugar cane or sugar beet, in general by a process of purification, consisting broadly of affination, melting, chemical treatment, filtration, decolourization and subsequent re-crystallization in vacuum pan, the treatment depending upon the nature of the initial material. It may be of any grain size (large, medium or small).

This Standard was first published in 1973 and revised in 1989. In this revision, raw sugar was excluded from the Standard as it was imported only for refining purposes and it does not reach to the final consumer and requirements for crystal candy sugar and sugar cubes were introduced. The test methods for most of the chemical requirements have been revised to fall in line with the International Commission for Uniform Methods of Sugar Analysis (ICUMSA) and SARSO refined sugar Standard.

The polarization value specified for icing sugar is for the product free of anticaking agents and starch. In the case of icing sugar containing anticaking agents or starch, there is no workable method developed to remove such additives. The possibility of specifying a polarization value for icing sugar containing additives is under consideration by the ICUMSA and the Codex Allimentarius Commission. The specified value will be reviewed when additional data is available at future late.

This Standard is subject to the restrictions imposed under the Food Act No. 26 of 1980 and the regulations framed thereunder.

For the purpose of deciding whether a particular requirement of this Standard is complied with, the final value, observed or calculated, expressing the result of a test or an analysis, shall be rounded off in accordance with **SLS 102**. The number of significant places retained in the rounded off value should be the same as that of the specified value in this Standard.

In the preparation of this Standard, valuable assistance derived from the publications of the International Commission for Uniform Methods of Sugar Analysis, South Asian Regional Standards Organization and the Codex Alimentarius Commission is gratefully acknowledged.

1 SCOPE

This Standard prescribes the requirements and methods of sampling and test for white sugar.

2 REFERENCES

SLS 102 Rules for rounding off numerical values.
SLS 143 Code of practice for general principles of food hygiene.
SLS 311 Method for the determination of lead.
SLS 312 Method for the determination of arsenic.
SLS 428 Random sampling methods.
SLS 699 Low density polyethylene films for packaging and allied purposes.
SLS 700 Jute Bags.

3 DEFINITIONS

For the purpose of this Standard the following definitions shall apply:

3.1 crystal candy sugar : Sugar crystallized by repeated boiling and slow evaporation. Large crystals of sugar formed by suspending strings in a strong sugar solution that hardens on the strings.

3.2 icing sugar : Finely pulverized refined white sugar with or without the addition of starch or permitted anticaking agent.

3.3 plantation white or mill white sugar: Crystalline sugar, off white in colour free from dirt and/or any other extraneous matter and manufactured by the vacuum pan process.

3.4 refined white sugar : White sugar (See **3.1**) which has been further purified to obtain white, odourless, crystalline sugar free from dirt and/or any other extraneous matter.

3.5 sugar cubes : Sugar cubes are small lumps of sugar shaped into cubes and used mainly for sweetening coffee/tea.

4 TYPES

White Sugar shall be of following types :

a) Refined white sugar;
b) Plantation white or mill white sugar;
c) Icing sugar (powdered sugar);
d) Crystal candy sugar; and
e) Sugar cubes.

5 ADDITIVES

5.1 The following anticaking agents may be used in icing sugar to a maximum of 1.5 per cent by mass, singly or in combination, provided starch is not present.

a) Calcium phosphate, tribasic;
b) Magnesium carbonate;
c) Silicon dioxide, amorphous (dehydrated silica gel);
d) Calcium silicate;

e) Magnesium trisilicate; and
f) Sodium calcium aluminosilicate.

5.2 If icing sugar contains starch, other anticaking agents shall not be present and the starch content shall not exceed 5 per cent by mass.

6 REQUIREMENTS

6.1 Hygiene

The product shall be manufactured, packaged, stored, transported and distributed in accordance with the hygienic conditions as prescribed in **SLS 143**.

6.2 General requirements

White sugar shall be odourless, white and free from dirt, iron filings and other extraneous matter.

NOTE : *Not applicable for plantation white sugar or mill white sugar.*

6.3 Other requirements

White sugar shall comply with the requirements given in Table **1** when tested according to the methods prescribed in Column **8** of table **1**.

TABLE 1 - Requirements for white sugar

Sl. No.	Characteristic	Requirement					Method of test
		Refined white sugar	Plantation white or mill white sugar	Icing sugar	Crystal candy sugar	Sugar cubes	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Polarization value, °S, min.	99.7	99.5	99.7*	99.7	99.7	Appendix B
ii)	Invert sugar, per cent by mass, max.	0.04	0.1	0.04	0.04	0.04	Appendix C
iii)	Loss on drying for 3 hours at 105 °C, per cent by mass, max.	0.10	0.10	0.10**	N/A	N/A	Appendix D
iv)	Conductivity ash, per cent by mass, max.	0.04	0.10	0.04*	0.04	0.04	Appendix E
v)	Colour in ICUMSA units,max.	60	200	60*	60	60	Appendix F
vi)	Water insoluble matter, per cent by mass, max.	N/A	0.1	N/A	N/A	N/A	Appendix G
vii)	Sulfur dioxide, mg/kg, max.	15	70	15	15	15	Appendix H

***** *The value specified is for icing sugar free of anticaking agents and starch (See Foreword).*
***Does not apply to icing sugar to which starch has been added.*

6.4 Heavy Metals

The product shall not exceed the limits for heavy metals given in Table **2**, when tested according to the methods given in Column **4** of Table **2**.

TABLE 2 - Limits for trace metals in white sugar

SI. No. (1)	**Heavy metal** (2)	**Limit** (3)	**Method of test** (4)
i)	Arsenic, mg/kg, max.	1.0	AOAC 999.10
ii)	Copper, mg/kg, max.	2.0	AOAC 960.40
iii)	Lead, mg/kg, max.	0.5	AOAC 994.02
iv)	Chromium, mg/kg, max.	2.0	Appendix J
v)	Cadmium, mg/kg, max.	1.5	AOAC 999.11

7 PACKAGING

7.1 Bulk packages

White sugar shall be packaged in clean woven polypropylene or jute bags conforming to **SLS 700**. The bag shall be lined / laminated/ extrusion coated with an inner food grade polyethylene lining conforming to **SLS 699**. The lining shall have a minimum thickness of 40 µm. The mouth of the each bag shall be securely fastened.

Any other food grade packaging material equivalent or superior in barrier properties to polyethylene may also be used.

7.2 Retail packages

White sugar shall be suitably packaged in food grade plastic polyethylene bags conforming to **SLS 699** or suitable food grade packaging material. The bag shall have a minimum thickness of 50 µm.

8 MARKING AND/OR LABELLING

8.1 Bulk packages

Each bag shall be legibly and indelibly marked or labelled with the following:

a) Name of the product including the type;
b) Brand name or trade name, if any;
c) Net mass of the product (in kg);
d) Name and address of the manufacturer,
e) Batch number or code number.

f) Country of origin;
g) year of manufacture / crop year; and
h) Date of the expiry.

8.2 Retail packages

Each bag or container shall be legibly and indelibly marked or labelled with the following:

a) Name of the product including the type;
b) Brand name or trade name, if any;
c) Net mass of product; in “g” or “kg”
d) Name and address of the manufacturer or packer, (including the country of origin);
e) Batch number or code number;
f) Month and year of manufacture;
g) Date of repacking; if applicable
h) Date of the expiry; and
j)Declaration of additives; if any.

10 METHODS OF TEST

Tests shall be carried out as prescribed in the appropriate appendices **B** to **J** of this Standard and AOAC 960.40, AOAC 994.02, AOAC 999.10, and AOAC 999.11.

12 CRITERIA FOR CONFORMITY

A lot shall be declared as conforming to the requirements of this Standard if the following conditions are satisfied.

12.1 Each container inspected as in **A.7.1** satisfies the relevant requirements.

12.2 The test results on the composite sample when tested as in **A.7.2** satisfy the relevant requirements.

APPENDIX A
SAMPLING

A.1 LOT

In any consignment all containers of sugar of the same type and belonging to one batch of manufacture or supply shall constitute a lot.

A.2 GENERAL REQUIREMENTS OF SAMPLING

A.2.1 Samples shall be taken in a protected place not exposed to damp air, dust or soot.

A.2.2 Precautions shall be taken to protect samples, the material being sampled, the sampling instruments and the containers for samples from adventitious contamination.

A.2.3 The sampling instrument shall be clean and dry when used.

A.2.4 The samples shall be placed in clean, dry and moisture proof containers which shall be sealed air-tight after filling and marked with necessary details of sampling.

A.2.5 The samples shall be protected from light as far as possible.

A.3 SAMPLING INSTRUMENT

A sampling tube or an appropriate instrument shall be used.

A.4 SCALE OF SAMPLING

Samples shall be tested from each lot for ascertaining its conformity to the requirements of this Standard.

A.4.1 Sampling from bulk containers

A.4.1.1 If a lot constitutes of bulk containers, then the number of containers to be selected from the lot shall be in accordance with Table 3.

TABLE 3 - Scale of sampling for bulk containers

Number of containers in the lot (1)	Number of containers to be selected (2)
Up to 150	5
151 to 500	12
501 to 3 200	17
3 201 to 10 000	25
10 001 to 25 000	35

A.4.1.2 If a lot contains more than 25,000 bulk containers, then the lot shall be divided into two or more equal or almost equal sub groups. These sub divisions shall be considered as separate lots.

A.4.2 Sampling from retail containers

A.4.2.1 If a lot constitutes of retail containers, then the number of retail containers to be selected from the lot shall be in accordance with Table 4.

TABLE 4 - Scale of sampling for retail containers

Number of retail containers in the lot (1)	Number of retail containers to be selected (2)
Up to 150	6
351 to 280	8
281 to 500	12
501 to 1 200	16
1 201 and above	20

A.4.2.2 The bulk containers and retail containers shall be selected at random. In order to ensure randomness of selection random numbers as given in **SLS 428** shall be used.

A.5 PREPARATION OF SAMPLES

A.5.1 Samples from bulk containers

Approximately equal quantities of material shall be taken from the top, middle and bottom portions of each container selected as in **A.4.1.1** with the help of an appropriate sampling instrument. The material thus obtained shall be mixed together and reduced using coning and quartering method to get composite sample of approximately 1 500 g.

A.5.2 Samples from retail containers

The containers selected as in **A.4.2.1** shall be emptied on a clean surface. The material shall be mixed together and reduced using coning and quartering methodto get a composite sample of approximately 1 500 g.

A.6 REFERENCE SAMPLE

If a reference sample is required the size of the composite sample shall be 4500 g. The sample thus obtained shall be divided into three equal parts, one for the purchaser, one for the supplier and the third for reference.

A.7 NUMBER OF TESTS

A.7.1 Each container selected as in **A.4.1.1** or **A.4.2.1** shall be inspected for packaging and marking and/or labelling requirements.

A.7.2 The composite, sample prepared as in **A.5.1** or **A.5.2** shall be tested for requirements given in clause **6.2**, **6.3** and **6.4**.

APPENDIX B
DETERMINATION OF POLARIZATION

B.1 REAGENTS AND MATERIALS

B.1.1 Basic lead acetate solution

Dissolve 560 g of basic lead acetate powder in 1 litre of freshly boiled distilled water, which has been previously cooled in a sealed container. Boil for 30 minutes and allow to settle overnight in a sealed container. Decant the supernatant liquid and dilute with freshly boiled distilled water to 1.25 specific gravity (54 ° Brix).

B.1.2 Filter paper, having moisture content in the range of 6 per cent to 8 per cent, determined by drying for 3 hours at 100 °C (see Note 1).

B.2 APPARATUS

B.2.1 Saccharimeters, fitted with the International Sugar Scale (as defined at the Eighth Session of ICUMSA) or calibrated by means of quartz plates to read International Sugar Degrees (see Note 2).

B.2.2 Quartz plates, having the design, material, workmanship, dimensions and properties of the quartz plates of an internationally acceptable standard (see Note 3).

B.2.3 Balances, having a sensitivity of 0.002 g.

B.2.4 Flasks, individually calibrated (see Note 4).

B.2.5 Tubes and accessory equipment, 200-mm glass or metal tubes either with end-filling or centre-filling (see Note 5).

B.2.6 Cover glasses, free from internal strain and having plane faces which are parallel to within 5 minutes of arc.

B.2.7 Funnels, stemless, of corrosion-resistant material.

NOTES

1. *This range of water content will normally be obtained if the paper is in equilibrium with the atmosphere, unless the atmosphere is unusually dry or humid.*

2. *Saccharimeters are set up in the laboratory (or in an adjoining room) in which the samples are unpacked for analysis. The humidity of the laboratory or room is kept as nearly constant as practicable, preferably in the range of* 65 *per cent to* 70 *per cent relative humidity.*

3. *The quartz plates used are either standard plates which have been certified by a recognized authority or plates which have been calibrated by direct comparison with such a certified plate.*

4. *Flask whose actual contents fall within the range* 100.00 ± 0.02 ml *may be used without correction. Flasks whose contents fall outside this range are used with the appropriate correction to* 100.00 ml.

5. *Use tubes either certified by a recognized testing laboratory or those which have been calibrated with reference to such a certified tube and comply with the following specifications.*

Do not apply tube correction to tubes that conform to these specifications.

Length : 200.00 ± 0.03 mm.

Parallelism of ends : Ends must be parallel within 10 minutes of arc.

Squareness of ends : The departure from squareness of the ends, relative to the axis of the tube, not exceeding 10 minutes of arc. Where the tube closely complies with the conditions for length and parallelism, slight latitude up to 15 minutes may be allowed for squareness, the criterion being that there should be no detectable change in the reading on rotating the tube.

The threaded metal collars of the tubes should be fitted so that they do not project, beyond the glass ends of the tubes.

B.3 PROCEDURE

B.3.1 Preparation of solution

Discard the top 15.0 mm of sugar layer before weighing out any sample. Weigh, to the nearest 0.002 g, approximately 26 g of sugar as rapidly as possible and transfer by washing with about 60 ml cold water into a 100-ml flask. Keep a supply of distilled or demineralized water at room temperature for this purpose. Dissolve by agitation, without heating. Maintain the test solution at 20 ± 0.5 °C. Adjust and maintain the temperature of the solution at 20 ± 0.1 °C while making up to the mark, filling the polarimeter tube and reading (see **B.3.2**). Dilute to 80 ml. Add 1.0 ml of the specified lead reagent from a burette fitted with a carbon dioxide trap. Mix the lead solution by swirling and wash down the sides of the flask until the volume is 95 ml. Thoroughly mix and further dilute to 99.5 ml. Maintain the flask and its contents at 20 ± 0.1 °C for 15 minutes (**B.3.4**).

Disperse any bubbles which have collected at the surface of the liquid with one drop of ethyl alcohol. Dry inside of the flask above the solution level with a rolled filter paper. Bring the volume exactly to 100 ml, by adding water from a fine jet and taking care of the meniscus. Mix thoroughly by shaking and completely inverting the flask at least three times. Allow the flask and its contents to stand for 5 minutes.

Filter through a 185-mm fluted filter paper contained in a funnel (**B.2.7**) by pouring all the contents of the flask on to the paper. The receiver should be of such a shape and size that the distance the filtrate has to fall from funnel to liquid surface does not exceed 40 mm.

Immediately cover the funnel with a glass or other appropriate cover. Discard the first 10 ml and collect the next 30 ml of filtrate.

B.3.2 Polarization

Rinse out the polarimeter tube twice using two-thirds its volume of the sugar filtrate and then fill the tube with sugar filtrate at 20 ± 0.1 °C (see **B.3.4**). Place the filled tube in the trough of the saccharimeter and allow remaining for at least 5 minutes before taking any readings. Take individual readings to at least 0.05 °S and determine the final polarization value by taking the average of five readings.

Standardize the saccharimeter at the time of observation by means of standard quartz plates whose values are close to the observed polarization. Do not use sucrose solutions for standardization.

Apply a scale correction based on the readings of the quartz plate to the observed polarization.

The corrections to be applied to the observed readings are those arising from instrumental defects (scale correction), inequalities of apparatus (flask correction) and temperature corrections.

B.3.3 Expression of results

Express the results in degrees S.

B.3.4 Temperature corrections

The following formula gives the temperature correction to be used in the above procedure and generally applicable to saccharimeters calibrated at 20.00 °C. This formula is valid within the range of 10 °C to 30 °C and for samples with a sucrose content between 90 per cent and 100 per cent (sucrose concentration 23.4 g/100 ml to 26.0 g/100 ml).

$$P_{20} = P_t \left[(1 - a\ (t_m - 20) - b\ (t_m - 20)^2 + C(t_r - 20) + d(t_q - 20) \right] - 0.004 \left[\frac{^{m}E}{26} \times {}^{w}I(t_r - 20) \right]$$

where,

P_{20} is polarization, in °S, corrected to 20 °C;

P_t is the measured polarization, in °S, at another temperature;

t_m is the temperature, in °C, of the solution in the volumetric flask when made up to the mark;

r_r is the temperature, in °C, of the solution during measuremen;

$\mathbf{t_q}$ is the temperature, in °G, of the quartz wedge compensator during measurement;

^{m}E is the mass, in g/100 ml, of the sample tested; and

^{w}I is the invert sugar content, per cent by the mass, of the sample tested.

Obtain coefficients a, b, c and d from Table **5.**

TABLE 5 - Coefficients for temperature correction formula

Volumetric flask (1)	Tube (2)	Coefficients x 10^6			
		a (3)	b (4)	c (5)	d* (6)
BS	BS	270	3.0	467	144
BS	N	270	3.0	462	144
BS	St	270	3.0	455	144
N	BS	2.55	3.0	467	144
N	N	255	3.0	462	144
N	St	255	3.0	455	144

where,

BS is the borosilicate glass (eg. Buran, Pyrex);
N is the normal glass (optical or instrument glass, window glass); and
St is the Steel [(Stainless, V2A - (austenitic, 18 % chromium, 8 % Nichol , less than 0.1 % carbon)].

***** *The Table and formula are valid for quartz wedge saccharimeters, the same values are applicable for circular polarimeters, except tha t d = 0.*

APPENDIX C
DETERMINATION OF INVERT SUGAR

C.l APPARATUS

C.1.1 Flasks, heat resistant, glass, flat-bottomed, 300-ml to 400-ml.

C.l.2 Burette, 50-ml, graduated in 0.1 ml for the sugar solution.

C.l.3 Pipettes, 10-ml, 25-ml and 50-ml.

C.2 REAGENTS

C.2.1 Fehlings solution *(Soxhlet's modification),* prepare by mixing immediately before use, equal volumes of solution A and solution B.

Solution A : Dissolve 69.28 g of cupric sulfate pentahydrate in distilled water and dilute to 1 litre.

Solution B : Dissolve 346 g of sodium potassium tartrate tetrahydrate and 100 g of sodium hydroxide in distilled water and dilute to 1 litre.

C.2.2 Sodium hydroxide, 1 mol/1 solution.

C.2.3 Standard invert sugar solution, 1 g invert sugar in 100 ml stock solution.

Preparation of standard invert sugar solution.

Dissolve 23.750 g of pure sucrose in about 120 ml of distilled water in a 250-ml volumetric flask. Add 9 ml of concentrated hydrochloric acid (rel. den. = 1.18) and mix gently. Immerse the flask in a water bath adjusted to 70 °C and when the temperature of the contents reaches 67 °C, continue the heating for further 5 minutes, by which time the temperature should have reached 69 °C. Remove the flask and cool immediately to room temperature by immersing the flask in cold water. Then make upto 250 ml. Check the solution for completion of hydrolysis by taking a saccharimeter reading (-11.80 ±0.05 °S at 20 °C).

To 200 ml of this solution (containing 10 g invert sugar/100 ml), add with stirring, about 71.5 ml of sodium hydroxide solution (see **2.2**) to ensure that the solution when diluted to 2000 ml would have an acidity of about 0.001 M with respect to hydrochloric acid. Then add 4 g of benzoic acid dissolved in warm water, mix and cool the solution and make up to 2000 ml. This solution contains 1 g of invert sugar/100 ml in a stable stock solution and is diluted immediately before use.

C.2.4 Invert sugar solution, 0.5 g invert sugar in 100 ml. Prepare this solution, immediately before use, for the standardization of the Fehling's solution.

C.2.5 Methylene blue indicator, 1 g/100 ml.

C.3 PREPARATION OF THE TEST SOLUTION

Weigh, to the nearest milligram, about 25 g of sugar and make upto 100 ml with distilled water in a volumetric flask. Filter the solution.

C.4 PROCEDURE

C.4.1 Standardization of the Fehling's solution

The copper content of the Fehling's solution prepared as described above (**2.1**) varies slightly from one solution to another and must therefore be adjusted to correspond with the tables used.

Using the standard method of titration (**4.3**) 25 ml of the Fehling's solution should require 24.80 ml of the invert sugar solution, containing 0.5 g invert sugar/100 ml, corresponding to a factor of 124 mg.

Make any small adjustment required, by the addition of a calculated amount of cupric sulfate or water followed by thorough mixing. Carry out standardization after any such adjustment.

C.4.2 Preliminary test-incremental titration

If the approximate concentration of reducing substances in the sample is unknown a preliminary titration is necessary.

Pipette 10 ml or 25 ml of Fehling's solution into a flask as for the standard method (**4.3**), 15 ml of the sugar solution or such a volume that will be just insufficient to reduce the Fehling's solution is run into the flask.

Then heat the mixture to boiling as in the standard method. If after the liquid has been boiling for 10 seconds to 15 seconds its colour shows that the Fehling's solution is not completely reduced, add further 10 ml or 15 ml at a time, with a few seconds boiling after each addition, until it is considered unsuitable to add more solution without overshooting the end point. Add 3 or 4 drops of the methylene blue indicator and continue the addition of the sugar solution, 1 ml or less at a time at intervals of about 10 seconds until the blue colour of the indicator just disappears. Usually the total volume of sugar solution required is slightly less than that required by the standard method.

The difference rarely amounts to 1 ml and if the titration conditions approach those of the standard method, the difference will be within 0.5 ml.

C.4.3 Standard method of titration

For higher accuracy the preliminary incremental titration must be followed by a titration performed according to the standard method.

C.4.4 Precautions

The titration shal be completed within 3 minutes from the commencement of boiling.

The heating device used for boiling during the titration is of prime importance for accurate results. The flask should remain on the wire gauze and boil at a moderate rate. The continuous emission of steam from the neck prevents atmospheric oxidation of the Fehling’s solution or of the indicator. During addition of sugar solution to the boiling liquid, the main burette tube must be kept out of the steam whilst the jet is brought over the mouth of the flask.

C.4.5 Results

Determine the concentration of reducing sugars by referring to Table **6** or Table **7** depending on the volume of Fehling’s solution (10 ml or 25 ml), the volume of sugar solution required and the concentration of sucrose.

Pipette 10 ml or 25 ml of Fehling's solution, according to the reducing sugars content of the sample, into a flash. Rinse the burette and fill with the solution to be titrated. Run nearly the whole volume required in the preliminary incremental titration to reduce Fehling's solution, in the flask, so that only about 0.5 ml to 1.0 ml, but not less than 0.5 ml is required later to complete the titration. A few fragments of pumice may be added to prevent bumping during the boiling.

Mix the contents of the' flask by swirling, and heat to boiling on a wire gauze over the bunsen flame. A specially developed electrical heater may be used for this purpose.

Keep the liquid boiling at a moderate rate for 2 minutes and then add carefully 3 or 4 drops of the methylene blue indicator, without touching the sides of the flask.

Complete the titration during the next minute by addition of the sugar solution, 2 or 3 drops at a time, at intervals of about 10 seconds, until the blue colour of the indicator just disappears. The boiling liquid resumes the bright orange appearance, due to cuprous oxide, which it had before the indicator was added.

C.4.6 Precautions

The titration should be completed within 3 minutes from the commencement of boiling.

TABLE 6 – Invert sugar table for 10ml of Fehling's Solution

	Solutions containing besides invert Sugar									
ml of sugar solution required	No sucrose		1 g sucrose per 100ml		5 g sucrose per 100ml		10 g sucrose per 100 ml		25 g sucrose per 100 ml	
	Invert sugar factor*	mg invert Sugar per 100 ml	Invert sugar factor*	mg invert Sugar per 100 ml	Invert sugar factor*	mg invert Sugar per 100 ml	Invert sugar factor*	mg invert Sugar per 100 ml	Invert sugar factor*	mg invert Sugar per 100 ml
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
15	50.5	336.6	49.9	333	47 .6	317	46 .1	307	43.4	289
16	50.6	316.6	50.0	312	47 .6	297	46 .1	288	43.4	271
17	50.7	298.8	50.1	295	47 .6	280	46 .1	271	43.4	255
18	50.8	282.2	50.1	278	47 .6	264	46 .1	256	43.3	240
19	50.8	267.7	50.2	264	47 .6	250	46 .1	243	43.3	227
20	50.9	254.5	50.2	251.0	47 .6	238 .0	46 .1	230 .5	43.2	216
21	51.0	242.9	50.2	239.0	47 .6	226 .7	46 .1	219 .5	43.2	206
22	51.0	231.8	50.3	228.2	47 .6	216 .4	46 .1	209 .5	43.1	196
23	51.1	222.2	50.3	218.7	47 .6	207 .0	46 .1	200 .4	43.0	187
24	51.2	213.3	50.3	209.8	47 .6	198 .3	46 .1	192 .1	42.9	179
25	51.2	204.8	50.4	201.6	47 .6	190 .4	46 .0	184 .0	42.8	174
26	51.3	197.4	50.4	193.8	47 .6	183 .1	46 .0	176 .9	42.8	164
27	51.4	190.4	50.4	186.7	47 .6	176 .4	46 .0	170 .4	42.7	158
28	51.4	183.7	50.5	180.2	47 .7	170 .3	46 .0	164 .3	42.7	152
29	51.5	177.6	50.5	174.1	47 .7	164 .5	46 .0	158 .6	42.6	147
30	51.5	171.7	50.5	168.3	47 .7	159 .0	46 .0	153 .3	42.5	142
31	51.6	166.3	50.6	163.1	47 .7	153 .9	45 .9	148 .1	42.5	137
32	51.6	161.2	50.6	158.1	47 .7	149 .1	45 .9	143 .4	42.4	132
33	51.7	156.6	50.6	153.3	47 .7	144 .5	45 .9	139 .1	42.3	128
34	51.7	152.2	50.6	148.9	47 .7	140 .3	45 .8	134 .9	42.2	124

ml of sugar solution required	No sucrose		1 g sucrose per 100ml		5 g sucrose per 100ml		10 g sucrose per 100 ml		25 g sucrose per 100 ml	
	Invert sugar factor*	mg invert Sugar per 100 ml	Invert sugar factor*	mg invert Sugar per 100 ml	Invert sugar factor*	mg invert Sugar per 100 ml	Invert sugar factor*	mg invert Sugar per 100 ml	Invert sugar factor*	mg invert Sugar per 100 ml
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
35	51.8	147.9	50.7	144.7	47.7	136.3	45.8	130.9	42.2	128
36	51.8	143.9	50.7	140.7	47.7	132.5	45.8	127.1	42.1	117
37	51.9	140.2	50.7	137.0	47.7	128.9	45.7	123.5	42.0	114
38	51.9	136.6	50.7	133.5	47.7	125.5	45.7	120.3	42.0	111
39	52.0	133.3	50.8	130.2	47.7	122.3	45.7	117.1	41.9	102
40	52.0	130.1	50.8	127.0	47.7	119.2	45.6	114.1	41.8	104
41	52.1	127.1	50.8	123.9	47.7	116.3	45.6	111.2	41.8	102
42	52.1	124.2	50.8	121.0	47.7	113.5	45.6	108.5	41.7	99
43	52.2	121.4	50.8	118.2	47.7	110.9	45.5	105.8	41.6	97
44	52.2	118.7	50.9	115.6	47.7	108.4	45.5	103.4	41.5	94
45	52.3	116.1	50.9	113.1	47.7	106.0	45.4	101.0	41.4	92
46	52.3	113.7	50.9	110.6	47.7	103.7	45.4	98.7	41.4	90
47	52.4	111.4	50.9	108.2	47.7	101.5	45.3	96.4	41.3	88
48	52.4	109.2	50.9	106.0	47.7	99.4	45.3	94.3	41.2	86
49	52.5	107.1	51.0	104.0	47.7	97.4	45.2	92.3	41.1	84
50	52.5	105.1	51.0	102.0	47.7	95.4	45.2	90.4	41.0	82

* mg of invert sugar corresponding to 10 ml of Fehling's solution.

Table 7 – Invert sugar table for 25 ml of Fehling's solution

ml of sugar solution required	Solution containing besides invert sugar			
	No sucrose		1g sucrose per 100ml	
	Invert sugar factor*	mg invert sugar per 100ml	Invert sugar factor*	Mg invert sugar Per 100 ml
(1)	(2)	(3)	(4)	(5)
15	123.6	821	122.6	817
16	123.6	772	122.7	767
17	123.6	727	122.7	721
18	123.7	687	122.7	682
19	123.7	751	122.8	646
20	123.8	619.0	122.8	614.0
21	123.8	589.5	122.8	584.8
22	123.9	563.2	122.9	558.2
23	123.9	538.7	123.9	534.0
24	124.0	516.7	122.9	512.1
25	124.0	496.0	123.0	492.0
26	124.1	477.3	123.0	473.1
27	124.1	459.7	123.0	455.6
28	124.2	443.6	123.1	439.6
29	124.2	428.3	123.1	424.4
30	124.3	411.3	123.1	410.4
31	124.3	401.0	123.2	397.4
32	124.4	388.7	123.2	385.0
33	124.4	377.0	123.2	373.4
34	124.5	366.2	123.3	362.6
35	124.5	355.8	123.3	352.3
36	124.6	346.1	123.3	342.5
37	124.6	336.8	123.4	333.5
38	124.7	328.1	123.4	324.7
39	124.7	319.7	123.4	316.4
40	124.8	311.9	123.4	308.6
41	121.8	304.4	123.5	301.2
42	124.9	297.3	123.5	294.1
43	124.9	290.5	123.5	287.3
44	125.0	184.1	123.6	280.9
45	125.0	277.9	123.6	274.7
46	125.1	272.0	123.6	268.7
47	125.1	266.3	123.7	263.1
48	125.2	260.8	123.7	257.7
49	125.2	255.5	123.7	252.5
50	125.3	250.6	123.8	247.6

* mg of invert sugar corresponding to 25 ml of Fehling's solution.

APPENDIX D
DETERMINATION OF LOSS ON DRYING AT 105 °C FOR 3 HOURS

D.1 PROCEDURE

Weigh, to the nearest milligram, approximately 20 g of sugar into a tared shallow aluminium dish with a tight-fitting lid and dry at 105 ± 2 °C for 3 hours (see Note). Remove, cool in a desiccator and weigh.

NOTE
If coarse, grind the sugar prior to weighing preferably in a moisture proof sample mill.

D.2 CALCULATION

$$\text{Loss on drying, per cent by mass} = \frac{(m_0 - m_1)}{(m_0 - m)} \times 100$$

where,

m is the mass, in g, of the empty dish;
m_0 is the mass, in g, of the sample with the dish; and
m_1 is the mass, in g, of the dry sample with the dish.

APPENDIX E
DETERMINATION OF CONDUCTIVITY ASH

E.1 FIELD OF APPLICATION

The conductivity ash in solutions gives measure of the concentration of ionized soluble salt present in solutions of low conductivity. This method is applicable to plantation white sugar, refined sugar and other types of sugars.

E.2 DEFINITION

E.2.1 Conductivity Ash

The ash determined conductimetrically, known as conductivity ash cannot be directly compared with the gravimetric ash determined by incineration and weighing of the ash. Conductivity ash has its own individual significance. The factors for converting conductivity to ash are chosen in such a way that the conductivity ash value corresponds approximately to values for sulphated ash. This coefficient is conventional and cannot be experimentally verified.

E.3 PRINCIPLE

The specific conductivity of a white sugar solution at a concentration of 28 g/100 g is determined. The equivalent ash is calculated by the application of a conventional factor.

E.4 REAGENTS

E.4.1 Purified Water
For preparation of all solutions (sugar and potassium chloride) use twice-distilled or deionized water with a conductivity of less than 2 µS/cm.

E.4.2 Potassium Chloride, 0.01 mol/l
Weigh out 745.5 mg after first dehydrating by heating to 500°C (dull red heat). Dissolve in water in a 1 litre volumetric flask and make up to the mark.

E.4.3 Potassium Chloride, 0.0002 mol/1
Dilute 10 ml of potassium chloride solution, 0.01 mol/1 (see **E.4.2**) and make up to the mark in a 500 ml volumetric flask. This solution has a conductivity of 26.6 ±0.3 µS/cm at 20°C (after deduction of the specific conductivity of the water used).

E.5 APPARATUS

E.5.1 Sugar ash bridge, null balance bridge or conductivity meter
E.5.2 Volumetric flasks, 100, 500 and 1000 ml.
E.5.3 Pipettes, 10ml, conforming to Class A of Indian Standard
E.5.4 Analytical balance, capable of weighing to the nearest 0.1 mg.

E.6 PROCEDURE

Dissolve 31.3 g ± 0.1 g of sugar in water in a 100 ml volumetric flask and make up to volume at 20°C (or dissolve 28.0 ± 0.1 g of sugar in water to give a solution of mass 100.0 g). In the case of liquids, the amount taken must be such that the test solution contains 31.3 g of solids/100 ml, or 28.0 g solids/100 g of solution. After thorough mixing, transfer the solution into the measuring cell and measure the conductivity at 20 ± 0.2°C. Check the measurement using the reference solution (see **E.4.3**)

E.7. CALCULATION

E.7.1 Calculation of results

If C1 is the measured conductivity in µS/cm at 20°C and if C2 is the specific conductivity of the water at 20°C, then the corrected conductivity (C28) of the 28 g/100 g solution is:

$C28 = C1 – 0.35\ C2$

and

Conductivity ash, percent = 6 x 10-4 x C28

E.7.2 Temperature Correction

1f the determination cannot be made at the standard temperature of 20°C make a temperature correction to the final result provided that the range of ± 5°C is not exceeded.

The correction is: C20° = CT 1+ 0.026 (T − 20)

where;

CT = conductivity at temperature T°C

NOTE: *The conductivity of the potassium chloride standard solution (see F.4.3) is given for a temperature of 20°C. If the measurement cannot be made at the standard temperature of 20°C then the conductivity of the potassium chloride standard solution has to be determined by the formula;*

Conductivity of KCI (see F.4.3) at T°C = 26.6 [1+0.021 (T- 20)] in the range 20°C ± 5°C.

APPENDIX F
DETERMINATION OF COLOUR

F.1 PREPARATION OF TEST SOLUTION

Prepare a solution of the sugar using distilled water. For refined sugar and icing sugar prepare a 50 per cent (m/m) solution. For plantation white or mill white sugar the concentration of the solution should be as high as practicable, consistent with reasonable filtration rates and cell depths.

Filter the solution under vacuum. Filter refined white or icing sugar solutions through a membrance filter of pore size 0.45 µm according to the mercury extrusion method or 0.6 µm according to the Hagen- Poiseulle method without addition of filter aid. Filter plantation white or mill white sugar solutions with analytical grade Kieselghur (1% on solids) over filter paper. Discard the first portion of the filtrate if cloudy.

Adjust the pH of plantation white sugar solutions to 7.0 + 0.2 with dilute hydrochloric acid or sodium hydroxide. Do not adjust tne pH of refined white sugar or icing sugar solutions (see Note). Remove entrained air under vacuum.

NOTE
Sugar having a polarization value greater than 99.7^0 S should be considered as refined white sugar.

F.2 PROCEDURE

F.2.1 Place the solution in a 1-cm absorption cell (choose the cell length so that the instrument reading will be between 10 per cent and 90 per cent transmittancy). Determine the

attenuancy (A* or-log T) of the solution at 420 nm in a spectrophotometer or equivalent, using distilled water as a reference standard of zero colour.

F.2.2 Determine the brix value of the sugar solution using a refractometer. Find out the concentration of total solids corresponding to the brix value using Table 8

F.3 CALCULATION

$$\text{Attenuation index } (a_c^*)\ 420 = \frac{A^*_c}{be} \quad \frac{\log T_s}{be}\ 100$$

where,

A_c is the attenuancy;
T_s is the transmittancy;
b is the cell length in cm;
c is the concentration of total solids, in g/ml, determined as in E.2.2; and
Attenuation index (a_c) 420 x 1000 = 'colour' in ICUMSA units.

TABLE 8 – Relationship between Brix value and number of gram of sucrose per 100ml of sugar solution

Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)
10.0	10.381	14.0	14.769	18.0	19.299
10.1	10.489	14.1	14.880	18.1	19.414
10.2	10.597	14.2	14.992	18.2	19.529
10.3	10.706	14.3	15.103	18.3	19.644
10.4	10.814	14.4	15.215	18.4	19.760
10.5	10.922	14.5	15.327	18.5	19.875
10.6	11.031	14.6	15.439	18.6	19.991
10.7	11.139	14.7	15.551	18.7	20.107
10.8	11.248	14.8	15.663	18.8	20.222
10.9	11.356	14.9	15.775	18.9	20.338
11.0	11.465	15.0	15.887	19.0	20.454
11.1	11.574	15.1	16.000	19.1	20.570
11.2	11.683	15.2	16.112	19.2	20.686
11.3	11.792	15.3	16.225	19.3	20.803
11.4	11.901	15.4	16.338	19.4	20.919
11.5	12.010	15.5	16.450	19.5	21.036
11.6	12.120	15.6	16.563	19.6	21.152
11.7	12.229	15.7	16.676	19.7	21.269
11.8	12.338	15.8	16.789	19.8	21.385
11.9	12.448	15.9	16.902	19.9	21.502
12.0	12.558	16.0	17.015	20.0	21.619
12.1	12.667	16.1	17.129	20.1	21.737
12.2	12.777	16.2	17.242	20.2	21.853
12.3	12.887	16.3	17.356	20.3	21.971
12.4	12.997	16.4	17.469	20.4	22.088
12.5	13.107	16.5	17.583	20.5	22.205
12.6	13.217	16.6	17.697	20.6	22.323
12.7	13.327	16.7	17.810	20.7	22.440
12.8	13.438	16.8	17.924	20.8	22.558
12.9	13.548	16.9	18.038	20.9	22.676
13.0	13.659	17.0	18.152	21.0	22.794
13.1	13.769	17.1	18.267	21.1	22.912
13.2	13.880	17.2	18.381	21.2	23.030
13.3	13.991	17.3	18.495	21.3	23.148
13.4	14.102	17.4	18.610	21.4	23.266
13.5	14.213	17.5	18.724	21.5	23.385
13.6	14.324	17.6	18.839	21.6	23.503
13.7	14.435	17.7	18.954	21.7	23.622
13.8	14.546	17.8	19.069	21.8	23.740
13.9	14.657	17.9	19.184	21.9	23.859

Table 8 Contd…….

Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)
22.0	23.978	26.0	28.813	30.0	33.810
22.1	24.097	26.1	28.935	30.1	33.937
22.2	24.216	26.2	29.059	30.2	34.064
22.3	24.335	26.3	29.182	30.3	34.191
22.4	24.454	26.4	29.305	30.4	34.318
22.5	24.573	26.5	29.428	30.5	34.446
22.6	24.693	26.6	29.552	30.6	34.574
22.7	24.812	26.7	29.675	30.7	34.701
22.8	24.932	26.8	29.799	30.8	34.829
22.9	25.052	26.9	29.923	30.9	34.957
23.0	25.172	27.0	30.046	31.0	35.085
23.1	25.292	27.1	30.170	31.1	35.213
23.2	25.412	27.2	30.297	31.2	35.341
23.3	25.532	27.3	30.418	31.3	35.470
23.4	25.652	27.4	30.543	31.4	35.598
23.5	25.772	27.5	30.667	31.5	35.727
23.6	25.893	27.6	30.792	31.6	35.855
23.7	26.013	27.7	30.916	31.7	35.984
23.8	26.134	27.8	31.041	31.8	36.113
23.9	26.255	27.9	31.165	31.9	36.242
24.0	26.375	28.0	31.290	32.0	36.371
24.1	26.496	28.1	31.415	32.1	36.500
24.2	26.617	28.2	31.540	32.2	36.630
24.3	26.738	28.3	31.666	32.3	36.759
24.4	26.860	28.4	31.791	32.4	36.889
24.5	26.981	28.5	31.916	32.5	37.018
24.6	27.102	28.6	32.042	32.6	37.148
24.7	27.224	28.7	32.167	32.7	37.278
24.8	27.345	28.8	32.293	32.8	37.408
24.9	27.467	28.9	32.419	32.9	37.538
25.0	27.589	29.0	32.545	33.0	37.668
25.1	27.710	29.1	32.671	33.1	37.798
25.2	27.833	29.2	32.797	33.2	37.929
25.3	27.955	29.3	32.923	33.3	38.059
25.4	28.077	29.4	33.049	33.4	38.190
25.5	28.199	29.5	33.176	33.5	38.320
25.6	28.322	29.6	33.302	33.6	38.451
25.7	28.444	29.7	33.429	33.7	38.582
25.8	28.567	29.8	33.556	33.8	38.713
25.9	28.690	29.9	33.683	33.9	38.844

Table 8 Contd……..

Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)
34.0	38.976	38.0	44.318	42.0	49.845
34.1	39.107	38.1	44.454	42.1	49.985
34.2	39.239	38.2	44.590	42.2	50.126
34.3	39.370	38.3	44.726	42.3	50.267
34.4	39.502	38.4	44.862	42.4	50.408
34.5	39.634	38.5	44.999	42.5	50.549
34.6	39.767	38.6	45.135	42.6	50.690
34.7	39.898	38.7	45.272	42.7	50.831
34.8	40.030	38.8	45.408	42.8	50.973
34.9	40.162	38.9	45.545	42.9	51.114
35.0	40.295	39.0	45.682	43.0	51.256
35.1	40.427	39.1	45.819	43.1	51.398
35.2	40.560	39.2	45.956	43.2	51.539
35.3	40.692	39.3	46.094	43.3	51.681
35.4	40.825	39.4	46.231	43.4	51.824
35.5	40.958	39.5	46.369	43.5	51.966
35.6	41.091	39.6	46.506	43.6	52.108
35.7	41.224	39.7	46.644	43.7	52.251
35.8	41.358	39.8	46.782	43.8	52.393
35.9	41.491	39.9	64.920	43.9	52.536
36.0	41.625	40.0	47.058	44.0	52.679
36.1	41.758	40.1	47.196	44.1	52.822
36.2	41.892	40.2	47.334	44.2	52.965
36.3	42.026	40.3	47.473	44.3	53.108
36.4	42.160	40.4	47.611	44.4	53.252
36.5	42.294	40.5	47.750	44.5	53.395
36.6	42.428	40.6	47.889	44.6	53.539
36.7	42.562	40.7	48.028	44.7	53.683
36.8	42.697	40.8	48.167	44.8	53.826
36.9	42.831	40.9	48.306	44.9	53.970
37.0	42.966	41.0	48.445	45.0	54.114
37.1	43.100	41.1	48.585	45.1	54.259
37.2	43.235	41.2	48.724	45.2	54.403
37.3	43.370	41.3	48.864	45.3	54.547
37.4	43.505	41.4	49.004	45.4	54.692
37.5	43.641	41.5	49.143	45.5	54.837
37.6	43.776	41.6	49.283	45.6	54.981
37.7	43.911	41.7	49.424	45.7	55.126
37.8	44.047	41.8	49.564	45.8	55.272
37.9	44.182	41.9	49.704	45.9	55.417

Table 8 Contd……..

Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)
46.0	55.562	50.0	61.478	54.0	67.601
46.1	55.708	50.1	61.629	54.1	67.757
46.2	55.853	50.2	61.780	54.2	67.912
46.3	55.999	50.3	61.930	54.3	68.069
46.4	56.145	50.4	62.081	54.4	68.225
46.5	56.291	50.5	62.232	54.5	68.381
46.6	56.437	50.6	62.383	54.6	68.537
46.7	56.583	50.7	62.535	54.7	68.694
46.8	56.729	50.8	62.686	54.8	68.851
46.9	56.876	50.9	62.838	54.9	69.008
47.0	57.022	51.0	62.989	55.0	69.164
47.1	57.169	51.1	63.141	55.1	69.322
47.2	57.316	51.2	63.293	55.2	69.479
47.3	57.463	51.3	63.445	55.3	69.636
47.4	57.610	51.4	63.597	55.4	69.794
47.5	57.757	51.5	63.750	55.5	69.951
47.6	57.904	51.6	63.902	55.6	70.109
47.7	58.052	51.7	64.055	55.7	70.267
47.8	58.199	51.8	64.208	55.8	70.425
47.9	58.347	51.9	64.360	55.9	70.583
48.0	58.495	52.0	64.513	56.0	70.742
48.1	58.643	52.1	64.666	56.1	70.900
48.2	58.791	52.2	64.820	56.2	71.059
48.3	58.993	52.3	64.973	56.3	71.217
48.4	59.087	52.4	65.127	56.4	71.376
48.5	59.236	52.5	65.280	56.5	71.535
48.6	59.385	52.6	65.433	56.6	71.694
48.7	59.533	52.7	65.588	56.7	71.854
48.8	59.682	52.8	65.742	56.8	72.013
48.9	59.831	52.9	65.896	56.9	72.173
49.0	59.980	53.0	66.050	57.0	72.332
49.1	60.129	53.1	66.205	57.1	72.492
49.2	60.279	53.2	66.359	57.2	72.652
49.3	60.428	53.3	66.514	57.3	72.812
49.4	60.578	53.4	66.669	57.4	72.973
49.5	60.728	53.5	66.824	57.5	73.133
49.6	60.878	53.6	66.979	57.6	73.193
49.7	61.028	53.7	67.134	57.7	73.454
49.8	61.178	53.8	67.290	57.8	73.615
49.9	61.328	53.9	67.445	57.9	73.776

Table 8 Contd……..

Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)	Percentage Of sucrose by weight (Brix) (1)	Number of grams of sucrose per 100ml of sugar solution (2)
58.0	73.937	58.7	75.068	59.4	76.207
58.1	74.098	58.8	75.230	59.5	76.369
58.2	74.260	58.9	75.393	59.6	76.533
58.3	74.421	59.0	75.555	59.7	76.696
58.4	74.583	59.1	75.718	59.8	76.860
58.5	74.744	59.2	75.880	59.9	77.024
58.6	74.906	59.3	75.043	60.0	77.188

APPENDIX G
DETERMINATION OF WATER INSOLUBLE MATTER

G.1 APPARATUS

G.1.1 Filtration apparatus, comprising of a holder for membrane filters of about 50-mm diameter fitted into a conical filtration flank of 4000-ml capacity connected with a vacuum system.

G.1.2 stainless steel jug, 2000 ml.

G.1.3 Plastic petridishes

G.1.4 Square mesh sieve, 200-nim in diameter (mesh size about 0.4 mm) set in a level pan containing hot distilled water in such a way that the water is just in contact with the screen. The sieve is covered by a lid.

G.1.5 Membrane filters, about 50~mm in diameter, a pore size of 8 μm (as measured by the mercury intrusion method).

G.1.6 Pic-filters, 35-mm in diameter, made of glass fibre with an acrylic binder.

G.2 REAGENTS

G.2.1 1-*naphthol/phosphoric acid chromatographic spray reagent, a* solution of 1 g of 1-naphthol in 100 *ml* of ethanol and 10 ml of phosphoric acid [85 per cent (m/m)

G.3 PROCEDURE

G.3.1 For White sugars with good filtration rate

G.3.1.1 *Preparation of membrane filters*

Wash the membranes by immersing in boiling distilled water for 6 minutes and after draining excess moisture, transfer individually to clean, dry petridishes which have been previously weighed with the lid. Remove the lids and dry the dishes with the membranes for 1 hour at 60°C. After replacing the lid, cool for 30 minutes in a desiccator. Weigh, to the nearest 0.1 mg and record the mass of the membranes on the dishes.

G.3.1.2 *Preparation of sugar solution*

Carefully rinse the jug with distilled water and weigh, to the nearest gram about, 1000 g of sugar directly into the jug. Add hot (about 95°C) distilled water to bring the total volume to about 1800 ml. Heat the mixture while stirring using a stainless steel rod, until the temperature of the solution reaches about 95 °C and all the sugar is dissolved.

G.3.1.3 *Filtration of sugar solution*

Moisten the weighed membrane filter by floating on distilled water in a petridish and insert in the filter holder. Filter the hot sugar solution through the membrane under reduced pressure. Carefully rinse the jug and stirring rod into the funnel with hot, distilled water. Wash the membrane carefully with hot, distilled water until the total volume of washed water is about 1000 ml

G.3.1.4 *Final washing of the membrane*

To remove the last traces of sugar which are always present in the periphery of the membrane, wash after its removal from the filter holder. Place the membrane on the wet sieve for 1 hour.

G.3.1.5 *Drying and washing of the membrane*

Replace the membrane filter after final washing on to its original dish and dry without the lid for 1 hour at 60 °C. Cool the dish after replacement of the lid for 30 minutes in a desiccators and reweigh.

G.3.1.6 *Special precautions*

Drying cloth may be a source of contamination. It is therefore important that all apparatus be rinsed thoroughly with distilled water but not dried with a cloth, immediately prior to use.
The effectiveness of the final washing is essential to obtain the accuracy of the test. This may be checked by spraying occasional membranes, with 1-naphthol/phosphoric acid chromatographic spray reagent and heating at 105 °C, after use. The membrane should be free of any trace of violet colouration.

G.3.2 Procedure for white sugars with poor filtration rates

G.3.2.1 *Preparation of membrane filters*

Wash the membranes as in the normal procedure. Place a washed membrane in the filter holder and lay a pre-filter on top of the membrane. Pour 1.5 litres of hot distilled water (90 °C to 95 °C) through the filter to remove any water soluble matter from the pre-filter. Remove the membrane and pre-filter, place on a petridish and dry at 60 °C to 65 °C for 1 1/2 hours.

Cool and weigh as in the normal procedure **(G.3.1).** Place the membrane and pre-filter in the filter holder ensuring that the pre-filter is not clamped by the holder. Moist these filters with distilled water to assist locating them in position.

Continue the procedure as described in the normal procedure **(G.3.1),** but with an increased amount of wash water (about 1.5 litres) and with a drying time of 1 1/2 hours.

G.4 RESULTS

The difference in mass of the dried membrane [plus the pre-filter, in the modified procedure **(G.3.2)**] before and after filtration (recorded in mg) is a direct measure of the insoluble matter in mg/kg sugar, assuming that the recommended sample mass of 1 kg is used.

When the level of insoluble matter is in excess of 20 mg/kg, the mass of the sample may be reduced to 500 g. In this case, the difference in mass is multiplied by 2.

APPENDIX H
DETERMINATION OF SULPHUR DIOXIDE BY THE ROSANILINE CALORIMETRIC METHOD

H.1 FIELD OF APPLICATION

This method is based on the calorimetric determination of sulphur dioxide and is applicable to plantation white sugar, refined sugar and sugar products.

H.2 PRINCIPLE

The colour of a sulphite/rosaniline complex is measured photometrically, at a wavelength near to 560 nm, after reaction with formaldehyde.

H.3 REAGENTS

H.3.1 Rosaniline hydrochloric solution (saturated)
Suspend 1 g of rosaniline hydrochloride in 100 ml of distilled water, heat to 50°C and cool with shaking. After standing for 48 h, filter the solution.

H.3.2 Decolourized rosaniline solution
Transfer 4 ml of saturated rosaniline hydrochloride solution to a 100 ml volumetric flask. After addition of concentrated hydrochloric acid (6 ml) make the mixture up to the mark. Decolourization takes places in short time but allows the solution to stand for at least 1 h before use.

H.3.3 Formaldehyde solution (approximately 0.2 g/ 100 ml)
Dilute 5 ml of analytical reagent grade formaldehyde solution, p20= 1.070– 1.080 to 1000 ml.

H.3.4 Pure Sucrose Solution
Dissolve 100 g of analytical reagent grade sulphite-free sucrose in water and make up to 1000 ml.

H.3.5 Sodium hydroxide solution, 0.1 mol/1.

H.3.6 Iodine solution, 0.05 mol/1
Dissolve 20 g of analytical reagent grade iodate-free potassium iodide in 40 ml of distilled water in a 1000 ml volumetric flask. After the addition of 12.69 g of analytical reagent grade iodine shake the flask until all the iodine is dissolved and then make up to the mark with distilled water.

H.3.7 Concentrated hydrochloric acid, p20= 1.18 g/ml.

H.3.8 Hydrochloric acid solution, approximately 1 mol/1.

H.3.9 Iodine (starch) indicator, ready-made, or a starch solution.

H.3.10 Sodium thiosulphate solution, 0.1 mol/l
Dissolve 24.817 g of analytical reagent grade sodium thiosulphate pentahydrate in 200 ml of distilled water in a 1000 ml volumetric flask and then makeup to the mark.

H.3.11 Standard sulphite solution
Dissolve approximately 2.5 g of general purpose reagent grade sodium sulphite heptahydrate in sucrose solution (see **H.3.4**) and make up to 500 ml with this pure sucrose solution. Determine the titre of this solution as follows. Place 25 ml of the 0.05 mol/1 iodine solution in a 300 ml conical flask and add 10 ml of the 1 mol/1 hydrochloric acid solution followed by approximately 100 ml of distilled water.

Pipette 25 ml of standard sulphite solution into this flask while swirling the flask. Then titrate the excess iodine with the 0.1 mol/1 sodium thiosulphate solution until the contents of the flask area pale straw colour. Then add the iodine (starch) indicator (0.2 to 0.5 g) to the flask and continue the titration until the blue colour disappears. Record the titre, t.

H.3.12 Dilute standard sulphite solution
Dilute 5 ml of standard sulphite solution to exactly 100 ml with pure sucrose solution. The exact value of the sulphite content, c is calculated as follows from the titre, t, found in **H.3.11**:
$c = (25 - t) \times 3.203 \times 2$ mg SO_2/ml

NOTE: *Users of this method are advised to consult their national health and safety legislation and chemical suppliers before handling rosaniline hydrochloride, formaldehyde and the other reagents here mentioned.*

H.4 APPARATUS

H.4.1 Spectrophotometer or Colorimeter, for use at approximately 560 nm.

H.4.2 Volumetric flasks, 10 ml, 500 ml and 1000 ml,

H.4.3 Graduated pipette, 10 ml,

H.4.4 Pipettes, 2 ml, 10 ml and 25 ml.

H.4.5 Burette, 10 ml, graduated by 0.05 ml.

H.4.6 Test Tubes

H.4.7 Analytical balance, capable of weighing to the nearest 0.1 mg.

H.5 PROCEDURE

H.5.1 Colour development

Dissolve 10-40 g of a sample of white sugar in distilled water in a 100 ml volumetric flask. After addition of 0.1 mol/1 sodium hydroxide solution (4 ml) make the contents of the flask up to the mark and mix: For levels

0-5 mg SO_2 /kg use 40 g of sample
5-15 mg SO_2/kg use 20 g of sample
15-30 mg SO_2/kg use 10 g of sample

Transfer a 10 ml aliquot to a clean, dry test tube. Add 2 ml of decolourized rosaniline solution and 2 ml of formaldehyde solution and allow the tube to stand at room temperature for 30 min. Measure the absorbance in a 1 cm cell in a spectrophotometer **(see H.4.1)** at about 560 nm using distilled water as a reference.

H.5.2 Standard Curve

Pipette aliquots of the dilute standard sulphite solution (1 ml, 2 ml, 3 ml, 4 ml, 5 ml and 6 ml) into a series of 100 ml volumetric flasks. Take an empty flask as well for the zero sulphite level. To each flask add 4 ml of 0.1 mol/1 sodium hydroxide and make the contents up to the mark with pure sucrose solution and mix. From each flask transfer a 10 ml aliquot to a clean, dry test tube. Add 2 ml of decolourized rosaniline solution and 2 ml of formaldehyde solution and allow the tubes to stand at room temperature for 30 min. Measure the absorbance as in **H.5.1** and plot the results on a graph. The amount of SO_2 in each test tube is:
c×n 10 µgSO_2

where,

n = the number of ml of dilute sulphite added to each 100 ml flask and c is from **H.3.12**.

H.6 Calculation

Calculate the concentration of sulphite by reference to the standard curve and express the result as mg SO_2/kg white sugar as follows:

$$\frac{\mu g SO_2 \text{ from graph} \times 10}{\text{Mass of sugar used in H.5.1}} \times \text{mg } SO_2 \text{ /kg sugar}$$

APPENDIX J
DETERMINATION OF CHROMIUM CONTENT

J.1 PRINCIPLE

Metals in solution are determined directly by atomic absorption spectrophotometry. Suspended metals are separated by membrane filtration or suspension is dissolved and analyzed.

J.2 APPARATUS

J.2.1 Atomic Absorption Spectrophotometer

Spectrophotometer capable of operating at conditions as given under :

Wavelength (mm) (1)	Flame (2)	Optimum range (mg/l) (3)
357.9	Reducing air - acetylene	1 to 200

J.3 REAGENTS

J.3.1 De-ionized Distilled Water - Distilled, ammonia free. Pass through ion exchange column of mixed strongly acidic cation and strongly basic anion exchange resins. Regenerate resins according to mixed strongly acidic cation and strongly basic anion exchange resins. Regenerate resins according to

J.3.2 Nitric Acid - Dilute 500 ml re-distilled nitric acid to 1000 ml with water.

NOTE: *Perform distillation in hood with protective ash in place.*

J.3.3 Hydrochloric Acid- Dilute 500 ml hydrochloric acid to 1000 ml with water and distill in all-Pyrex or equivalent glass apparatus.

J.3.4 Chromium Solution

J.3.4.1 Chromium stock solution - Accurately weigh amount of metal specified in Table 4 into a beaker and add dissolving medium. When metal is completely dissolved, transfer quantitatively into 1000 ml volumetric flask and dilute to volume with water.

Weight (1)	Compound (2)	Dissolving medium (1 litre total) (3)
1.923	Chromium oxide (Cr_2O_3)	Water + 10 ml redistilled nitric acid

J.3.4.2 Chromium working solution - Prepare daily. Dilute aliquots of stock solutions with water to make more than or equal to 4 standard solutions within the range of detection as given in **J.2.1**. Add 1.5 ml nitric acid per litre to all working standard solutions before diluting to volume. Add 1 ml lanthanum chloride for every 10 ml making the working standard solution.

J.3.5 Lanthanum stock solution - Slowly add 250 ml hydrochloric acid to 58.65 g lanthanum oxide (La_2O_3), purity 99.9 percent by mass, dissolve and dilute to 1000 ml.

J.3.6 Ammonium pyrrolidine dithiocarbamate solution - Dissolve 1g ammonium pyrrolidine dithiocarbamate in 100 ml water. Prepare fresh daily.

J.4 PREPARATION OF SAMPLE

Take 5 g of sample and dissolve in distilled water and make up the volume to 100 ml with water in a 100 ml volumetric flask. Transfer an aliquot of well mixed sample to the beaker and add 3 ml nitric acid. Heat and evaporate to dryness (do not boil). Cool and add 3 ml nitric acid and heat until digestion is complete, generally indicated by light coloured residue. Add 2 ml hydrochloric acid (1: 1, v/v) and heat gently to dissolve the residue. Wash the watch-glass and beaker with water and filter. Wash the filter and discard. Dilute the filtrate with water to such a concentration that it is within the range of the instrument.

J.5 DETERMINATION

Transfer an aliquot of the sample to a 250 ml beaker and dilute to 100 ml with water. Prepare blank and standard solution in the same manner. Adjust the pH of the sample and standard solutions to 2.5 with hydrochloric acid using a pH-meter. Transfer quantitatively to a 200 ml volumetric flask, add 2.5 ml of ammonium pyrrolidine dithiocarbamate solution and mix. Add 10 ml methyl iso-butyl ketone and shake vigorously for 1 min. Let the layers be separated and then add water until the ketone layer is in the neck of the flask. Centrifuge, if necessary. Aspirate the ketone layer and record readings of standards and samples against blank. The fuel-to-air ratio should be adjusted to as blue flame as possible since organic solvents add to fuel supply. Prepare the calibration curve from the average of each standard and read the sample concentration.

J.6 CALCULATION

Chromium content, mg/1 = Chromium, in mg, in the aliquot/litre.

……..

No.1

CORRIGENDUM TO SLS 191: 2017
SRI LANKA STANDARD SPECIFICATION FOR WHITE SUGAR
(SECOND REVISION)

6.4 Heavy Metals

Insert decimal value for limit given in Column 3 of the Table 2 serial number i), ii) and iv) to read as follows :

SI. No. (1)	Heavy metal (2)	Limit (3)
i)	Arsenic, mg/kg, max.	1.0
ii)	Copper, mg/kg, max.	2.0
iv)	Chromium, mg/kg, max.	2.0

CORRIGENDUM NO: 02 TO SLS 191: 2017

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APPENDIX F

F.3 CALCULATION

Replace the content in F.3 with the following.

$$Attenuation\ \ index\ \ (a^*_C)\,420 \;=\; \frac{A^*_C}{bc} \;=\; \frac{-\,Log\,T_S}{bc}$$

where,

A^*_C is the attenuancy;

T_S is the transmittancy;

b is the cell length in cm;

c is the concentration of total solids, in g/ml, determinded as in **F.2.2**; and

Attenuation index (a^*_c) 420 × 1000 = 'Colour' in ICUMSA units.

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