SRI LANKA STANDARD 859 : PART 2 : 1989

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SPECIFICATION FOR

PRESERVATIVE TREATMENT WITH COAL TAR CREOSOTE OF WOOD POLES FOR OVERHEAD POWER AND TELECOMMUNICATION LINES

PART 2 - TEST METHODS

SRI LANKA STANDARDS INSTITUTION

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PART 2 : TEST METHODS

SLS 859 : Part 2 : 1989

Gr.11

SRI LANKA STANDARDS INSTITUTION
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Sri Lanka.

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SRI LANKA STANDARD

SPECIFICATION FOR PRESERVATIVE TREATMENT WITH COAL TAR CREOSOTE OF WOOD POLES FOR OVERHEAD POWER AND TELECOMMUNICATION LINES

PART 2 : TEST METHODS

FOREWORD

This Sri Lanka Standard was authorized for adoption and publication by the Council of the Sri Lanka Standards Institution on 1989.09.07, after the draft finalized by the Drafting Committee on Wood Poles for Overhead Power and Telecommunication Lines, had been approved by the Electrical Engineering Divisional Committee.

Decay of timber poles is caused by fungi, bacteria and insects, and can only be effectively prevented by preservative treatment. Effective preservation depends upon the preservative employed and its proper application. An efficient preservative should be poisonous to fungi, bacteria and insects, but not to persons handling it; permanent; able to penetrate sufficiently; cheap; readily available; non-corrosive to metal fastenings; and should not render the timber more flammable by its use. Creosote has most of the above requirements but it increases flammability and is subject to evaporation. Preservative treatment of wood poles by pressure impregnation with creosote is widely used and well proven.

A standard on preservative treatment of wood poles using creosote was considered opportune due to the

a) wide application of this method of treatment;
b) greater vulnerability of wood poles to decay due to favourable temperature regime in Sri Lanka for growth of fungi and bacteria, supply of moisture by ground contact, and access to termites and insects through soil contact;
c) use of timber species of lesser natural durability for better utilization of the timber resources in the country; and
d) need to adhere to acceptable values of net retention and penetration as successful timber preservation by creosoting is largely dependent on the depth of penetration of the creosote and the amount retained in the timber.

This part (Part 2) of the standard specifies test methods. Part 1 of this standard specifies requirements of creosote, the method of application, and the retention and penetration to be attained by the prescribed treatment.

All values given in this specification are in SI units.

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 test or observation shall be rounded off in accordance with CS 102. The number of figures to be retained in the rounded off values shall be the same as that of the specified value in this standard.

The assistance derived from publications of the British Standards Institution and Standards Association of Australia in the preparation of this standard is gratefully acknowledged.

1 SCOPE

This part of the standard specifies test methods related to the preservative treatment with creosote of wood poles for overhead power and telecommunication lines.

2 REFERENCES

ISO 3696	Water for laboratory use
BS 458	Xylenes
BS 479	Coal-tar napthas
BS 658	Apparatus for determination of distillation range (including flasks and receivers)
BS 805	Toluenes
CS 102	Presentation of numerical values
SLS 848	Wood poles for overhead power and telecommunication lines Part 2 Selection and preparation of wood poles for treatment
SLS 859	Preservative treatment with coal tar creosote of wood poles for overhead power and telecommunication lines Part 1 Treatment processes

3 SAMPLING OF CREOSOTE FOR TESTING

3.1 Safety

All personnel concerned with sampling and testing shall be acquainted with the safety precautions stated in Appendix A of SLS 859 : Part 1 : 1989.

3.2 Sampling

A representative sample of the creosote measuring not less than 1 litre shall be submitted as a laboratory sample. The sample shall be placed in a clean, dry airtight container. In all cases about 5 per cent ullage shall be allowed in the sample container. In the course of sampling, the material shall be examined for the presence of separated undissolved matter, particularly water and crystalline solids, the presence or absence of which shall be reported. If the creosote contains crystalline solids and has been sampled after heating and mixing, this shall be reported. When it is necessary to seal the sample container, care shall be taken to avoid the risk of contaminating the contents in any way.

3.3 Preliminary treatment of the laboratory sample
Mix the laboratory sample thoroughly immediately before any portion is withdrawn for testing. If it shows signs of depositing soluble solid constituents, immerse the container in a water-bath at a temperature just high enough to dissolve these solids, and take portions for test from the warmed, mixed sample. Do not use a naked flame or other source of intense heat to warm the sample.

4 METHOD FOR THE DETERMINATION OF DENSITY OF CREOSOTE

4.1 Apparatus.
Ordinary laboratory apparatus and the following are required :

a) Hydrometer
A density hydrometer, calibrated for the determination of density in g/ml, with an accuracy of + 0.05 g/ml, for use in liquids of low surface tension, and constructed of soda-lime glass.

b) Hydrometer vessel
A cylindrical glass vessel several millimetres greater in diameter than the hydrometer bulb diameter, free from local irregularities producing distortions. A 1000 ml measuring cylinder is suitable.

c) Thermometer
A thermometer with a range of 25 °C to 45 °C and an accuracy of + 0.05 °C.

4.2 Procedure
Fill the clean hydrometer vessel to a sufficient depth with the liquefied laboratory sample (see 3.3), warmed to approximately 38 °C, so that the hydrometer will not touch the bottom of the vessel when it is completely immersed in the sample. To avoid the formation of air bubbles. Pour the sample down the side of the vessel. Stir the sample, again avoiding the formation of air bubbles. Hold the hydrometer by the top of the stem, insert it carefully into the sample and release it when approximately in the position of equilibrium, so that the hydrometer rises or falls only by a small amount.

Note the approximate reading and lightly press down on the top of the hydrometer stem so that the stem is immersed a few millimetres more. Remove the hand and note the reading when the hydrometer is steady after a few oscillations about the equilibrium position.

Observe the meniscus during this period. If the hydrometer stem is clean the meniscus shape will remain unchanged during the hydrometer oscillations; if the meniscus shape changes the hydrometer should be cleaned.

Record the hydrometer reading and also the temperature of the creosote to the nearest 0.1 °C. For opaque creosotes take the hydrometer reading at the level where the meniscus merges into the stem of the hydrometer.

4.3 Calculation

4.3.1 Correction of Hydrometer reading
Calculate the corrected hydrometer reading, R_t, as follows :

$$R_t = R + C + 0.0007$$

where R is the hydrometer reading;
C is the certification correction (provided by the manufacturer); and
0.0007 is the meniscus height correction for opaque creosotes only.
The value of R_t obtained is the density of the sample at the temperature t of the creosote in the test.

4.3.2 Calculation of the density at 38 °C
Calculate the density, in grams per millilitre, of the creosote at 38 °C, (d_{38}) as follows :

$$d_{38} = R_t m + a$$

where m is the multiplication factor; and
a is the addition factor
both obtained from Table 1 under t, the temperature of creosote in the test

5 METHOD OF TEST FOR LIQUIDITY OF CREOSOTE

5.1 Apparatus
Ordinary laboratory apparatus and the following are required :

a) Conical flask, capacity 100 ml.
b) Thermometer, with a range of 25°C to 40°C an accuracy of + 0.05°C.
c) Two constant temperature baths, capable of being controlled respectively at the temperatures 38 + 0.1°C and 32 + 0.1°C, as required.

TABLE 1 - Multiplication factor 'm' (upper figure) and addition factor 'a' (lower figure), for conversion of corrected hydrometer reading at t^0C to density at 38^0C

t C (1)	0.0 (2)	0.1 (3)	0.2 (4)	0.3 (5)	0.4 (6)	0.5 (7)	0.6 (8)	0.7 (9)	0.8 (10)	0.9 (11)
34	1.003 18	1.003 09	1.002 99	1.002 90	1.002 81	1.002 71	1.002 62	1.002 53	1.002 43	1.002 34
	-0.006 67	-0.006 50	-0.006 34	-0.006 17	-0.006 00	-0.005 84	-0.005 67	-0.005 50	-0.005 33	-0.005 17
35	1.002 25	1.002 15	1.002 06	1.001 97	1.001 88	1.001 78	1.001 69	1.001 60	1.001 50	1.001 41
	-0.005 00	-0.004 83	-0.004 66	-0.004 50	-0.004 33	-0.004 16	-0.004 00	-0.003 83	-0.003 66	-0.003 50
36	1.001 32	1.001 22	1.001 13	1.001 04	1.000 94	1.000 85	1.000 76	1.000 67	1.000 57	1.000 48
	-0.003 33	-0.003 16	-0.003 00	-0.002 83	-0.002 66	-0.002 50	-0.002 33	-0.002 16	-0.002 00	-0.001 83
37	1.000 39	1.000 30	1.000 20	1.000 11	1.000 02	0.999 92	0.999 83	0.999 74	0.999 64	0.999 55
	-0.001 66	-0.001 50	-0.001 33	-0.001 16	-0.001 00	-0.000 83	-0.000 67	-0.000 50	-0.000 33	-0.000 17
38	0.999 46	0.999 37	0.999 28	0.999 78	0.999 09	0.999 00	0.998 90	0.998 81	0.998 72	0.998 63
	-0.000 00	-0.000 17	-0.000 33	-0.000 50	-0.000 66	-0.000 83	-0.001 00	-0.001 16	-0.001 33	-0.001 49
39	0.998 53	0.998 44	0.998 35	0.998 26	0.998 16	0.998 07	0.997 98	0.997 89	0.997 80	0.997 70
	-0.001 66	-0.001 83	-0.001 99	-0.002 16	-0.002 32	-0.002 49	-0.002 66	-0.002 82	-0.002 99	-0.003 15
40	0.997 61	0.997 52	0.997 43	0.997 33	0.997 24	0.997 15	0.997 06	0.996 97	0.996 87	0.996 78
	-0.003 32	-0.003 48	-0.003 65	-0.003 81	-0.003 98	-0.004 14	-0.004 31	-0.004 48	-0.004 64	-0.004 81
41	0.996 69	0.996 60	0.996 50	0.996 41	0.996 32	0.996 23	0.996 14	0.996 04	0.995 95	0.995 86
	-0.004 97	-0.005 13	-0.005 30	-0.005 47	-0.005 63	-0.005 80	-0.005 96	-0.006 13	-0.006 29	-0.006 46

5.2 Procedure
Pour about 50 ml of the laboratory sample (see 3.3) into the conical flask. Fit the thermometer by means of a cork into the neck of the flask, with the bulb of the thermometer immersed in the creosote. Place the flask in the constant temperature bath, controlled at 38 + 0.1°C, so that the surface of the creosote is below that of the water in the bath and stir until the creosote reaches 38 + 0.1°C. Withdraw the flask and examine the surface of the creosote for the presence of solid matter. Rotate the flask slowly in a horizontal position and examine the inside surface of the flask for the presence of solid matter.

Then place the flask in the second bath maintained at 32 + 0.1°C. When the contents have reached the bath temperature, examine for solids as before. Maintain the contents at the bath temperature for 2 hours and re-examine for solids.

5.3 Reporting of results
Report whether creosote remained completely liquid at 38°C; after cooling to 32 °C; and after standing at 32 °C for 2 hours.

6 METHOD FOR THE DETERMINATION OF WATER CONTENT OF CREOSOTE

6.1 Apparatus
Ordinary laboratory apparatus and the following are required :
a) Graduated measuring cylinder, capacity 100 ml.
b) Round bottom flask, capacity about 500 ml, fitted with a Dean and Stark condensing and collecting system (see Figure 1 in Appendix A) and using a 2 ml receiver.

6.2 Reagents
Either solvent naptha complying with the requirements of **BS 479 : Part 3** or 3° xylene complying with **BS 458 : Part 1.**

6.3 Procedure
Fill the graduated cylinder to the 100 ml mark with the thoroughly mixed sample at laboratory temperature, or at the lowest temperature of complete liquidity if that is above laboratory temperature, and transfer the sample to the flask. Measure 50 ml of solvent into the same cylinder, without rinsing or drying, and transfer it similarly to the flask. Add a fragment of porous inert material and connect the flask to the Dean and Stark condensing and collecting system.

Heat the flask with a Bunsen burner, regulating the flame so that the condensate falls from the end of the condenser at a rate of two to five drops per second. Continue the distillation until condensed water is no longer visible in any part of the apparatus except the bottom of the graduated tube and until the volume of water collected remains constant. The presence of a persistent ring of condensed water in the condenser tube suggests that the tube may not be absolutely clean. Finally, note the volume in millilitres of water in the graduated tube.

6.4 Expression of results
The water content (expressed as a percentage by volume) is equal to the volume, in millilitres, of water in the graduated tube.

7 METHOD FOR THE DETERMINATION OF DISTILLATION RANGE OF CREOSOTE

7.1 Apparatus
Ordinary laboratory apparatus and the following are required. The apparatus is shown in Figure 2 in Appendix A, except as otherwise indicated below.

a) Distillation flasks
   i) capacity 250 ml, untared
   ii) capacity 150 ml, tared ; held in the vertical position by means of a clamp at the extreme upper end of the neck.
b) Condensers (Figure 3 and Figure 4 in Appendix A), Types 1 (all glass construction) and 2.
c) Draught screen(Figure 5 in Appendix A) Type 2, from which the shelf has been removed.
d) Crow receivers(Figure 6 and Figure 7 in Appendix A) of capacity 25 ml and 50 ml and tared. The smaller size is used to receive a distillate which it is known will not exceed 25 ml in volume.
e) Thermometer, with range of -2°C to 400°C and an accuracy of + 0.5°C .
f) Separating funnel, 50 ml.

7.2 Corrections to the specified distillation temperatures

If the reading of the barometer is in mbar, correct the barometric readings as described in BS 658, using the approximate conversion 1 mmHg = 1.33 mbar. If the corrected reading differs from 1013 mbar, apply corrections to the specified distillation temperature by adding the value given in Table 3 for every 1 mbar above 1013 mbar or subtracting the value for every 1 mbar below 1013 mbar.

NOTE

1 mbar = 100 N/m^2 = 100 Pa

If the reading of the barometer is in mm Hg, correct the barometer readings as described in BS 658 and, if the reading differs from 760 mm Hg, apply corrections to the specified distillation temperature by adding the value given in Table 3 for every 1 mm Hg above 760 mm Hg or subtracting the value for every 1 mmHg below 760 mm Hg.

NOTE

1 mm Hg = 133.322 N/m^2 = 133.322 Pa

Table 3 - Corrections to barometric pressure

Specified temperature	Corrections per mbar	Per mmHg
°C	°C	°C
205	0.076	0.057
230	0.080	0.060
315	0.095	0.071
355	0.100	0.075

Make the appropriate adjustments indicated by the thermometer test certificate at any of the corrected specified temperatures calculated as described above.

7.3 Procedure.
Distil about 120 g of the sample from the 250 ml untared distillation flask, to which has been added fragments of porous inert material, using the Type 1 condenser. Collect the distillate in a small separating funnel, and stop the distillation when water ceases to come over. Allow the contents of the separating funnel to settle, run the water off and return the oil layer to the distillation flask when the latter has cooled to about 40 °C. Mix the contents of the flask thoroughly, ensuring that the oil is completely liquid. Weigh, to an accuracy of 0.1 g, 100 g of the mixture directly into the tared distillation flask, add fragments of porous inert material and assemble the apparatus, with the side arm of the flask extending at least 25 mm beyond the cork in the upper end of the Type 2 condenser.

Using the naked flame of a Bunsen burner, distil at a rate of 5 $\pm$ 0.5 ml/min; if for any reason the distillation rate falls outside the specified limits at any time after the first 5 ml of distillate have collected and before the final temperature is reached, discontinue the test and start another on a further portion of the original sample. The specified distillation rate corresponds to approximately 90 drops/min (i.e.3 drops in 2 seconds) but this figure should be taken only as a guide; graduated receivers are specified for the collection of the distillate in order that the rate in millilitres per minute may be kept under close observation.

Should solids be deposited during the distillation, warm the condenser so that such solids are collected in the fraction with which they distil.

Change the receiver at each corrected specified temperature (see Table 3), without stopping the distillation, but extinguish the flame when the thermometer indicates the highest corrected specified temperature. The final fraction includes the oil which drains from the condenser within 5 min after the flame has been extinguished. Weigh the separate receivers containing distillate fraction, and note the mass of each fraction. Reserve the distillate fractions for test according to 8.

7.4 Expression of results
Calculate the cumulative distillate as a percentage by mass of the 100 g test portion at 205^0C, 230^0C, 315^0C and 355^0C.

8 METHOD FOR THE DETERMINATION OF EXTRACTABLE PHENOLS CONTENT OF CREOSOTE

8.1 Apparatus
Ordinary laboratory apparatus and the following are required
a) Phenols flask, capacity 200 ml or 150 ml(see Note 1 in 8.3) with graduated neck (see Figure 8 in **Appendix A**)
b) Separating funnel, capacity 250 ml, stoppered. (See Figure 9 in **Appendix A.**)
c) Glass fibre filter papers.

8.2 Reagents
a) Sodium hydroxide solution, clear, 10 per cent (m/m).
b) Sodium chloride solution, saturated
c) Sodium chloride, powdered.
d) Hydrochloric acid, concentrated, 36 per cent (m/m),
e) Coal-tar solvent or heavy naphtha, phenols-free complying with the requirements of BS 479 : **Part** 3 or **Part** 5.
f) Methyl orange indicator solution.
g) Water, complying with the requirements of BS 3978.

8.3 Procedure
Warm all the distillate fractions which passed over below 315^0C in the distillation test (see 7) until completely liquid and transfer them to the separating funnel. Use 50 ml of the sodium hydroxide solution to rinse the receivers from which the distillates were transferred and add it to the latter in the separating funnel. If the combined distillates contain naphthalene which tends to separate, warm both the distillate and the sodium hydroxide solution sufficiently just to maintain the naphthalene in solution. Agitate the contents of the funnel vigorously for 5 min and allow to stand. During the washing process, keep the contents of the funnel liquid, immersing the funnel, if necessary, in water warmed to between 40^oC and 70^oC.

After settlement (and dilution of the upper layer with the naphtha, if necessary, to secure satisfactory separation), run the alkaline layer into a beaker. Agitate the upper layer for 5 min with 25 ml of the sodium hydroxide solution and then with further successive quantities, each of 25 ml, of the same solution until all the phenols have been removed. This can be ascertained by slightly acidifying the washing, using concentrated hydrochloric acid, and examining for separated phenols.

It is necessary to avoid a large excess of sodium hydroxide but maintenance of some excess is necessary ; as a rough guide, it may be assumed that 25 ml of 10 per cent sodium hydroxide solution is sufficient to remove about 5 ml of phenols.

Combine the sodium hydroxide washings, including any of those acidified for the purpose of checking the washing procedure. Ensure that the combined washings are alkaline : boil vigorously for 10 min, maintaining approximately the initial volume by addition of the water. Fragments of porous inert material may be used to prevent bumping. Cool the sodium hydroxide washings to laboratory temperature and, if clear, transfer direct to the phenols flask. If the solution is not clear, filter it through a glass fibre filter paper previously moistened with saturated aqueous sodium chloride solution. Collect the filtrate in the phenols flask. Wash the filter paper with 25 ml of the saturated sodium chloride solution and add the solution to the filtered sodium hydroxide washings. Add the methyl orange indicator solution followed by the concentrated hydrochloric acid until the methyl orange just indicates distinct acidity after vigorous shaking together of the two layers. During the addition of the hydrochloric acid keep the contents of the flask cool by immersing the flask, from time to time, in cold water.

Add just sufficient powdered sodium chloride to saturate the aqueous layer and to leave a few particles undissolved. Bring the phenols into the graduated portion of the flask by adding saturated sodium chloride solution. After settlement overnight, swirl the phenols flask to dislodge any phenols adhering to the sides.

Read the volume of phenols.

NOTES

1. In the case of samples containing only small amounts of phenols, it is preferable to use about half the specified volumes of sodium hydroxide solution for the successive washings and to collect the sodium hydroxide washing (after filtration through the glass wool if necessary) in the 150 ml phenols flask.

2. In the case of some creosotes, the measurement of the liberated phenols is difficult because of their viscous nature. This may be overcome by adding a measured volume of the heavy naphtha to the phenols flask immediately before the final addition of the saturated sodium chloride solution. From the observed volume of the separated upper layer in the phenols flask, subtract the volume of naphtha added.

8.4 Expression of results
Record the extractable phenols content as a volume of extractable pheonols per 100 g of creosote.

9 METHOD FOR THE DETERMINATION OF THE AMOUNT OF MATTER IN CREOSOTE THAT IS INSOLUBLE IN TOLUENE.

9.1 Apparatus
Ordinary laboratory apparatus and the following are required.

a) A Gooch crucible, with a glass fibre filter pad.
b) Stainless steel gauze filter, of mesh size 150 um.

9.2 Reagent
Toluene, complying with the requirements of BS 805 : Part 1.

9.3 Procedure
Dry and weigh the prepared crucible to the nearest 0.2 mg. Pour 25 g to 30 g of the well mixed sample, treated as described in 3, throught the stainless steel gauze filter into a 250 ml beaker and weigh to an accuracy of 0.1g. Add to the beaker an amount of toluene equivalent to about four times the volume of the sample. Cover the beaker with a clock glass and warm on a boiling water bath; cautiously stir the contents of the beaker with a glass rod. When the sample has dissolved, cover the beaker with the clock glass and leave it on the water bath for about 10 min to allow the greater part of the insoluble matter to settle. Decant the supernatant solution through the crucible using gentle suction to assist filtration. By means of hot toluene, transfer the insoluble residue to the filter and rinse out the beaker. Wash the filter with hot toluene until a few drops of the filtrate yield no residue of tar oil on evaporation. Dry the crucible and residue in an oven at between 95°C and 105°C to constant mass.

9.4 Calculation
Matter insoluble in toluene is given, as a percentage by mass, by

$$\frac{m_1}{m_0} \times 100$$

where,
m_1 = mass of residue on the crucible (g); and
m_0 = mass of test portion (g).

10 DETERMINATION OF MOISTURE CONTENT OF POLES

10.1 Introduction
Two methods are available for the determination of moisture content, one by oven-drying the sample and the second by the distillation method using the Dean and Stark apparatus. These two methods will not necessarily give the same result, that by the first method tending to be higher than that by the second, owing to loss of other volatile products. Normally this difference is small and, as the determination is required in connection with the maximum moisture content specified in 5 of **SLS 859 : Part 1 : 1989**, it is not usually significant. However, with timbers having a high content of non-aqueous volatile substances it is preferable to use the Dean and Stark method. For the species of timber specified for poles in **SLS 848 : Part 2**, oven-drying method is adequate and hence only that method is given below.

10.2 Oven-drying method of test

10.2.1 *Selection of samples*
Samples of 75 mm or the full depth of the sapwood, whichever is the greater, shall be taken from the poles, at a point not less than 1.5 m from either end of the pole, by means of a test borer consisting of a hollow auger and extractor. The poles shall be carefully plugged, with durable or preservative treated plugs, as soon as the samples have been extracted.

10.2.2 *Procedure*
Weigh the sample (m_1) immediately after extraction. Dry the samples in an oven at a temperature of 103 + 2 °C until the mass is constant, and again weigh immediately after removal from the drying oven (m_2) .

10.2.3 *Calculation*
The moisture content (ω) expressed as a percentage of the oven dry mass is calculated from the equation :

$$\omega = \frac{m_1 - m_2}{m_2} \times 100$$

10.2.4 *Expression of results*

When the sample has been selected according to the requirements of 10.2 (i.e.it is an average sample) or when the moisture content of a representative selection of samples has been determined and the average value has been calculated, the result may be reported as the average moisture content and as such may be used for assessing compliance with the moisture content requirement specified in 5 of SLS 859 : Part 1 : 1989.

APPENDIX A

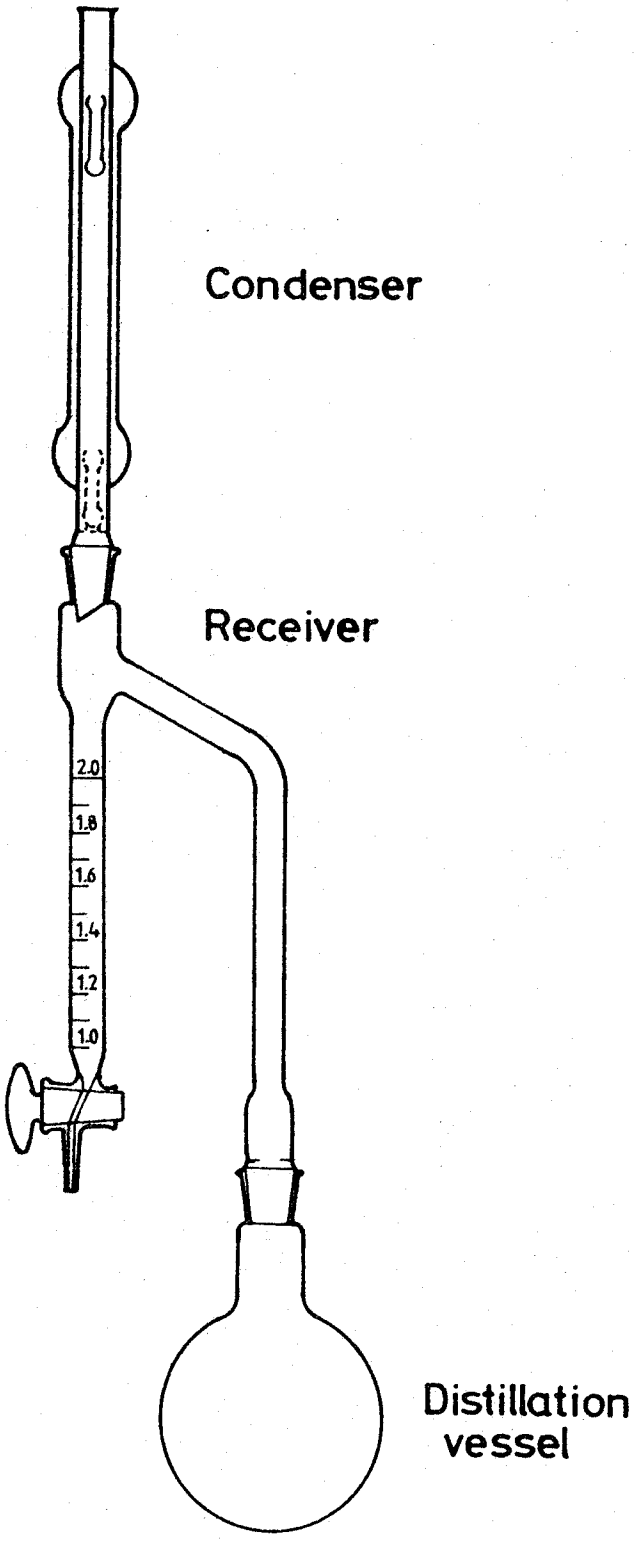


FIGURE 1 - Typical assembly of dean and stark apparatus

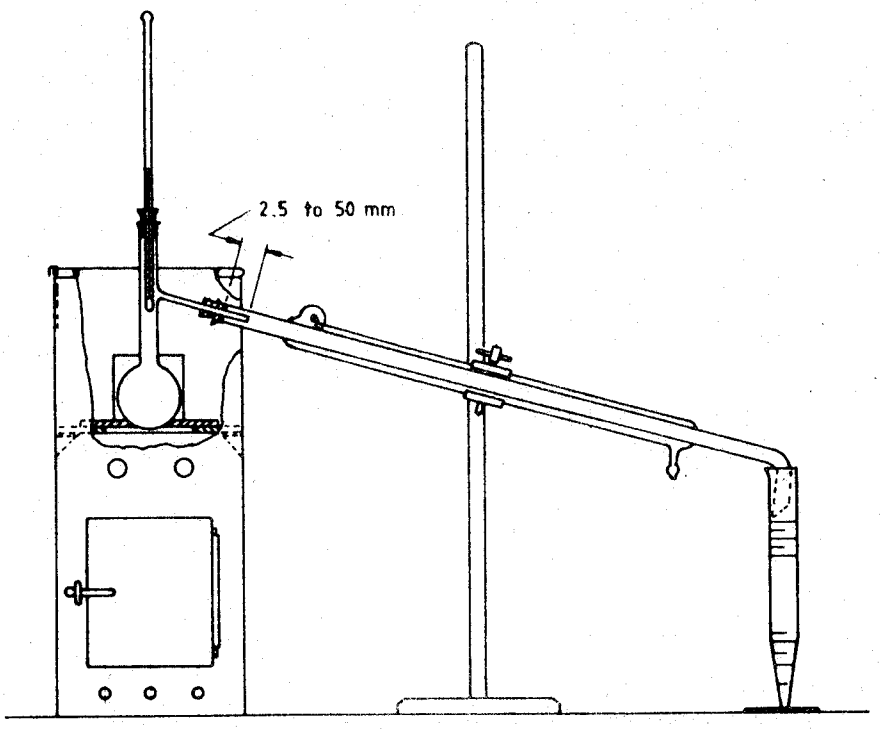


FIGURE 2 - Typical assembly of distillation apparatus with Type 1 condenser.

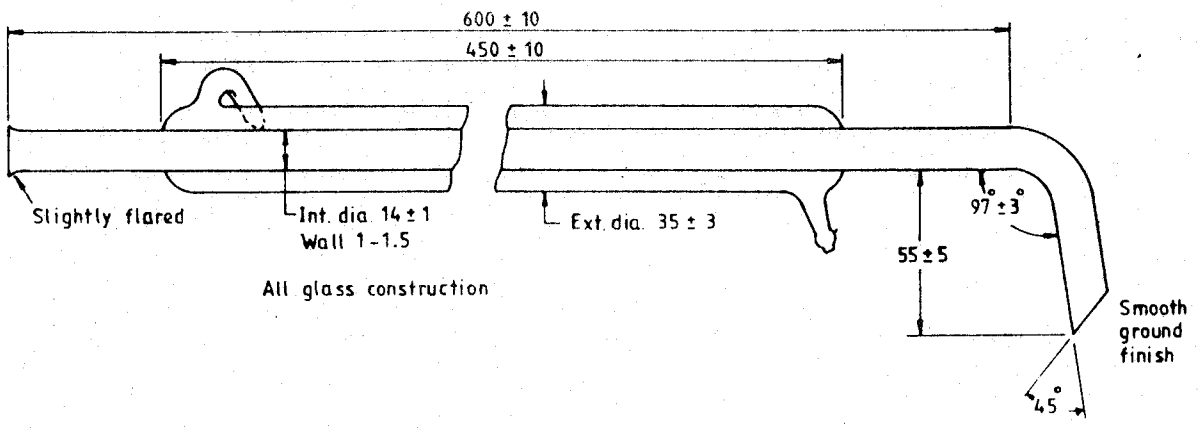
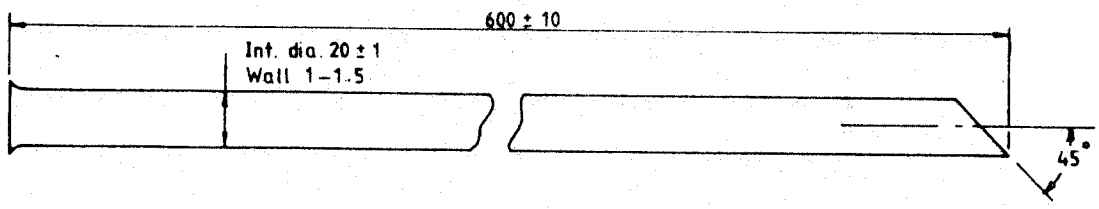
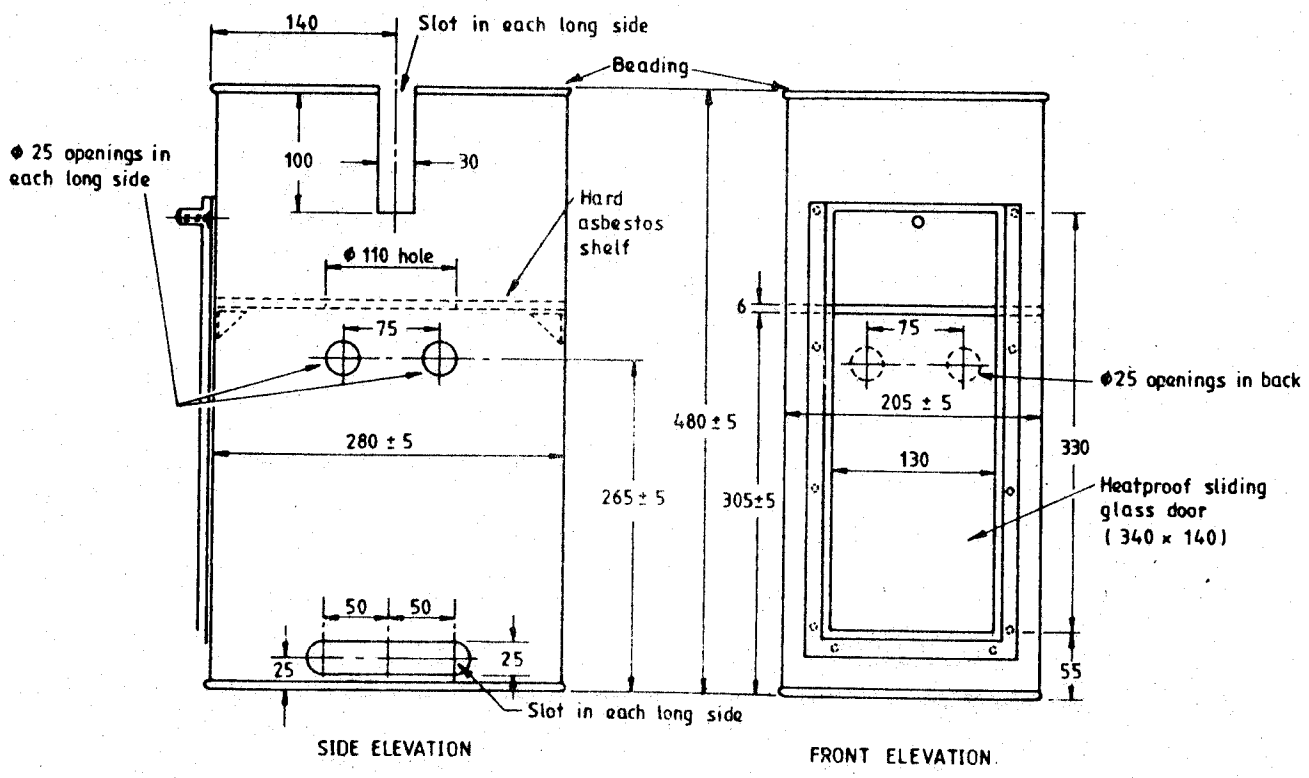


FIGURE 3 - Typical Type 1 condenser.



Dimensions in millimetres

FIGURE 4 - Typical Type 2 condenser.



Material : 22 S.W.G. sheet metal

Dimensions in millimetres

FIGURE 5 - Typical Type 2 draught screen.

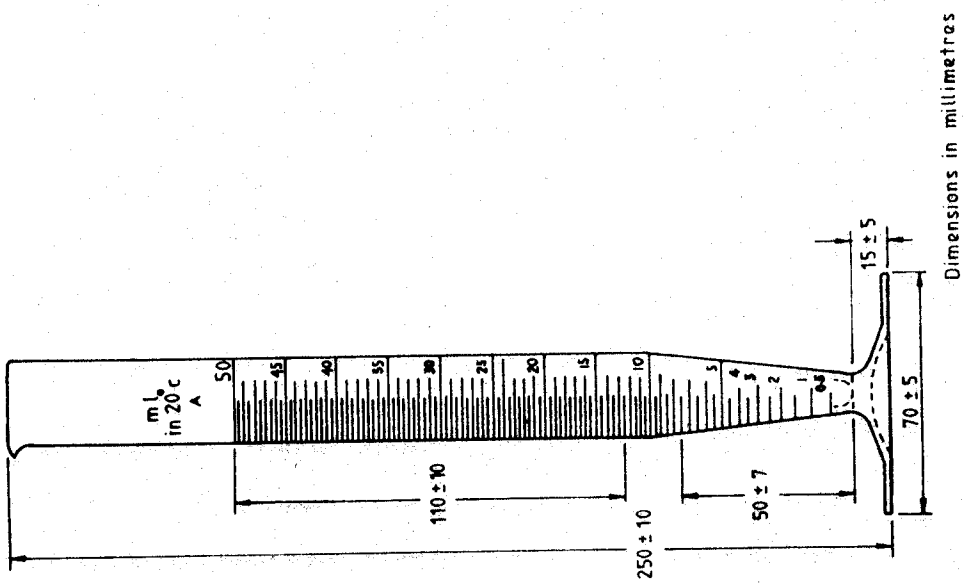


FIGURE 7 - Typical Crow receiver of capacity of 50 ml

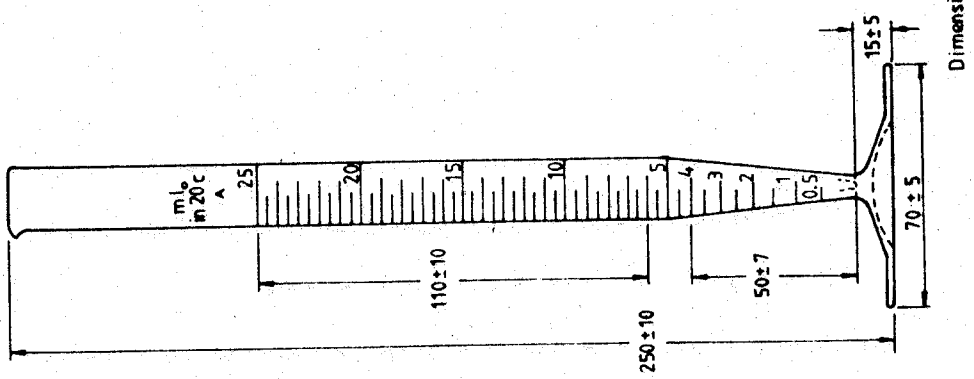
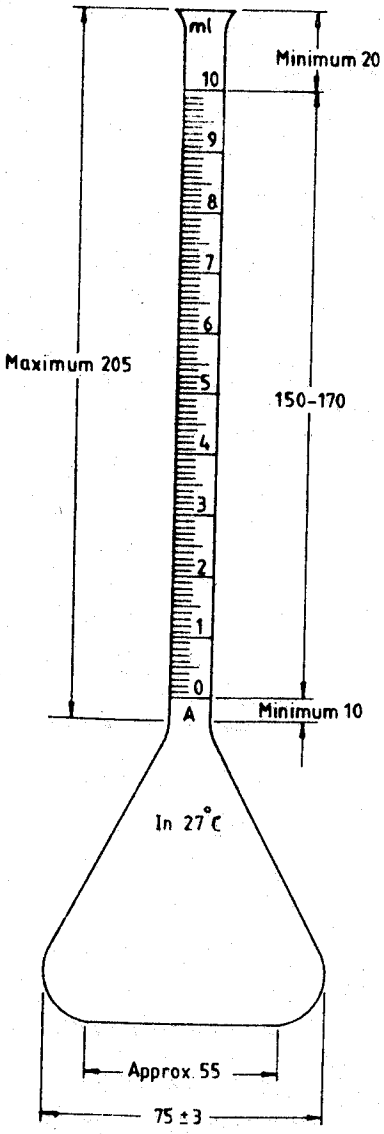
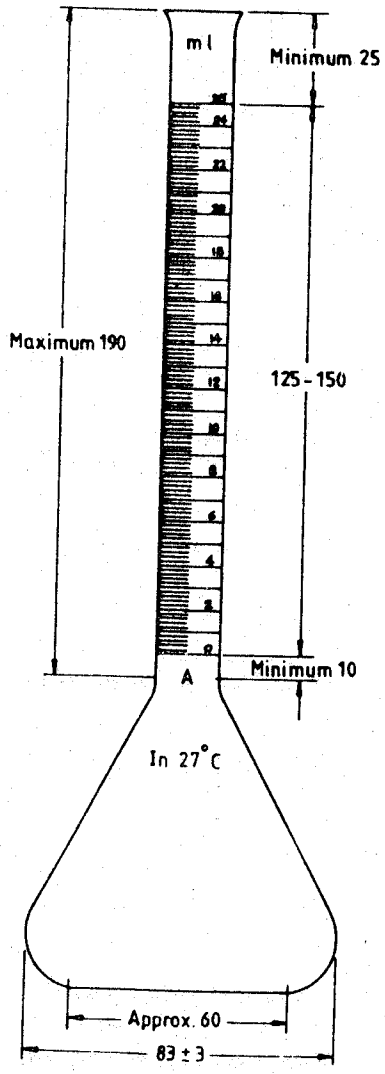


FIGURE 6 - Typical Crow receiver of capacity of 25 ml



(a) 150 ml flask with 10 ml scale



(b) 200 ml flask with 25 ml scale

FIGURE 8 - Flasks with scales

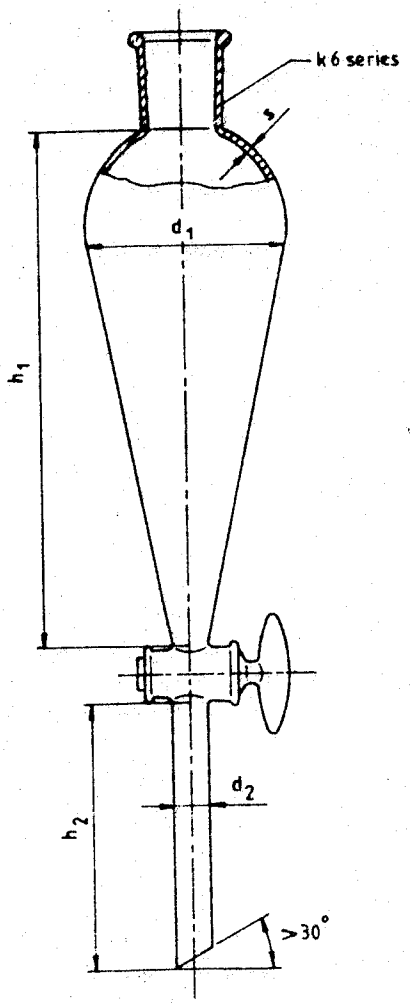


FIGURE 9 - 250ml capacity separating funnel

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