SRI LANKA STANDARD 1125 : 1996

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SPECIFICATION FOR WROUGHT ALUMINIUM FOR ELECTRICAL PURPOSES - SOLID CONDUCTORS FOR INSULATED CABLES

SRI LANKA STANDARDS INSTITUTION

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SLS 1125 : 1996

Gr. 8

SRI LANKA STANDARDS INSTITUTION
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Colombo 03
Sri Lanka.

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This standard does not purport to include all the necessary provisions of a contract.

Sri Lanka Standard
SPECIFICATION FOR WROUGHT ALUMINIUM FOR ELECTRICAL PURPOSES-SOLID CONDUCTORS FOR INSULATED CABLES

FOREWORD

This standard was approved by the Sectoral Committee on Electrical Cables and Conductors and was authorized for adoption and publication as Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 96-05-23.

This standard specifies the specification for wrought aluminium for electrical purposes -solid conductors for insulated cables.

The standard values which have been adopted for the purpose of this standard, are given in Appendix **A** for information. Details of the international alloy designations and chemical composition limits for wrought aluminium alloys system have also been given in Appendix **B** for information.

All the values given in this specification are in SI units.

For the purposes of deciding whether a particular requirements of this standard is complied with, the final value, observed or calculated, expressing the results of a test or analysis shall be rounded off in accordance with **CS 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, the assistance obtained from the **BS 3988 : 1970** Specification for Wrought Aluminium for Electrical Purposes - Solid conductors for insulated cables, including amendment No. 1, No.2 and No.3, published by the British Standards Institution is greatefully acknowledged.

1 SCOPE

This standard specifies requirements for circular solid and 2-core, 3-core and 4-core shaped solid conductors in a range of standard sizes from 16 mm^2 up to and including 300 mm^2.

2 REFERENCES

IEC 468 Method of measurement of resistivity of metallic material.
SLS 978 Tensile testing of metallic materials,
Part 1 : Method of test at ambient temperature.

3 DEFINITIONS

For the purposes of this standard the following definitions shall apply:

3.1 diameter (for circular solid conductors) : The mean of two measurements at right angles taken at the same cross section.

3.2 shaped solid conductor : A conductor of one of the shapes shown in Table 3, Table 4(a), Table 4(b) and Table 5, the dimensions of which are as defined.

4 REQUIREMENTS

4.1 General

The material shall comply with the general requirements of **4.1.1** and **4.1.2**.

4.1.1 *Freedom from defects*

The material shall be free from defects prejudicial to its use as an electrical conductor.

4.1.2 *Joints*

There shall be no joints in the finished conductor. In the case of conductors drawn to size, joints made in the base rod before final drawing shall be permitted.

4.2 Properties

The material shall comply with the general requirements of **4.1.1** and **4.1.2,** and shall have the chemical composition, condition, dimensions and mechanical and electrical properties as specified in **4.2.1** to **4.2.3**.

4.2.1 *Chemical composition*

The chemical composition of material in per cent (minimum content of aluminium and maximum allowable for other materials) shall be as given in Table **1**.

TABLE 1 - Chemical Composition

Element	Percentage
Silicon	0.10
Iron	0.40
Copper	0.05
Manganese	0.01
Chromium	0.01
Zinc	0.05
Gallium	0.03
Boron	0.05
Vanadium + Titanium	0.02
Others*	
Each	0.03
Total	0.01
Aluminium	99.50 min. **

* *Analysis is regularly made only for the elements for which specific limits are shown. If, however, the presence of other elements is suspected to be, or in the course of routine analysis is indicated to be in excess of the specified limits, further analysis is made to determine that these other elements are not in excess of the amount specified.*

** *The aluminium content for unalloyed aluminium not made by a refining process is the difference between 100.00 per cent and the sum of all other metallic elements present in amounts of 0.010 per cent or more each, expressed to the second decimal before determining the sum.*

4.2.2 *Condition*

The material shall be supplied in the condition which provides the properties given in **4.2.3** and **4.2.4**.

4.2.3 *Dimensions*

4.2.3.1 Circular solid conductors

The diameters of circular solid conductors shall be within the limits specified in Column **7** and Column **8** of Table **2**, and the difference between the maximum and minimum measurements taken at the same cross section shall not exceed 1 per cent.

4.2.3.2 Shaped solid conductors

The dimensions of shaped solid conductors shall be such that the profile of the conductor shall at no point lie outside the envelope defined by the dimensions specified in Column **12**, Column **13**, Column **14** and Column **15** of Table **3**, Table **4** and Table **5** and the widths and depths shall be not less than the values specified in Column **10** and Column **11** of Table **3**, Table **4** and Table **5**.

The angle subtended by the two flat faces of 3-core and 4-core shaped solid conductors shall not vary from that specified by more than $\pm 1^0$.

The flat faces of shaped solid conductors shall not show any degree of concavity.

TABLE 2 - Circular solid conductors

Nominal area	Calculated area	Resistance per km at 20 °C		Nominal mass	Diameter mm		
		Standard	Maximum*	kg/km	Nominal	Minimum	Maximum
mm^2	mm^2	Ω	Ω				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
16	15.62	1.79	1.83	43.0	4.50	4.46	4.54
25	24.48	1.14	1.16	66.2	5.58	5.52	5.64
35	33.96	0.825	0.842	91.8	6.58	6.51	6.65
50	45.97	0.610	0.622	124	7.65	7.57	7.73
70	66.44	0.422	0.430	180	9.20	9.11	9.29
95	92.14	0.304	0.310	249	10.83	10.72	10.94
120	116.5	0.241	0.246	315	12.18	12.06	12.30
150	143.1	0.196	0.200	387	13.50	13.36	13.64
185	179.5	0.156	0.159	485	15.12	14.97	15.27
240	235.9	0.119	0.121	638	17.33	17.16	17.50
300	295.8	0.0943	0.0967	800	19.41	19.22	19.60

* Including an allowance of 2 per cent over the standard value.

TABLE 3 -Two Core shaped solid conductors

Nominal area	Calcu-lated area	Resistance per km at 20 °C		Nominal mass	Nominal dimensions mm				Minimum dimensions		Dimensions of maximum envelope mm			
		Standard	Maxi-mum*	kg/km	Width	Depth	Back radius	Corner radius	Width	Depth	Width	Depth	Back radius	Corner radius
mm^2	mm^2	Ω	Ω						mm	mm				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
16	15.62	1.79	1.84	42.2	6.82	2.95	3.65	0.50	6.68	2.87	6.89	2.98	3.68	0.50
25	24.48	1.14	1.17	66.2	8.57	3.70	4.50	0.50	8.36	3.56	8.66	3.74	4.54	0.50
35	33.96	0.825	0.850	91.8	10.02	4.40	5.20	0.52	9.74	4.20	10.12	4.44	5.25	0.52
50	45.97	0.610	0.628	124	11.54	5.16	5.96	0.59	11.24	4.95	11.66	5.21	6.02	0.60
70	66.44	0.422	0.435	180	13.74	6.25	7.05	0.70	13.40	6.03	13.80	6.28	7.08	0.71
95	92.14	0.304	0.313	249	16.05	7.40	8.20	0.82	15.68	7.16	16.13	7.43	8.23	0.82
120	116.5	0.241	0.248	315	17.95	8.36	9.16	0.91	17.55	8.10	18.03	8.39	9.20	0.92
150	143.1	0.196	0.202	387	20.00	9.22	10.22	1.02	19.57	8.95	20.10	9.27	10.27	1.03
185	179.5	0.156	0.161	485	22.29	10.37	11.37	1.13	21.83	10.08	22.40	10.42	11.42	1.14
240	235.9	0.119	0.123	638	25.51	11.90	13.00	1.30	25.00	11.59	25.63	11.96	13.07	1.31
300	295.8	0.0948	0.0976	800	28.44	13.37	14.47	1.44	27.88	13.04	28.58	13.44	14.54	1.45

* Including an allowance of 3 per cent over the standard value.

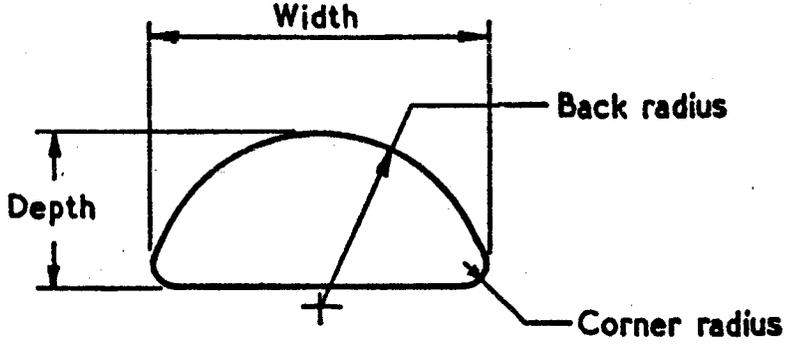


TABLE 4(a) - Three Core Shaped Solid conductors for Voltages up to and Including 1900 V/3300 V

Nominal area	Calculated area	Resistance per km at 20 °C, Ω		Nominal mass	Nominal dimensions dimensions,				Minimum dimensions		Dimensions of maximum envelope mm			
		Standard	Maximum*	kg/km	Width	Depth	Back radius	Corner radius	Width	Depth	Width	Depth	Back radius	Corner radius
mm²	mm²	Ω	Ω		mm	mm	mm	mm	mm	mm				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
16	15.62	1.79	1.84	42.2	6.53	3.70	4.60	0.50	6.39	3.60	6.60	3.74	4.64	0.50
25	24.48	1.14	1.17	66.2	8.22	4.66	5.67	0.56	8.02	4.51	8.30	4.71	5.72	0.57
35	33.96	0.825	0.850	91.8	9.66	5.50	6.53	0.65	9.39	5.29	9.76	5.56	6.58	0.66
50	45.97	0.610	0.628	124	11.20	6.42	7.47	0.74	10.90	6.19	11.31	6.48	7.55	0.76
70	66.44	0.422	0.435	180	13.42	7.74	8.81	0.88	13.09	7.49	13.49	7.78	8.85	0.88
95	92.14	0.304	0.313	249	15.76	9.14	10.24	1.02	15.39	8.87	15.84	9.19	10.29	1.03
120	116.5	0.241	0.248	315	17.69	10.30	11.41	1.14	17.29	10.02	17.78	10.35	11.47	1.15
150	143.1	0.196	0.202	387	19.64	11.40	12.76	1.27	19.22	11.10	19.74	11.46	12.82	1.28
185	179.5	0.156	0.161	485	21.97	12.78	14.17	1.41	21.51	12.46	22.07	12.84	14.24	1.42
240	235.9	0.119	0.123	638	25.17	14.66	16.20	1.62	24.66	14.31	25.29	14.73	16.28	1.63
300	295.8	0.0948	0.0976	800	28.14	16.44	18.01	1.80	27.59	16.06	28.28	16.52	18.09	1.81

* Including an allowance of 3 per cent over the standard value.

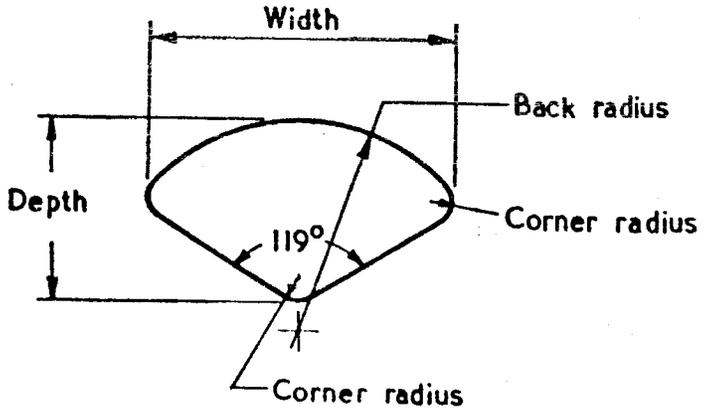


TABLE 4(b) - Three Core Shaped Solid Conductors for Voltages of 3800 V/6600 V and above

Nominal area	Calculated area	Resistance per km at 20 °C		Nominal mass	Nominal dimensions mm				Minimum dimensions		Dimensions of maximum envelope mm			
		Standard	Maximum*	kg/ km	Width	Depth	Back radius	Corner radius	Width	Depth	Width	Depth	Back radius	Corner radius
mm^2	mm^2	Ω	Ω						mm	mm				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
70	66.44	0.422	0.435	180	11.28	7.86	9.94	2.80	10.98	7.61	11.35	7.90	9.97	2.80
95	92.14	0.304	0.313	249	13.92	9.12	11.42	2.80	13.58	8.85	14.00	9.16	11.47	2.80
120	116.5	0.241	0.248	315	15.31	10.24	12.58	3.00	15.44	9.96	15.91	10.29	12.63	3.00
150	143.1	0.196	0.202	387	17.93	11.30	13.87	3.00	17.53	11.00	18.03	11.35	13.92	3.00
185	179.5	0.156	0.161	485	20.52	12.62	15.42	3.00	20.08	12.30	20.64	12.63	15.48	3.00
240	235.9	0.119	0.123	638	24.02	14.45	17.49	3.00	23.53	14.10	24.16	14.53	17.56	3.00
300	295.8	0.0948	0.0976	800	27.30	16.19	19.45	3.00	26.76	15.82	27.45	16.27	19.54	3.00

* Including an allowance of 3 per cent over the standard value.

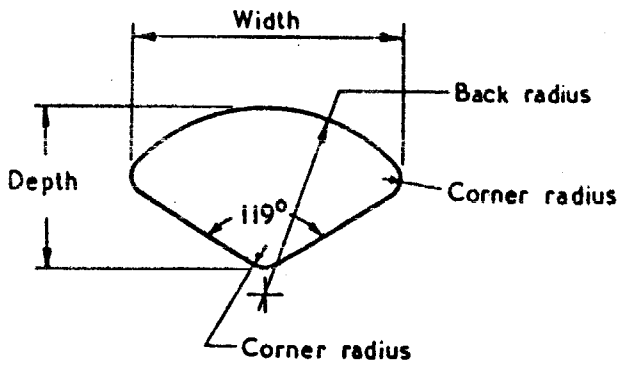
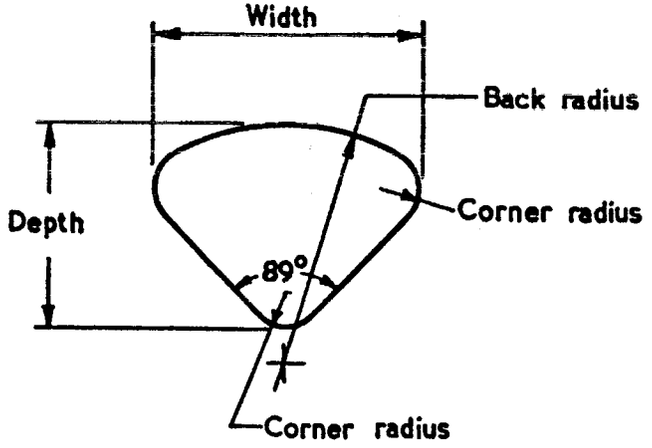


TABLE 5 - Four Core Shaped Solid Conductors

Nominal area	Calculated area	Resistance per km at 20 °C		Nominal mass	Nominal dimensions mm				Minimum dimensions		Dimensions of maximum envelope mm			
		Standard	Maximum*	kg/km	Width	Depth	Back radius	Corner radius	Width	Depth	Width	Depth	Back radius	Corner radius
mm^2	mm^2	Ω	Ω						mm	mm				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
16	15.62	1.79	1.84	42.2	5.96	4.21	5.44	0.54	5.83	4.11	6.02	4.25	5.48	0.55
25	24.48	1.14	1.17	66.2	7.45	5.28	6.71	0.67	7.26	5.12	7.52	5.33	6.77	0.68
35	33.96	0.825	0.850	91.8	8.78	6.24	7.71	0.77	8.52	6.02	8.87	6.30	7.78	0.78
50	45.97	0.610	0.628	124	10.21	7.28	8.79	0.87	9.93	7.04	10.31	7.35	8.87	0.89
70	66.44	0.422	0.435	180	12.26	8.77	10.35	1.03	11.95	8.51	12.32	8.81	10.40	1.04
95	92.14	0.304	0.313	249	14.43	10.35	12.00	1.20	14.08	10.06	14.49	10.40	12.06	1.21
120	116.5	0.241	0.248	315	16.22	11.65	13.36	1.33	15.85	11.35	16.29	11.71	13.42	1.34
150	143.1	0.196	0.202	387	17.99	12.90	14.96	1.49	17.59	12.58	18.08	12.96	15.03	1.50
185	179.5	0.156	0.161	485	20.14	14.46	16.59	1.65	19.71	14.11	20.25	14.53	16.67	1.67
240	235.9	0.119	0.123	638	23.08	16.59	18.96	1.89	22.60	16.21	23.20	16.67	19.04	1.90
300	295.8	0.0948	0.0976	800	25.83	18.59	21.06	2.10	25.31	18.18	25.96	18.68	21.18	2.12

* Including an allowance of 3 per cent over the standard value



4.2.4 *Mechanical properties*

The mechanical properties, obtained from test pieces selected as specified in **6** and prepared and tested as specified in **5.2** and **5.3** shall be as given in Table **6**.

TABLE 6 - Mechanical properties

Tensile strength, maximum MPa	Elongation on 250 mm minimum %
80	25

4.2.5 *Electrical resistance*

The resistance per kilometer at 20 ^{0}C determined in accordance with **5.4** shall not exceed the appropriate value given in Column **4** of Table **2**, Table **3**, Table **4(a)**, Table **4(b)** and Table **5**.

5 METHODS OF TEST

5.1 Sampling

Test samples for the tensile, elongation and electrical resistance tests specified in **5.2**, **5.3**, and **5.4** shall be selected as follows:

Lengths of conductor of the same dimensions, produced in the same way and of the same condition, shall be grouped into batches not exceeding 1000 kg in weight and test samples shall be cut from one length selected from each batch. Before the test samples are cut off they shall be marked to identify them. The test samples shall be taken from the conductor as supplied and shall not be annealed or mechanically worked other than straightening before testing.

5.2 Tensile test

The test shall be made in accordance with **SLS 978 : Part 1 : 1992**. The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25 mm per minute and not greater than 100 mm per minute.

5.3 Elongation test

The test shall be made in accordance with **SLS 978 : Part 1 : 1992.** The load shall be applied gradually and uniformly on straightened lengths of conductor, having an original gauge length of 250 mm.

The elongation shall be measured on the gauge length after the fractured ends have been fitted together. The determination shall be valid, whatever the position of the fracture, if the specified value is reached. If the specified value is not reached, the determination shall be valid only if the fracture occurs between the gauge marks and not closer than 25 mm to either mark.

5.4 Electrical resistance test

The resistance shall be determined by measurement in accordance with the routine method given in **IEC 468 : 1974.**

5.5 Retests

Should any one of the test pieces first selected fail to pass the mechanical or resistance tests, two further samples from the same batch shall be selected for testing, one of which shall be taken from the length from which the original test sample was taken unless that length has been withdrawn by the supplier.

Should the test pieces from both these additional samples satisfy the requirements of the mechanical and resistance tests, the batch represented by these samples shall be deemed to comply with the standard. Should the test pieces from either of the two additional samples fail, the batch represented shall be deemed not to comply with the standard.

APPENDIX A
STANDARD VALUES
(for information only)

For the purposes of this standard the following standard values have been adopted.

a) Density at 20 ^{0}C — 2.703 x 10^3 kg/m^3.

b) Constant mass temperature coefficient of resistance at 20 ^{0}C, measured between two potential points rigidly fixed to the conductors — 0.004 03/ ^{0}C.

c) Coefficient of linear expansion between 0 and 30 ^{0}C — 23 x 10^{-6}/ ^{0}C.

d) Volume resistivity at 20 ^{0}C — 2.803 x 10^{-8} Ωm.

APPENDIX B

DETAILS OF THE INTERNATIONAL ALLOY DESIGNATIONS AND CHEMICAL COMPOSITION LIMITS FOR WROUGHT ALUMINIUM ALLOYS SYSTEM

B.1 Alloys groups : general

The first of the four digits in the designation indicates the alloy group as follows:

B.1.1 Aluminium, 99.00 per cent minimum and greater — 1 xxx

B.1.2 Aluminium alloys groups by major alloying elements

Copper	2 xxx
Manganese	3 xxx
Silicon	4 xxx
Magnesium and silicon	5 xxx
Magnesium and silicon	6 xxx
Zinc	7 xxx
Other element	8 xxx
Unused series	9 xxx

B.2. 1xxx group

In the 1 xxx group for minimum purities of 99.00 per cent and greater, the last two of the four digits in the designation indicate the minimum aluminium percentage. These digits are the same as the two digits to the right of the decimal point in the minimum aluminium per centage when it is expressed to the nearest 0.01 per cent.

The second digit in the designation indicates modifications in impurity limits or alloying elements. If the second digit in the designation is zero, it indicates unalloyed aluminium having natural impurity limits : integers **1** to **9**, which are assigned consecutively as needed, indicate special control of one or more individual impurities or alloying elements.

B.3. 2xxx to 8xxx group

In the **2** xxx to **8** xxx groups the last two of the four digits in he designation have no special significance but serve only to identify the different aluminium alloys in the group. The second digit in the alloy designation indicates the original alloy ; integers **1** to **9**, which are assigned consecutively, indicate alloy modifications.

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Further particulars of the terms and conditions of the permit may be obtained from the Sri *Lanka Standards Institution, 17, Victoria Place, Elvitigala Mawatha, Colombo 08.*

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SRI LANKA STANDARDS INSTITUTION

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In the International field the Institution represents Sri Lanka in the International Organization for Standardization (ISO), and participates in such fields of standardization as are of special interest to Sri Lanka.

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