SRI LANKA STANDARD 139 : 2003
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SPECIFICATION FOR
MILD STEEL WIRE FOR GENERAL ENGINEERING PURPOSES
(FIRST REVISION)

SRI LANKA STANDARD INSTITUTION

SPECIFICATION FOR MILD STEEL WIRE FOR GENERAL ENGINEERING PURPOSES [FIRST REVISION]

SLS 139: 2003

Gr. 8
(AMD 405 Attached)

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Sri Lanka.

Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

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

SRI LANKA STANDARD
SPECIFICATION FOR MILD STEEL WIRE-FOR GENERAL ENGINEERING PURPOSES
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FOREWORD

This standard was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2003.01.14 after the draft, finalized by the working group on mild steel wire for general engineering purposes, had been approved by the Sectoral Committee on Engineering Materials, Mechanical systems and Manufacturing Engineering.

This is the first revision of CS 139: 1972 Specification for mild steel wire for general engineering purposes. In this edition, mainly the requirements for sizes, coating mass, and dimensional tolerances have been revised.

Guidelines for the determination of compliance of a lot with the requirements of this standard, based on statistical sampling and inspection is given in Appendix **C**.

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 **CS 102**. The number of significant places retained in the rounded off value shall be the same as that of the specified value in this standard.

In the preparation of this specification valuable assistance derived from the relevant publications of the International Organization for Standardization, British Standards Institution and Japanese Standard Association is gratefully acknowledge.

1 SCOPE

This Sri Lanka Standard covers the requirements, materials, sizes, finishes, mechanical properties and marking for drawn mild steel wire for general engineering purposes.

2 REFERENCES

ISO 377 Location and preparation of samples test pieces for mechanical testing
SLS 978 Tensile testing of metallic materials
CS 102 Presentation of numerical values

3 DEFINITIONS

3.1 zinc coated wire: Mild steel wire to which a coating of zinc has been applied as a protection against corrosion. This can be performed either by dipping in a bath of molten zinc or electro deposition in an aqueous solution of zinc salt.

3.2 coating mass: Mass of the zinc coating per unit area of wire expressed in grams per square meter

3.3 wire: Finished product with uniform circular cross section, the dimensions of the section being very small compared to the length, manufactured by cold drawing and generally supplied in coils.

3.4 length: A straight piece of drawn wire cut to a specified length.

4 DESIGNATION

The level of zinc coating shall be indicated as a quality designated by the letters A, AB, B, C or D as shown in Table **3.**

5 REQUIREMENTS

5.1 Material

The composition of mild steel used for the manufacture of wire shall comply with the following limits of phosphorus and sulphur.

Phosphorus, maximum 0.065 per cent
Sulphur, maximum 0.060 per cent

5.2 Manufacture

The mild steel wire shall be cold drawn. It shall be cleanly drawn to the nominal dimensions specified in **5.3** and physical properties as specified in Table **4** and shall be sound and free from splits, surface flaws and scale.

5.3 Sizes

5.3.1 *Preferred sizes*

The following are the preferred wire diameters for mild steel wire for general engineering purposes.

mm	mm	mm	mm
0.10	0.32	1.20	4.50
0.12	0.35	1.40	5.00
0.14	0.40	1.60	5.50
0.16	0.45	1.80	6.00
0.18	0.50	2.00	6.50
0.20	0.55	2.30	7.00
0.22	0.62	2.60	7.50
0.24	0.70	2.90	8.00
0.26	0.80	3.20	8.50
0.28	0.90	3.50	9.00
0.30	1.00	4.00	10.0

5.4 Dimensional tolerances

5.4.1. The tolerance on diameter with respect to coating quality shall be in accordance with Table **1** or Table **2.**

TABLE 1 – Tolerance on diameter for all finishes other than galvanized wire

All values in millimetres

Size of wire (Diameter) **(1)**	**Tolerance** **(2)**	**Maximum difference between two readings of any two diameters at the same cross-section** **(3)**
Over 0.200 to 0.260	± 0.025	0.025
Over 0.260 to 0.550	± 0.030	0.030
Over 0.55 to 1.60	± 0.040	0.040
Over 1.60 to 5.50	± 0.050	0.050
Over 5.50	± 0.060	0.060

TABLE 2 - Tolerance on diameter for galvanized wire

All values in millimetres

Nominal diameter (1)	Tolerance on diameter	
	Class A and AB (2)	Class B, C and D (3)
Up to 1.60	± 0.08	± 0.05
Over 1.60 to 2.60	± 0.10	± 0.07
Over 2.60 to 3.20	± 0.11	± 0.08
Over 3.20 to 5.00	± 0.13	± 0.10
Over 5.00	± 0.15	± 0.12

NOTE

It is recognized that the surface of zinc coating on wire, particularly those produced by hot dipping, are not perfectly smooth or devoid of irregularities. If the diameter tolerances shown in ***Table*** *2 are rigidly applied to such irregularities that are inherent in the product, unjustified rejection may occur of coated wire, which is actually satisfactory. Therefore, it is intended that these tolerances be used in measuring the uniform areas of the zinc-coated wire.*

5.5 Finish

The mild steel wire shall be supplied planed, galvanized or in any other special finish to be agreed upon at the time of order.

5.5.1 *Galvanizing*

5.5.1.1 Coating mass

The minimum mass of zinc per unit area of surface shall comply with the requirements of Table **3** for the appropriate class.

TABLE 3 – Mass of Coating

Diameter (d) mm (1)	Classes * A g/m² (2)	AB g/m² (3)	B g/m² (4)	C g/m² (5)	D g/m² (6)
0.15 d< 0.20	--	-	15	--	10
0.20 d< 0.25	30	20	20	20	15
0.25 d< 0.32	45	30	30	25	15
0.32 d< 0.40	60	30	30	25	15
0.40 d< 0.50	85	55	40	30	15
0.50 d< 0.60	100	70	50	35	20
0.60 d< 0.70	115	80	60	40	20
0.70 d< 0.80	130	90	60	45	20
0.80 d< 0.90	145	100	70	50	20
0.90 d< 1.00	155	110	70	55	25
0.10 d< 1.20	165	115	80	60	25
1.20 d< 1.40	180	125	90	65	25
1.40 d< 1.65	195	135	100	70	30
1.65 d< 1.85	205	145	100	75	30
1.85 d< 2.15	215	155	115	80	40
2.15 d< 2.50	230	170	125	85	45
2.50 d< 2.80	245	185	125	95	45
2.80 d< 3.20	255	195	135	100	50
3.20 d< 3.80	265	210	135	105	60
3.80 d< 4.40	275	220	135	110	60
4.40 d< 5.20	280	220	150	110	70
5.20 d< 8.20	290			110	80
8.20 d< 10.00	300			110	80

* The coating class with a designation starting with A relates to thick coatings (generally final coating). Designation ending in B relate to classes usually but not always obtained by (zinc coating) and subsequent drawing. Classes C and D are standard classes for low mass coating which are usually produced but not exclusively, produced by hot zinc dipping and then wiping.

5.5.1.2 Coating appearance
The coating shall be continuous and as smooth and evenly distributed as practicable.

5.5.2 *Special finishes*
If the purchaser requires a special finish or an exceptionally smooth and/or bright finish, this is to be agreed at the time of inquiry and order.

5.5.3 *Adhesion of coating*

When tested in accordance with **7.6.1** the coating shall remain firmly adhered to the steel base and shall not crack or flake when rubbed with the bare fingers. Loosening or detachment during the test of superficial, small particles of zinc formed by mechanical polishing of the surface of the zinc-coated wire shall not be considered a cause for rejection.

5.6 Defects

The mild steel wire shall be free from internal or surface defects likely to affect adversely on its subsequent processing or / and use.

5.7 Tensile strength

When tested as specified in **7.3** the tensile strength of mild steel wire shall be in accordance with Table **4.**

TABLE 4 - Tensile strength

Conditions	Finishes other than galvanized	Galvanized (supplied in soft and hard conditions only)
(1)	Tensile strength N/mm^2 (2)	Tensile strength N/mm^2 (3)
Soft	310 to 430	310 to 660
¼ - Hard	430 to 540	-
½- Hard	540 to 660	-
Hard	660 to 930	660 to 930

NOTE
Tensile strength shall be determined for the nominal diameter of the wire.

6 MARKING

Each coil or bundle shall be legibly marked with the following:

a) Type of wire (finish);
b) Diameter, in millimetres;
c) Mass, in kilograms;
d) Name or trade mark of manufacturer; and

NOTE

Attention is drawn to the certification marking facilities offered by the Sri Lanka Standards Institution. See the inside back cover of this standard.

7 METHODS OF TEST

7.1 Selection and preparation of samples and test pieces

The general conditions given in **ISO 377** for the selection, preparation of samples and test pieces shall apply.

7.2 Ageing

7.2.1 Material covered by this standard will in time exhibit changes in mechanical properties after manufacture, particularly tensile strength and elongation. These changes result from a phenomenon known as strain ageing or strain age hardening, and lead to an increase in tensile strength and a decrease in elongation, compared to the wire immediately after coating with zinc.

7.2.2 It is customary to carry out tests immediately after manufacture. At room temperatures, strain ageing may proceed slowly. Therefore, results of test performed by the purchaser, may be at variance with those reported by the supplier.

7.3 Tensile test

The tensile test shall be carried out in accordance with **SLS 978**.

7.4 Wrapping test (for size below 5 mm in diameter)

The mild steel wire shall withstand without breaking or splitting when wrapped eight times round its own diameter subsequently straightened. Wrapping and unwrapping shall be done at a constant speed sufficiently slow to prevent any rise in temperature.

7.5 Bend test (for size 5 mm in diameter and above)

The mild steel wire shall withstand without breaking or splitting when bent through an angle of 90^{o} round a former of diameter equal to twice its own diameter.

7.6 Testing of zinc coating

7.6.1 *Adhesion test*

For mild steel wires of nominal diameter 7.5 mm and smaller, the adhesion of the zinc coating shall be tested by wrapping the wire at least six close turns around a cylindrical mandrel. The ratio of mandrel diameter to wire diameter shall be in accordance with Table **5**.

TABLE 5 – The ratio of mandrel diameter to wire diameter

All values in millimetres

Wire diameter, (*d*)		Mandrel diameter
Over	Up to and incl.	
(1)	(2)	(3)
-	3.8	4 *d*
3.8	10	5 *d*

For mild steel wires over 7.5 mm nominal diameter, the wire shall be bent through an angle of at least 90^0 around the mandrel the ratio of mandrel diameter to wire diameter be in accordance with Table **5.**

7.6.2 *Determination of coating mass*

The determination of the coating mass shall be carried out in accordance with one of the following methods, to be agreed at the time of inquiry and order:

a) the volumetric method described in Annex A; or
b) the gravimetric method described in Annex B.

APPENDIX A
DETERMINATION OF MASS OF ZINC DEPOSITED PER UNIT SURFACE AREAS (VOLUMETRIC METHOD)

A.1 PRINCIPLE

The zinc coating of a test specimen of mild steel wire of given dimensions is dissolved in hydrochloric acid solution. The mass of zinc so dissolved is determined by measuring the volume of hydrogen released during dissolution of the coating (gas volumetric method). By relating the mass of zinc determined in this way to the surface area of the test specimen, measured after dissolving the coating, the mass of zinc deposited per unit surface area is obtained.

A.2 REAGENTS

A.2.1 Hydrochloric acid solution, of suitable concentration.

A.2.2 Inhibitor, for example, hexamethylene tetramine ($C_6H_{12}N_4$), antimony (III) chloride ($SbCl_3$) or antimony (III) oxide (Sb_20_3).

A.3 APPARATUS

The apparatus used consists of the following elements (see Figure **1**)

A.3.1 Tube, graduated in millimetres at least, with a tap at each end.

A.3.2 Flask, with a nozzle near the bottom connected by a rubber tube to a nozzle near the bottom of the graduated tube as shown in Figure **1**

A.3.3 Beaker : for holding the test specimen after removal of the zinc coating.

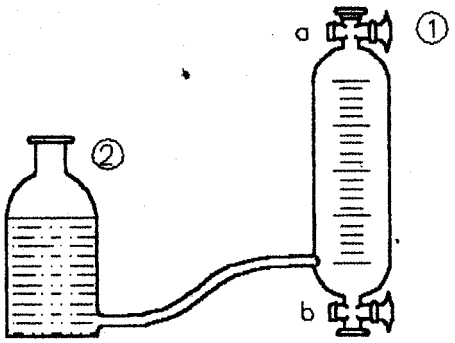

FIGURE 1 – Apparatus for determination of coating mass (volumetric method)

A.4 PREPARAITON OF TEST SPECIMENS

After carefully straightening the samples of wire, test specimens shall be cut to a length of

300 mm for wires less than 1.00 mm in diameter;
150 mm for wires 1.00 to 1.49 mm in diameter;
100 mm for wires 1.5 to 3 mm in diameter; and
50 mm for wires more than 3 mm in diameter.

Care shall be taken that these lengths are measured accurately.

A.5 PROCEDURE

With tap "b" closed, the graduated tube and part of the flask are filled with hydrochloric acid solution (**A.2.1**) containing a suitable inhibitor (**A.2.2**).

The level of the liquid in the graduated tube (**A.3.1**) is raised to just under tap "a" by raising the acid reservoir flask (**A.3.2**). The level in the tube and flask should be the same.

After introducing the test specimen into the graduated tube through tap "a", tap "a" is closed and the hydrogen released by the action of the acid on the zinc coating is accumulated in the upper part of the graduated tube.

When hydrogen is no longer released, the flask is lowered in relation to the graduated tube so as to bring the levels of the solution in the tube and in the flaks into the same plane. The position of the meniscus of the liquid in the tube then indicates the volume of hydrogen released.

The remaining part of the solution contained in the graduated tube is collected in the flaks by placing the flask on a table and opening to "a".

Tap "b" is then opened so that the test specimen can be extracted into the beaker (**A.3.3**). The test specimen is washed and carefully wiped before measuring its length and diameter.

The test is carried out on one test specimen at a time, the temperature in the tube being held at 20 ^{o} C ± 2 ^{o} C.

A.6 EXPRESSION OF RESULTS

The result is determined after testing of all test specimens
The mass m, in grams per square metre, of zinc deposited per unit of surface area, is given by the equation.

$$m = \frac{2\,720\ V}{\eth\ d.1}$$

where,

d is the diameter, in millimetres, of the uncoated wire;

l is the length, in millimetres, of the test specimen;
V is mean volume, in millilitres, of hydrogen released during each of the test.

Where the barometric pressure is known to be outside the range 740 to 780 mmHg[1)], the right-hand side of the equation above shall be multiplied by the factor p/760, where p is the barometric pressure, in conventional millimetres of mercury.

In practice, tables allow the mass of zinc per square metre of the surface of the uncoated wire to be read directly as a function of the diameter of the wire and the volume of hydrogen released.

APPENDIX B
DETERMINATION OF MASS OF ZINC DEPOISTED PER UNIT SURFACE AREA
(GRAVIMETRIC METHOD)

B.1 PRINCIPLE

The zinc coating on surface of known area is dissolved in inhibited acid and the resultant loss in mass is determined by weighing the test specimen before and after and the coating is dissolved.

B.2 STRIPPING SOLUTION

Warning – Care must be exercised in handling the stripping solution in view of the toxicity of antimony compounds.
Dissolve about 3.2 g of antimonous chloride ($SbCl_3$) or 2 g of antimony (III) oxide (Sb_20_3) in 500 ml of concentrated hydrochloric acid (Q = 1.190 g/ml). Dilute this solution with distilled water to 1 litre.

B.3 PROCEDURE

Where necessary, the test specimen shall be degreased with an organic solvent that does not attach the coating, then dried.

Before stripping, the test specimen shall be weight to accuracy better than 1 % of the presumed coating mass.

The quantity of stripping solution taken shall be measured to that at least 10 ml of solution is available for each square centimetre of the surface of these test specimens. The test specimen shall be completely immersed in the solution at room temperature and left until the coating has completely dissolved. The end of the dissolution process can be recognized by the cessation of the originally brisk evolution of hydrogen. The test specimen shall then be rinsed running water and, if necessary, brushed to remove any loose substances, which may be adhering to the surface, dipped in alcohol quickly dried and again weighed to the previously stated accuracy.

The surface are A of the exposed surface shall then be determined, to an accuracy of 1%, by measuring the dimensions of the test specimen.

B.4 CALCULATION OF COATING MASS

The loss in mass m, Δm, in grams, is obtained from the equation

$\Delta m = m_1 - m_2$
where,
m_1 is the mass, in grams, of the test specimen before stripping; and

m_2 is the mass, in grams, of the test specimen after stripping.

The mass per unit area, m_A, in grams per square meter, of the coating is obtained, form the equation.

$$m_A = \frac{\Delta m}{A} 10^6$$

Where Δm is expressed in grams and A in square millimetres.

NOTE
With steel wire, it is often advantageous to calculate the mass per unit area m_A of the zinc coating in grams per square metre using the equation.

$$m_A = 1960 \times d \times \frac{\Delta m}{m_2}$$

Where d is the diameter, in millimetres, of the wire after stripping and the density of the steel is taken as 7 850 kg/m^3.

In this way, it is not necessary to know the length of the wire.

The reproducibility (different observers, different apparatus and different operating conditions) is about ± 5% of the mean value.

APPENDIX C
COMPLIANCE OF A LOT

This sampling scheme shall be applied where compliance of a lot to the requirements of this standard is to be assessed based on statistical sampling and inspection.

Where compliance with this standard is to be assured based on manufacture's control system coupled with type testing and check tests or any other procedure, appropriate, scheme of sampling and inspection should adopt.

C.1 Lot – In any consignment, all the coils or bundles of wire of one size and quality manufactured at the same place or on any one date shall be grouped together to constitute a lot.

C.2 The number of coils or bundles to be examined from each lot for freedom from defects specified in **C.4**, for tolerance in diameter, for mechanical properties and for coating (in the case of coated wire) shall be in accordance with Table **6**, and coils or bundles shall be selected at random.

TABLE 6-Number of coils or bundles to be selected and permissible number table of defective coils or bundles

Number of coils or bundles in the lot (1)	Number of coils bundles to be selected (2)	Permissible number of defective coils or bundles (3)
Up to 25	3	0
26 to 65	4	1
66 to 180	5	1
181 to 300	7	1
Above 300	10	2

C.3 From each of the coils or bundles selected as in **C.2** test pieces shall be cut from one end of a coil or length of wire, at a distance of not less than 60 cm from the end, and shall be subjected to the tests specified in **C.4**.

C.4 Examination and tests

All the test pieces taken as in **C.2** shall be examined for manufacturing defects, diameter and then subjected to the other tests as follows:

(a) One test piece for Tensile Test (see **7.3**)
(b) One test piece for Wrapping Test or Bend Test (see **7.4** and **7.5**)
(c) One test piece for the determination of mass of coating per unit area (see **7.6.2**)

C.5 Conformity to standard

C.5.1 A coil or bundle selected as in **C.2** shall be considered as conforming to requirements of this standard if the test pieces from that coil or bundle pass all the relevant tests given in **C.4** depending on the finish.

C.5.2 The lot shall be considered as conforming to requirements of this standard if the number of defective coils or bundles is less than the number given in Column 3 of Table **6**.

C.6 Repeat tests

C.6.1 Should any of the test pieces, first selected not fulfil the test requirements, two additional test pieces in respect of each failure may be taken.

C.6.2 Should the additional test pieces pass the test, the coil or bundle represented sh `all be accepted as conforming to this specification. If the re-test pieces fail the re-test, the coil or the bundle represented by them shall be considered as not conforming to this standard.

AMD 405

AMENDMENT NO . 01 TO SLS 139 :2003
SRI LANKA STANDARD SPECIFICATION FOR MILD STEEL WIRE FOR GENERAL ENGINEERING PURPOSES

SRI LANKA STANDARDS INSTITUTION

AMD 405

Amendment No. 01 Approved on 2010-02-16 to SLS 139 : 2003

AMENDMENT NO . 01 TO SLS 139 : 2003
SRI LANKA STANDARD SPECIFICATION FOR MILD STEEL WIRE FOR GENERAL ENGINEERING PURPOSES

Clause 5.2

Delete the existing text and substitute with the following:

"The mild steel wire shall be cold drawn. It shall be cleanly drawn to the nominal dimensions specified in **5.3** or as agreed by the purchaser. The physical properties shall be as specified in Table **4** and shall be sound and free from splits, surface flaws and scale."

SRI LANKA STANDARDS INSTITUTION

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The principal objects of the Institution as set out in the Act are to prepare standards and promote their adoption, to provide facilities for examination and testing of products, to operate a Certification Marks Scheme, to certify the quality of products meant for local consumption or exports and to promote standardization and quality control by educational, consultancy and research activity.

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

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