

SRI LANKA STANDARD 609:1983
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SPECIFICATION FOR
AUTOMATIC LINE VOLTAGE STABILIZERS
(STEP TYPE) FOR DOMESTIC USE

BUREAU OF CEYLON STANDARDS

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FOREWORD

This Sri Lanka Standard specification was authorised for adoption and publication by the Council of the Bureau of Ceylon Standards on 1983-04-08 after the draft, finalised by the Drafting Committee on Automatic Line Voltage Stabilizers, had been approved by the Electrical Engineering Divisional Committee.

References have been made in this specification with regard to general and safety requirements as well as methods of tests to SLS 579 which is a necessary adjunct to this specification. Should however any deviation exist between the requirements of SLS 579 and those of this specification, the provision of the latter shall apply.

All values in this standard have been given in SI units.

For the purpose of deciding whether a particular requirement of this specification is complied with, the final value observed or calculated expressing the result of a 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 specification.

In the preparation of this specification, the assistance derived from the publications of the International Electrotechnical Commission, and Indian Standards Institution is gratefully acknowledged.

1 SCOPE

This standard specification covers automatic line voltage stabilizers (auto-transformers) step type, rated up to and including 5 kVA single-phase operation for use with domestic electrical equipment like television sets, refrigerators, airconditioners etc.

2 REFERENCES

- IEC 51 Direct acting electrical measuring instruments
- IEC 68-2-4 Basic environmental testing procedures
- IEC 337 Low voltage contact relays
- CS 102 Presentation of numerical values
- SLS 352 Fuse carriers and fuse bases used in rewirable type electric fuses up to 660 volts
- SLS 428 Random sampling methods
- SLS 512 Three pin plugs socket-outlets and socket-outlet adaptors
- SLS 579 General and safety requirements for household and similar electrical appliances.

3 TERMINOLOGY

For the purpose of this specification, the following definitions shall apply:

- 3.1 **auto transformer** : A transformer in which the primary and secondary windings have a common part of parts.
- 3.2 **automatic line voltage stabilizer (auto-transformer) step type** : An auto-transformer wherein with the output voltage fixed, the output to input voltage ratio can be varied automatically.
- 3.3 **booster transformer** : A transformer the secondary winding of which is in series with a circuit to which it adds (or opposes) its voltage to that provided by another source.
- 3.4 **cooling air temperature** : The temperature of the cooling air above which the temperature-rise is measured.
- 3.5 **no-load current** : The current flowing through a line terminal of a winding when rated voltage is applied at rated frequency, the other winding being open-circuited.
- 3.6 **temperature-rise** : The difference between the temperature of the part under consideration and the temperature of the cooling air.
- 3.7 **acceptance-tests** : Those tests which demonstrate to the satisfaction of the purchaser that the equipment complies with this specification.
- 3.8 **response time** : Response time is defined as the time period between the instant at which the output voltage variation occurs, and the instant at which the output voltage deviation is reduced to 37 per cent of the original value.

3.9 routine tests : A test to which every unit is subjected.

3.10 type tests : A test made on one or more units to prove that the quality and design of a given type of equipments are in accordance with this specification.

4 RATINGS

4.1 The preferred kVA ratings shall be 0.25, 0.5, 1.2, 2.5, 3, 4 and 5 kVA.

4.2 The preferred input voltage range shall be 160 V to 260 v.

NOTE - In case of voltages below 160 V a booster transformer may be used in series with the line voltage stabilizer.

4.3 The rated output voltage shall be 230 V.

4.4 The rated frequency shall be 50 Hz.

5 REQUIREMENTS

5.1 Design and construction

5.1.1 The stabilizer shall have a suitable enclosure. The enclosure if metallic shall be adequately earthed, and suitably treated with a corrosive resistant material.

5.1.2 A circuit breaker or a fuse of suitable rating, conforming to SLS 352, shall be provided on the input side.

NOTE - The rating of the fuse should be calculated at the lowest input voltage (for example 160 V).

5.1.3 The auto-transformer shall be dry type with natural air cooling.

5.1.4 The relays if provided, shall conform to IEC 337.

5.1.5 Plugs and socket outlets for stabilizers upto and including 2.5 kVA, shall conform to SLS 512. For stabilizers above 2.5 kVA suitable terminal for input and output shall be provided.

5.1.6 A suitable indicator lamp should be provided on the chassis to indicate that the input voltage is present.

5.1.7 A voltmeter of accuracy class not less than 2.5 conforming to IEC 51 may be provided on the chassis to read the output voltage.

5.1.8 A cord of minimum length of 1.5 m, along with a 3 pin plug shall be provided with the stabilizer.

5.1.9 Suitable markings shall be done on the stabilizer to indicate input and output terminals.

5.1.10 Adequate means of protection shall be provided to switch off the stabilizer automatically when the input voltage reaches above or below the input voltage range. The stabilizer shall preferably be reset manually, but automatic reset may be accepted, provided a time delay is incorporated and indicated.

5.2 Safety requirements

- 5.2.1 Protection against electric shock - Provision of Clause 9 of SLS 579 shall apply
- 5.2.2 Leakage current under normal operating conditions - Provisions of Clause 14 of SLS 579 shall apply
- 5.2.3 Moisture resistance - Provisions of Clause 16.8 of SLS 579 shall apply
- 5.2.4 Stability - Provision of Clause 21 of SLS 579 shall apply
- 5.2.5 Mechanical strength - Provision of Clause 22 of SLS 579 shall apply
- 5.2.6 Earthing - Provision of Clause 28 of SLS 579 shall apply
- 5.2.7 Screws and connections - Provisions of Clause 29 of SLS 579 shall apply
- 5.2.8 Creepage distances - Provisions of Clause 30 of SLS 579 shall apply
- 5.2.9 Insulation resistance between the terminals and the body of the stabilizer, shall not be less than 5 megohms when tested as in 7.4.
- 5.2.10 *No-load current*

No-load current shall not be more than the values given in the Table 1.

TABLE 1 - No-load current values

kVA rating	No-load current (maximum)
0.25 and 0.5	8 per cent of the rated output current
above 0.5	5 per cent of the rated output current

5.3 Limits of temperature rise

5.3.1 The temperature-rise of the winding of the stabilizer above the cooling air temperature when tested in accordance with 7.12 shall not exceed the following values.

Temperature class of insulation	Temperature rise C°
A	50
L	65
B	70
F	95
H	120

NOTE - The reference ambient temperature for the purpose of temperature measurement shall be 35°C.

5.3.2 During the temperature-rise test the temperature rise of the enclosure if metallic, shall not be more than 20°C, above a reference temperature of 35°C.

5.4 Performance requirements

The stabilizer shall be able to adjust the output voltage at 230 ± 6 per cent.

6 MARKING

6.1 The stabilizer shall have the following information indelibly marked on it, or on a label permanently attached to it.

- a) Manufacturer's name or trade mark;
- b) Manufacturer's serial No. and type number, if any;
- c) Rated input voltage range;
- d) Rated output voltage and tolerance;
- e) Response time;
- f) Rated frequency;
- g) Rated output current; and
- h) Rated kVA output.

6.2 The stabilizer may also be marked with the Certification Mark of the Bureau of Ceylon Standards illustrated below on permission being granted for such marking by the Bureau of Ceylon Standards.



NOTE - The use of the Bureau of Ceylon Standards Certification Mark (SLS Mark) is governed by the provisions of the Bureau of Ceylon Standards Act and the regulations framed thereunder. The SLS Mark on products covered by a Sri Lanka Standard is an assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control, which is devised and supervised by the Bureau and operated by the producer. SLS marked products are also continuously checked by the Bureau for conformity to that standards as a further safeguard. Details of conditions under which a permit for the use of the Certification Mark may be granted to manufacturers or processors may be obtained from the Bureau of Ceylon Standards.

7 TESTS

7.1 General notes on tests

7.1.1 The test shall be performed at the room temperature.

7.1.2 The following shall comprise the type tests.

- | | |
|--|--------|
| a) Physical examination | (7.2) |
| b) Output voltage | (7.3) |
| c) Insulation resistance | (7.4) |
| d) High voltage test | (7.5) |
| e) No-load current test | (7.6) |
| f) Protection against electric shock | (7.7) |
| g) Stability | (7.8) |
| h) Technical strength | (7.9) |
| j) Provision for earthing | (7.10) |
| k) Screws and connections | (7.11) |
| l) Temperature-rise test | (7.12) |
| m) Leakage current under normal operating conditions | (7.13) |
| n) Moisture resistance | (7.14) |
| o) Creepage distances and clearances | (7.15) |
| p) Induced voltage test | (7.16) |
| q) Damp heat test | (7.17) |
| r) Stability test for relay operation | (7.18) |
| s) Test for continuous operation | (7.19) |

7.1.3 The following shall comprise acceptance tests

- a) Physical examination (7.2)
- b) Output voltage test (7.3)
- c) Insulation resistance test (7.4)
- d) High voltage test (7.5)
- e) No-load current test (7.6)
- f) Protection against electric shock (7.7)
- g) Provision for earthing (7.10)
- h) Leakage current under normal operating conditions (7.13)
- j) Induced voltage test (7.16)

7.1.4 The following shall comprise routine tests

- a) Physical examination (7.2)
- b) Output voltage test (7.3)
- c) Insulation resistance test (7.4)
- d) High voltage test (7.5)
- e) No-load current test (7.6)

7.2 Physical examination

The stabilizers shall be checked for conformity of 5.1 and 6.

7.3 Output voltage test

7.3.1 For this test a voltmeter of accuracy class not worse than 1.0 shall be connected across the output terminals.

7.3.2 The output voltage shall be recorded for different input voltages both at full load (That is the rated current flowing in the output circuit) and at no-load covering the specified input voltage range.

7.3.3 The voltage reading shall be taken at the stabilizer input and output points excluding the mains lead.

7.3.4 The output voltage shall be as specified in 5.4.

7.4 Insulation resistance test

The insulation resistance between the terminals and body of the stabilizer shall be measured at 500 V d.c. for one minute and recorded.

7.5 High voltage test

A test voltage as given in 7.5.1 shall be applied at rated frequency for one minute between the winding and the body of the stabilizer

which shall be earthed. This test shall be carried out immediately after the temperature-rise test. There shall be no disruptive discharge.

7.5.1 Test voltages

- a) for routine test - 1.5 kV (r.m.s.). The voltage shall be applied on the whole unit.
- b) for type test - 2.5 kV (r.m.s.). The voltage shall be applied on the transformer, only when it is isolated from the other control circuits.
- c) for acceptance test - 2.5 kV (r.m.s.). The voltage shall be applied on the transformer, only when it is isolated from the other control circuits.

7.6 No-load current test

The test shall be carried out on the transformer (auto or isolating type) isolated from the other control circuits. The no-load current shall be measured at rated frequency with the rated maximum input voltage applied to the input terminals, the output terminals being kept open circuited. The no-load current shall not be more than the specified values given in Table 1.

7.7 Protection against electric shock

Provision of Clause 9 of SLS 579 shall apply.

7.8 Stability

Provision of Clause 21 of SLS 579 shall apply.

7.9 Mechanical strength

Provision of Clause 22 of SLS 579 shall apply.

7.10 Provision for earthing

Provision of Clause 28 of SLS 579 shall apply.

7.11 Screws and connections

Provision of Clause 29 of SLS 579 shall apply.

7.12 Temperature - rise test.

7.12.1 Measurement of temperature of cooling air

The cooling air temperature shall be measured by means of several (at least 3) thermometers placed at different points around the transformer, at a level approximately half way up the cooling surface, at a distance of 1 metre to 2 metres from the cooling surface. The thermometers shall be protected from draught and abnormal heat radiation.

The value to be adopted for the temperature of the cooling air for the test is the average of the readings taken on these thermometers at equal intervals of time during the last quarter of the test period.

The temperature of the cooling air shall be as constant as possible during the test period, especially during the last quarter.

7.12.2 *Determination of winding temperature*

The winding temperature shall be measured using the resistance method.

The temperature of winding (T_1) at the end of test period shall be calculated from its measured resistance (R_1) at that temperature and its measured resistance (R_2) at some other temperature (T_2) using the following formula;

$$T_1 = \frac{R_1 (235 + T_2)}{R_2} - 235 \text{ (for copper)}$$

$$T_1 = \frac{R_1 (225 + T_2)}{R_2} - 225 \text{ (for aluminium)}$$

where,

T_1 and T_2 are measured in $^{\circ}\text{C}$.

The measured temperature rise of the windings shall not exceed the value given in 5.3.

7.12.3 *Duration of test of temperature rise*

Evidence shall be obtained by the highest temperature-rise shall not exceed the value given in 5.3 even if tests were continued until thermal equilibrium is reached. Temperature shall taken where possible during operation, as well as when the transformer is shut down. The test shall not be regarded as completed until the temperature-rise increment is less than 1°C in one hour.

7.12.4 *Loading*

The minimum rated input voltage shall be applied to the terminals of the transformer and a suitable load shall be connected at the output terminals of the transformer so that the rated current flows through the output circuits at rated voltage.

7.12.5 *Temperature correction for cooling of transformer after shut down*

To provide for the interval between the instant of switching off the power and the measurement of winding resistance a correction of 1°C per minute of time elapsing between shut down and resistance measurement shall be added to the winding temperature obtained from the resistance measurement.

7.13 Leakage current under normal operating conditions

Provisions of Clause 14 of SLS 579 shall apply.

7.14 Moisture resistance

Provisions of Clause 16 of SLS 579 shall apply.

7.15 Creepage distance and clearances

Provisions of Clause 30 of SLS 579 shall apply.

7.16 Induced voltage test

The test shall be carried out on the transformer isolated from the other control circuits. To test the interturn insulation of the winding on a.c. voltage shall be applied to the output terminals of the windings. The magnitude of the test voltage shall be 500 V rms. The test voltage shall be applied for 60 seconds for any test frequency up to and including twice the rated frequency. When test frequency exceed twice the rated frequency the duration of the test shall be;

$$\frac{120 \times (\text{rated frequency})}{\text{test frequency}} \text{ seconds}$$

but not less than 15 seconds. After this test stabilizer shall pass the no-load current test specified in 7.6.

7.17 Damp heat test

The stabilizer shall be subjected to the first cycle of damp heat (accelerated) test in accordance with IEC 68-2-4. The duration of the recovery period shall be 1½ hours. After recovery the stabilizer shall be visually examined and shall not show any damage or deterioration.

7.18 Stability test for relay operation

The purpose of this test is to check the stability of relay operation against minor and surge fluctuations in line voltage.

The stabilizer shall be subjected to varying test voltage with continuously variable auto-transformer. At switching point of various relays the difference in voltage at pick-up and drop-out shall not be less than 3 V.

7.19 Test for continuous operation

The stabilizer shall be subjected to continuous run for at least 24 hours at full load while the input voltage is varied from minimum to maximum of the input voltage range and back to minimum in 60 ± 10 seconds. The output voltage shall remain within the values specified in 5.4.

8 SAMPLING

8.1 Sampling for type tests

Type tests shall be carried out on three line voltage stabilizers of the same rating, design and type.

8.2 Sampling procedure for acceptance tests

8.2.1 Lot

In any consignment, all stabilizers of the same make, rating and type manufactured under similar conditions of production shall be grouped to constitute a lot.

8.2.2 Scale of sampling

8.2.2.1 The conformity of the lot to the requirements of acceptance test given in this specification shall be ascertained on the basis of tests carried out on the sample selected from the lot.

8.2.2.2 The number of stabilizers to be selected from the lot shall be in accordance with Column 1 and Column 2 of the Table 2.

8.2.2.3 Stabilizers shall be selected at random. In order to ensure randomness of selection, methods given in SLS 428 shall be used.

8.2.3 Number of tests

Each stabilizer selected as in 8.2.2.2 shall be subjected to the acceptance tests specified in 7.1.3.

TABLE 2 - Scale of sampling and criteria for acceptance

No. of stabilizers in the lot (1)	No. of stabilizers to be selected (2)	Acceptance number (3)
2 to 15	2	0
16 to 25	3	0
26 to 100	5	0
101 to 150	8	0
151 and above	13	1

9 CRITERIA FOR CONFORMITY

9.1 Conformity to type tests

All samples shall pass all the tests mentioned in 7.1.2 for proving conformity with the requirements of this specification. If any of the samples fail in any of the type tests, fresh samples may call for not exceeding twice the original number and subject them again to all the tests in which failures occurred. No single failure shall be permitted in the repeat tests.

9.2 Conformity to acceptance test

The lot shall be considered as conforming to the requirements of acceptance tests if number of stabilizers not conforming any one or more requirements specified in 7.1.3 is less than or equal to the corresponding acceptance number given in Column 3 of the Table 2.

SLS CERTIFICATION MARK

The Sri Lanka Standards Institution is the owner of the registered certification mark shown below. Beneath the mark, the number of the Sri Lanka Standard relevant to the product is indicated. This mark may be used only by those who have obtained permits under the SLS certification marks scheme. The presence of this mark on or in relation to a product conveys the assurance that they have been produced to comply with the requirements of the relevant Sri Lanka Standard under a well designed system of quality control inspection and testing operated by the manufacturer and supervised by the SLSI which includes surveillance inspection of the factory, testing of both factory and market samples.

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.



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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