SRI LANKA STANDARD 703 : PART 3 : 1998

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CODE OF PRACTICE FOR ELECTRICAL INSTALLATIONS

PART 3 : INDUSTRIAL BUILDINGS (FIRST REVISION)

SRI LANKA STANDARDS INSTITUTION

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SLS 703:Part 3 : 1998

Gr. 6

SRI LANKA STANDARDS INSTITUTION
53, Dharmapala Mawatha
Colombo 03.
SRI LANKA.

Sri Lanka Standard
CODE OF PRACTICE FOR ELECTRICAL INSTALLATIONS
Part 3 : Industrial buildings
(First Revision)

FOREWORD

This code was approved by the Sectoral Committee on Electrical Installations and was authorized for adoption and publication as a Sri Lanka Standard Code of Practice by the Council of the Sri Lanka Standards Institution on 1998-02-12.

This is the first revision of **SLS 703 : 1985** and is presented in three parts namely :

Part 1 Electrical installations in small residential buildings
Part 2 Electrical installations in larger buildings including flats, commercial and office buildings
Part 3 Electrical installations in industrial buildings

This code of practice covers electrical installations where the system voltage does not exceed 1000 V a.c. The code aims to provide information on matters of common interest to engineers, architects, building contractors and others concerned. This code is intended chiefly to lay down requirements regarding design, quality of materials, and installation practices.

The electricity Act No. 19 of 1950 sets out the legal requirements for the regulation of generation, transmission, transformation, distribution, supply and use of electrical energy in Sri Lanka. The Regulations under this Act require that all electrical installations should conform to the Wiring Regulations of the Institution of Electrical Engineers of the United Kingdom.

All users of this code should recognize the inherent dangers, such as fire and shock, in the usage of electricity.

All values in this code are given in SI units.

In the preparation of this standard, the assistance derived from **BS 7671 : 1992** (incorporating Amendment No.1 : 1994), Requirements for Electrical Installations, IEE Wiring Regulations Sixteenth Edition (This document herein after is referred to as IEE Wiring Regulations) published by the British Standards Institution and the Institution of Electrical Engineers of the United Kingdom is gratefully acknowledged.

1 SCOPE

This part of the code sets out the requirements for the electrical installations in industrial buildings. The supply to be used in these buildings is three phase with a nominal voltage between phase conductors of 400 V a.c. 50 Hz or single phase with a nominal voltage between phase and neutral conductor of 230 V a.c. 50 Hz.

2 REFERENCES

IEC 269	Low voltage fuses
IEC 309	Plugs, socket-outlets and couplers for industrial purposes.

3 DEFINITIONS

For the purpose of this code the following definition shall apply.

3.1 industrial buildings : Buildings or parts of buildings intended predominantly for industrial purposes and not for dwelling or commercial purposes.

4 ABBREVIATIONS

4.1 ELCB : Earth Leakage Circuit Breaker

4.2 MCB : Miniature Circuit Breaker

4.3 MCCB : Moulded Case Circuit Breaker

4.4 RCD : Residual Current Device

5 REGULATORY REQUIREMENTS

The Electricity Act No. 19 of 1950, and the Subsidiary Legislation under this Act, which may be cited as Electricity Regulations 1951, require that electrical installations in Sri Lanka conform to the IEE Wiring Regulations, subject to such additions or modifications to meet local conditions as may be made from time to time by the Chief Electrical Inspector and published in the Gazette (see Appendix A).

6 SAFETY REQUIREMENTS

6.1 Good workmanship and proper materials shall be used.

6.2 All equipment used in the installation shall have voltage and current ratings suitable for their intended purposes.

6.3 All conductors shall be of sufficient size and current carrying capacity for the purposes for which they are intended.

6.4 All wiring in the installation shall be continuous, and free of joints.

6.5 To prevent danger every installation shall be :

a) protected against over current;
b) protected against earth fault current; and
c) provided with a means of isolation.

6.5.1 *Protected against over current.*

For this purpose any of the following protective devices may be used.

a) Moulded Case Circuit Breakers.
b) Miniature Circuit Breakers.
c) Fuses.

Where fuses are used cartridge fuse complying with **IEC 269** or equivalent standard is recommended. The protective device should be rated for the nominal voltage and the required current rating and should be of adequate fault current rating.

6.5.2 *Protected against earth fault current*

For this purpose the installation should be earthed and one or more Residual Current Devices and/or earth fault relays should be used.
Earthing means connecting all metal work associated with the installation to a main earthing terminal and connecting it to a suitable earth electrode.

6.5.3 *Provided with a means of isolation*

This shall be provided by means of an isolator, a main switch or a circuit breaker, all having adequate contact separation.
The isolation device should not be located in places where access may be difficult at times of emergency.

NOTE

*The switch or circuit breaker mentioned in **6.5.1** and **6.5.2** above may also be used as an isolating switch in times of emergency, and hence it should be readily accessible.*

6.6 All equipment likely to be exposed to the weather, corrosive atmosphere or other adverse conditions, shall be so constructed or protected as may be necessary to prevent danger resulting from such exposure. All equipment in surroundings susceptible to the risk of fire or explosion shall be so constructed, and such other special precautions taken, as necessary to prevent danger.

6.7 No addition or alteration, temporary or permanent, may be made to an existing installation unless it has been ascertained that the rating and condition of any existing equipment, including that of the electricity supply authority, which has to carry the additional load, is adequate for that purpose, and that the earthing arrangement is also adequate.

7 EXCHANGE OF INFORMATION

7.1 Full and progressive co-operation and collaboration should be effected between the client, the electrical engineer, the architect, the building contractor and other interested persons concerned in the provision of engineering services that will ultimately be required. It is strongly recommended that the local fire officer is also consulted.

7.2 The electrical installations in buildings are becoming more extensive and complex. To ensure that safety, economy, durability and appearance are given due consideration, the detailed planning of the installation should be the responsibility of a suitably qualified and experienced electrical engineer who is recognized by the Supply Authority.

7.3 The electrical engineer should specify at an early stage, the space that would be required for the location of

a) the switch board;
b) ducts for service cables;
c) rising mains;
d) distribution cables;
e) extra low voltage circuits such as fire protection, control circuits, telecommunication services and data networks; and
f) other equipment

He should indicate the locations of distribution boards, and the openings and chases in floors, walls and ceilings for all required electrical services. He should also indicate the depth of floor screed required and other special facilities such as the provision of false ceilings and similar requirements which may affect the building work.

7.4 Recommendations regarding internal work in industrial buildings are given in Appendix **B**.

7.5 The person responsible for the installation work shall submit working drawings and obtain the approval of the electrical engineer before commencing work. Then all work is over, "as completed" drawings shall be prepared by the installer and be certified by the electrical engineer, for record purposes.

8 SUPPLY INTAKE ARRANGEMENTS

8.1 Electrical service connections are provided by the Supply Authority at low or high voltage depending on the requirements of the installation. The service may either be underground or overhead depending upon the Supply Authority's distribution system in the vicinity of the building.

8.2 The Supply Authority's service connection terminates in their metering equipment and hence the care and maintenance of the service connection up to that point is the responsibility of the Supply Authority.

8.3 The legal requirements and the settlement of disputes between the consumer and the Supply Authority are given in Appendix A.

9 MATERIALS, COMPONENTS AND EQUIPMENT

The materials, components and equipment used shall conform to the relevant Sri Lanka standards or standards of the International Electrotechnical Commission.

10 DESIGN

10.1 General

10.1.1 The planning and design of an electrical installation should, wherever possible, give special consideration to the needs of the end users, whilst conforming to this code.

10.1.2 The matters to be considered in the design stage are :

a) the type of supply (single phase or three phase);
b) short circuit level the origin of the installation;

NOTE

This information may be obtained from the Supply Authority.

c) the minimum and maximum expected ambient temperatures;
d) abnormal levels of moisture, salt-laden atmosphere, corrosive gases, etc;
e) anticipated changes to the installation in the short term, say five years;
f) method of wiring; whether in embedded conduit, surface conduit, and surface casing and covers;
g) location of distribution boards, switches, socket outlets, fan regulators and similar fittings in relation to the equipment and the convenience of their use. Further, care should be exercised in the positioning of switches, socket-outlets etc. in relation to structural features and machinery such as gantry cranes etc;
h) use of energy efficient luminaires and equipment; and
j) use of two-way switches.

10.1.3 The design of the electrical installation will also depend upon the type of building construction adopted and upon whether it is to be :

a) in a new building ; or
b) in existing buildings or as an extension of an existing installation; or
c) in low temperature area (cold room) or in high temperature area (boiler room).

10.1.4 Main switchboards and distribution boards are exposed to dusty, corrosive or damp conditions they should be of suitable construction to withstand such conditions.

10.1.5 Where fire or explosion risks are involved, distribution boards and main switchboards should be installed outside such danger zones. It is considered essential to install distribution boards in such areas, they should be of flame proof construction or designed for the specific environment.

10.1.6 In the case of installations in the coastal areas, which are subject to excessive corrosion due to salt-deposition, it is imperative, in the interest of ensuring the safety of persons and of equipment, that equipment constructed to withstand such conditions be deployed.

10.1.7 The location of switch boards and distribution boards should take account of accessibility in relation to maintenance requirements and the need for identification of faulty circuits.

10.2 Distribution

10.2.1 Every endeavour should be made to site the main switch board near the load centre. For this purpose the main electrical load should be identified.

10.2.2 The distribution system may be in metal or plastic conduits or in trunking depending upon the particular products and facilities in the factory.

10.3 Main switchboards

10.3.1 The distribution system in industrial buildings should be provided with a main switchboard to ensure efficient control of the system. Main switchboards shall be either wall mounted or floor mounted. It is recommended that the top of the switchboard shall be limited to 2 m from finished floor level.

10.3.2 The main switchboard shall be equipped with a main circuit breaker, three phase busbars and neutral busbar and an earth bar all adequately rated for their designed duty.

10.3.3 All circuit breakers shall be equipped with over current and short circuit protective devices. Switchboards shall also be equipped with earth fault relays. It is recommended that a voltmeter with a selector switch and three ammeters (one per phase) are installed in the switchboard to measure the in-coming voltage and load currents. It is also desirable to incorporate indicator lamps (one per phase coloured red yellow and blue) to signal the presence of the incoming supply voltage.

10.4 Distribution boards

10.4.1 Distribution boards should be fitted with enclosed busbars and circuit breakers or fuse units. Means of insulating the busbars should be provided within the board or in close proximity.

10.4.2 Special attention shall be paid to the positioning of switches and socket-outlets etc. such that their usage may not impair safety of the occupants.

10.5 Circuits and their protection

10.5.1 *General*

10.5.1.1 To facilitate safe inspection and testing, operation, maintenance and to avoid danger in the event of a fault, every installation shall be divided into several final circuits. These final circuits may be single phase or three phase.

10.5.1.2 Circuit wiring

Any type of cable complying with the Regulations may be used for circuit wiring, in accordance with this code.

10.5.1.3 Lighting final circuits

Lighting for commonly used areas should be fed from more than one final circuit. However these final circuits shall preferably be of the same phase.

10.5.1.4 Socket-outlet circuits

The use of domestic type of socket outlets in an industrial environment is discouraged. For such applications industrial socket-outlets and plugs to conform to **IEC 309** should be deployed.

10.5.1.5 Lift shafts

Wiring, other than that for lift control circuits, should not be installed in lift shafts.

10.5.1.6 Non-luminous heating appliances

Where non-luminous heating appliances are to be used, pilot lamps should be arranged in a prominent position to indicate when the circuit is live.

10.5.2 *Final Circuits*

10.5.2.1 To ensure that any final circuit which is isolated is not inadvertently energized by a live circuit, the wiring of each final circuit (i.e. the line or phase conductor, the neutral conductor and the circuit protective conductor) shall be electrically separate from all other circuits.

10.5.2.2 The phase conductor of each final circuit shall be connected to a separate way in the distribution board. The neutral conductor of each final circuit shall be connected to the neutral bar in the distribution board, and the earth continuity conductor of each final circuit to the earth bar. To facilitate the identification of the wiring of different final circuits, the neutral conductors and the earth conductors shall be connected in the same order in which the phase conductors have been connected.

10.5.2.3 Separate final circuits shall be used to supply

a) socket-outlets;
b) lamps and ceiling fans; and
c) other individual fixed devices.

Each final circuit shall extend over a particular zone in each floor.

10.5.2.4 The number of final circuits required and the number of points supplied by each such final circuit should be determined by taking into account the layout of the building, its usage and the overcurrent protection envisaged.

10.5.3 *Protection*

10.5.3.1 General

Appropriate protection against over-current and earth faults should be provided at switchboards and distribution boards for all circuits. Such protective apparatus should be capable of interrupting without danger, any short-circuit current that may occur.

The ratings and settings of circuit breakers (and fuses if used for protection against short-circuit) should be co-ordinated so as to afford discrimination in operation where necessary.

10.5.3.2 Discrimination between circuits

Discrimination between a main circuit breaker and any other circuit breaker used down-stream could be obtained by adjusting the down-stream breaker to operate before the main circuit-breaker, by suitable adjustments to the current and/or time settings.

10.5.3.3 The use of fuses for protection of circuits is strongly discouraged.

10.6 Stand-by supplies

10.6.1 Stand-by supplies should be provided in factories, to allow for essential lighting and power.

10.6.2 The wiring system should be so designed that all circuits are normally connected to the public supply and that, under emergency conditions, the circuits are automatically disconnected from the public supply and then connected to the stand-by supply. To ensure this, the circuits considered essential should be connected to separate distribution boards which will in turn be connected to the stand-by supply. The provision of separate distribution boards may not be necessary if the entire installation is to be fed from the stand-by supply.

10.7 Special circuits

Segregation of circuits is required to prevent mutual detrimental influences.

a) Low voltage circuits (Category 1), must be segregated from extra low voltage circuits.
b) If telecommunications (Category 2), fire alarm or emergency lighting (Category 3), systems are installed together with low voltage mains circuits, electrical segregation must be provided between the different types circuits.

NOTE

Category 1, 2 *and* 3 *circuits, referred to above are defined in the 16th Edition of IEE Wiring Regulations (***BS 7671***).*

10.8 Earthing

10.8.1 Every electrical installation shall be provided with an "Earth". Earthing is the connection of all exposed conductive parts to the general mass of earth in such a manner as to cause an immediate discharge of electrical energy to earth without danger. This will ensure the safety of persons and property in the event of a defect (see Appendix **C**).

10.8.2 The following types of earth electrodes are allowed.

a) Earth pipe
b) Earth plate
c) Earth mat

10.8.3 The material used and the construction of the electrode shall be such as to resist corrosion. The earthing conductor shall be of copper with a cross sectional area in conformity with the IEE Wiring Regulations. The use of aluminium or copper-clad aluminium conductors for connection of the earthing terminal to the earth electrode is prohibited.

10.8.4 Every endeavor shall be made to have the earth electrode resistance as low as possible. Where this cannot be achieved with a single electrode an earthing system such as multiple electrodes bonded together or an earth mat may be used.

10.8.5 The point of connection of the circuit protective conductor to the earth electrode shall be available for inspection, testing and maintenance. The connection shall not be buried in concrete or brick work. The conductor connected to the earth electrode shall be protected against mechanical damage by enclosing it in a conduit.

11 INSPECTION AND TESTING

11.1 On completion of the electrical installation, it is essential to inspect and test the installation in accordance with the current IEE Wiring Regulations to ensure that the installation complies with the said Regulations. If, at a subsequent date, any modifications, additions or alterations are effected to the installation, a similar inspection and test must be carried out.

11.2 The installation shall first be visually inspected to :

a) check that materials and equipment comply with the appropriate Sri Lanka standard or relevant international standards; and
b) check for damage, correct mounting, tightness of bolts, nuts and screws and access for safe operation and maintenance.

11.3 Thereafter the following tests shall be carried out (where applicable), in the given sequence :

a) continuity of ring final circuit conductors;
b) continuity of protective conductors;
c) earth electrode resistance;
d) insulation resistance; and
e) polarity, phase sequence and colour coding;

11.4 Two further tests given below should be carried out after energizing the installation and before putting the installation to use.

a) Earth fault loop impedance and
b) Operation of Residual Current Devices and fault-voltage operated devices.

11.5 In the event of the installation failing any of the above tests, all the tests shall be repeated after the fault has been rectified. The main purpose of these tests is to reduce the risks of shock, burn and fire. As great care should be taken in the inspection and testing, it should be carried out only by persons authorized to do so.

11.6 Special care should be paid to testing the change-over switching systems and the electrical and mechanical inter-locks.

APPENDIX A

The Electricity Act requires licensees (CEB, LECO and Local Supply Authorities) to provide a supply of electricity to any owner or occupier whose premises is within 46 m (150 feet) of the licensees distribution lines. This is subject to the owner or occupier making a written application for such supply, paying the cost of providing same to the licensee, and entering into an agreement in regard to paying for the energy consumed.

The Act also requires that the supply of energy should in every case be in accordance with the provisions of the Act and the Regulations made thereunder. These provisions impose certain obligations and duties on both licensees and electricity consumers.

Licensees are required to ensure that :

a) a suitable service, which includes the meter and all items right up to it is laid and maintained in a safe condition;
b) the service connection is anchored from insulators on the pole to insulators fixed firmly, and in a place inaccessible except with a ladder, on the consumers building;
c) every service line has a suitable cutout or a circuit breaker; and
d) phase and neutral conductors are readily identifiable.

The Regulations stipulate that a licensee shall not connect, to his lines, installations that do not conform to the IEE Wiring Regulations. Further, that where the licensee detects defects in an installation he should notify the consumer of the defects, and ensure that they are corrected before providing supply. It is also provided that the consumer is responsible for keeping his installation in proper order.

The Act provides for settling disputes between consumers and licensees, on metering and billing matters.

APPENDIX B

INTERNAL WORK IN INDUSTRIAL BUILDINGS

In Industrial buildings a separate switchroom will usually be necessary. This should be located as close as possible to the electrical load centre. Suitable ducts should be laid as directly as possible from the point of entry of the supply to the position of the main switchgear. The switch room should also be placed where practicable, in such a position that rising ducts can readily be provided therefrom to the upper floors of the building in one straight vertical run. In some large buildings, more than one duct may be required for running cables from the switchroom to the foot of the rising main or mains. Ducts for electrical cables should be reserved exclusively for electrical services. Extra-low-voltage circuits, fire alarm circuits, call systems circuits, telecommunication circuits and data circuits when installed in the same duct should be suitably segregated from each other. Under no circumstances should these ducts be used for such services as sewerage, water, gas and air conditioning.

Provision will be required on each floor of multi-storey buildings for electrical control gear, distribution panels and other apparatus and these may conveniently be mounted adjacent to the rising mains referred to above.

Unless electrical wiring is to be installed on the surface of walls and ceilings, it will be necessary to make provision for concealing conduits in walls and ceilings for the running of cables. Such concealed conduits may also be run in the floor structure or in voids formed by the use of false ceilings. These ceilings may also be used to provide concealed lighting. where high intensity lighting fittings are installed in false ceilings ample ventilation should be provided. Special provision is necessary to ensure that the electric wiring is not adversely affected by heat. It is essential to have access for carrying out maintenance work on the concealed services.

APPENDIX C

In order to protect persons and property from risks associated with electricity it is necessary to have a low value of earth loop impedance. Of the various components that make up the earth loop impedance, the only one that is under the control of the consumer is his earth electrode resistance. Hence every endeavour should be made by the consumer to have his earth electrode resistance as low as possible.

The maximum value of earth electrode resistance for various final circuits is given in Table 1.

TABLE 1 - Values of earth electrode resistances

Final circuit current A (1)	Resistance Ohm (2)
15	4
30	2
60	1

NOTE

If the above values of earth electrode resistances cannot be attained it is necessary to use a Residual Current Device of sensitivity 30 mA for personal protection.

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