IS 16107 (Part 2/Sec 1) : 2012

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खंड 1 एल ई डी सहायकांग

Indian Standard

LUMINAIRES PERFORMANCE

PART 2 PARTICULAR REQUIREMENTS

Section 1 LED Luminaire

ICS 29.140.99

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Illumination Engineering and Luminaires Sectional Committee, ETD 24

FOREWORD

This Indian Standard (Part 2/Sec 1) was adopted by the Bureau of Indian Standards, after the draft finalized by the Illumination Engineering and Luminaires Sectional Committee had been approved by the Electrotechnical Division Council.

This standard specifies the performance requirements for LED luminaires for general lighting applications. The other part in the series is:

Part 1 General requirements

Safety requirements have been covered in IS 10322 (Part 1) : 2012 'Luminaires: Part 1 General requirements and tests (*first revision*)'.

This standard for LED luminaires for general lighting applications acknowledges the need for relevant tests for luminaires using this new source of electrical light, sometimes called solid state lighting. This standard is seen in close context with simultaneously developed publication of performance standards for luminaires in general and for LED modules. Changes in the LED luminaires standard will have impact on the module standards and *vice versa*, due to the behaviour of LED.

The provisions in the standard represent the technical knowledge of experts from the fields of the semiconductor (LED chip) industry and of those of the traditional electrical light sources and luminaires.

This standard is based on IEC/PAS 62722-2-1(2011) 'Luminaire performance — Part 2-1: Particular requirements for LED luminaire' issued by the International Electrotechnical Commission (IEC) with following modifications:

Schedule of type test and acceptance test has been incorporated.

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 analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

LUMINAIRES PERFORMANCE

PART 2 PARTICULAR REQUIREMENTS

Section 1 LED Luminaire

1 SCOPE

1.1 This standard (Part 2/Sec 1) specifies the performance requirements for LED luminaires, together with the test methods and conditions, required to show compliance with this standard. It applies to LED luminaires for general lighting purposes, where claims of operational performance are made.

The following types of LED luminaires are distinguished:

a) *Type A* — Luminaire using LED modules that have not been shown to comply with IS 16103 (Part 2) : 2012 'LED modules for general lighting: Part 2 Performance requirements';

b) *Type B* — Luminaire using LED modules that have been shown to comply with IS 16103 (Part 2); and

c) *Type C* — Luminaire using a LED lamp and covered in IS 16107 (Part 1) : 2012 'Luminaires performance: Part 1 General requirements'.

NOTE — The definition of the LED module is given in IS 16101 : 2012 'General lighting — LEDs and LED modules — Terms and definitions'.

This standard does not cover LED luminaires that intentionally produce coloured light; neither does it cover modules based on OLEDs (organic LEDs).

The performance requirements are additional to the requirements given in IS 16107 (Part 1).

As this standard has been simultaneously developed with the standard for LED modules, where appropriate, the compliance of the modules to the provisions of IS 16103 (Part 2) may be transferred to the whole luminaire.

Life time of LED luminaires is in most cases much longer than the practical test times. Consequently, verification of manufacturer's life time claims cannot be made in a sufficiently confident way. For that reason the acceptance or rejection of a manufacturer's life time claim, past 25 percent of rated life (with a maximum of 6 000 h), is out of the scope of this standard.

Instead of life time validation, this standard has opted for lumen maintenance categories at a defined finite test time. Therefore, the category number does not imply a prediction of achievable life time. The categories are lumen-depreciation character categories showing behaviour in agreement with manufacturer's information which is provided before the test is started.

In order to validate a life time claim, an extrapolation of test data is needed. A general method of projecting measurement data beyond limited test time is under consideration.

The acceptance or rejection criterion of the life time test as defined in this standard is different from the life time metrics claimed by manufacturers. Explanation of recommended life time metrics is given in Annex B of IS 16103 (Part 2).

The performance requirements specified in this standard are additional to the safety requirements given in IS 10322 (Part 1).

1.2 It may be expected that LED luminaires which comply with this standard shall start and operate satisfactorily at voltages between 90 and 110 percent of rated supply voltage and at an ambient air temperature within the declared range of the manufacturer.

1.3 Testing of principle components is not within the scope of this standard.

2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Title*
10322 (Part 1) : 2012	Luminaires: Part 1 General requirements and tests (*first revision*)
16101 : 2012	Method of measurement of centre beam intensity and beam angle(s) of reflector lamps
16103 (Part 1) : 2012	LED modules for general lighting: Safety requirements
(Part 2) : 2012	Performance requirements

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 16103 (Part 2) and the following shall apply.

3.1 LED Luminaire — Luminaire incorporating LED as the light sources.

3.2 Family of LED Luminaires — Group of LED luminaires that have,

a) LED modules with the same method of control and operation (self-ballasted, semi-ballasted, non-ballasted);

b) LED modules with the same classification according to the method of installation [*see* **6** of IS 16103 (Part 1)];

c) same class of protection against electrical shock; and

d) same design characteristics, distinguished by common features of materials, components, and/or method of processing and heat management.

3.3 Temperature — Ambient temperature around the luminaire related to the performance of the luminaire.

NOTES

1 $t_q = t_a$ For t_a *see* **1.2.25** of IS 10322 (Part 1).

2 For a given life time, the t_q temperature is a fixed value and not a variable.

3 There can be more than one t_q temperature, depending on the life time claim.

3.4 LED Light Source — Unit supplied as being a LED lamp or LED module.

3.5 Type Test — Test or series of tests made on a type test sample for the purpose of checking compliance of the design of a given product with the requirements of the relevant standard.

3.6 Type Test Sample — Sample consisting of one or more similar units submitted by the manufacturer or responsible vendor for the purpose of the type test.

3.7 Acceptance Test — Tests carried out on samples taken from a lot for the acceptance of the lot.

4 MARKING

4.1 General Requirements for Marking

Information on the parameters shown in Table 1 shall be provided by the manufacturer or responsible vendor on the product datasheets, leaflets or website.

Compliance is checked by inspection.

NOTE — This information is in addition to the mandatory marking given in IS 10322 (Part 1).

4.2 BIS Certification Marking

4.2.1 The LED luminaire may also be marked with the Standard Mark.

Table 1 Required Markings and Places of Marking
(*Clause* 4.1)

Sl No. (1)	Parameters (2)
i)	Rated input power (W)
ii)	Photometric code (*see* Note 1)
iii)	Rated luminous flux (lm).
iv)	Rated life (in h) of the LED module in the luminaire and the associated rated lumen maintenance (L_x)
v)	Failure fraction (F_y), corresponding to the rated life of the LED module in the luminaire
vi)	Lumen maintenance code (*see* Note 2)
vii)	Rated chromaticity coordinate values both initial and maintained (*see* Note 3)
viii)	Rated colour temperature (CCT in K)
ix)	Rated colour rendering index (CRI)
x)	Ambient temperature (t_q) range for luminaire (*see* Note 4)
xi)	LED luminaire efficacy (in lm/W)
xii)	Aging time, if different to 0 h

NOTES

1 See Annex D of IS 16103 (Part 2).

2 See Table 6 of IS 16103 (Part 2).

3 See Table 5 of IS 16103 (Part 2).

4 See last paragraph of **A-1** to understand the relation between t_p and t_q.

4.2.2 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

5 NOT USED

6 TEST CONDITIONS

6.1 General Conditions of Test

Test conditions for testing electrical and photometric characteristics, lumen maintenance and life are given in Annex A.

All tests are measured on '*n*' LED luminaires of the same type. The number '*n*' shall be a minimum of products as given in Table 3. LED luminaires used in the endurance tests shall not be used for other tests.

Each sample luminaire shall comply with all the relevant tests except for the tests of **10** where one sample is required for each of the three separate tests. In order to reduce the time of testing the manufacturer or responsible vendor may submit additional luminaires or parts of luminaires provided that these are of the same materials and design as the original luminaire and that the results of the test are the same as if carried out on an identical luminaire.

LED luminaires with dimming control shall be adjusted to maximum output for all tests.

LED luminaires with adjustable colour point shall be adjusted/set to one fixed value as indicated by the manufacturer or responsible vendor.

LED luminaires of linear geometry and variable length shall be tested at a length at which the parameters are given, for example performance per 'x' cm.

6.2 Luminaires with LED Modules not in Compliance with IS 16103 (Part 2)

6.2.1 *Testing where Reliability Data of Components Available*

Test duration is 10 percent of rated life time up to a maximum of 2 000 h for LED luminaires making use of components where long-term test data are available.

Compliance criteria for allowance of 2 000 h test duration.

Component test data for the principle components shall cover at least 25 percent of rated LED module lifetime up to a maximum of 6 000 h. The principle components, where applicable, shall be LED packages, electronics, diffusers (including remote phosphors), lenses, reflectors and active cooling systems.

Apart from the full set of data provided upon the 2 000 h, the manufacturer or responsible vendor shall also provide the expected data for at least 25 percent of rated LED module lifetime up to a maximum of 6 000 h of,

a) chromaticity co-ordinates; and
b) lumen maintenance code.

NOTE — The method of how to obtain reliability data of principle components and their interaction on LED module level is under consideration.

6.2.2 *Testing where no Reliability Data of Components Available*

If component long-term test data is not available, the manufacturer shall conduct testing for 25 percent of rated life up to a maximum of 6 000 h.

6.2.3 *Creation of Module Families to Reduce Test Effort*

6.2.3.1 *General*

The provisions of **6.2.1** of IS 16103 (Part 2) shall apply to the LED luminaire.

6.2.3.2 *Variations within Family*

The provisions of **6.2.2** of IS 16103 (Part 2) shall apply to the LED luminaire.

6.2.3.3 *Compliance Testing of Family Members*

The provisions of **6.2.3** of IS 16103 (Part 2) shall apply to the LED luminaire.

6.3 LED Modules in Compliance with IS 16103 (Part 2)

Tests are only carried out for initial performance test.

6.4 Performance Requirements

The performance criteria given in Table 2 apply only to LED luminaires and the required testing for each type of luminaire is indicated by the letter 'x'. All other data is available from the respective product standard.

7 TOTAL INPUT POWER

Total input power shall be measured at the supply to the luminaire or in case of remote control gear, at the supply to the control gear. The provisions of **7** of IS 16103 (Part 2) shall apply to luminaire.

NOTE — For calculation of confidence intervals, *see* Annex E of IS 16103 (Part 2).

8 LIGHT OUTPUT

8.1 Luminous Flux

The provisions of **8.1** of IS 16103 (Part 2) shall apply to the LED luminaire. In addition, the provisions of Annex A, shall apply where a declared ambient air temperature other than 25 °C is declared by the manufacturer.

8.2 Luminous Intensity Distribution, Peak Intensity and Beam Angle

8.2.1 *General*

The provisions of **8.2.1** of IS 16103 (Part 2) shall apply to the LED luminaire.

8.2.2 *Measurement*

The provisions of **8.2.2** of IS 16103 (Part 2) shall apply to the LED luminaire.

8.2.3 *Luminous Intensity Distribution*

The provisions of **8.2.3** of IS 16103 (Part 2) shall apply to the LED luminaire.

8.2.4 *Peak Intensity*

The provisions of **8.2.4** of IS 16103 (Part 2) shall apply to the LED luminaire.

8.2.5 *Beam Angle*

The provisions of **8.2.5** of IS 16103 (Part 2) shall apply to the LED luminaire.

8.3 Luminaire Efficacy

The provisions of **8.3** of IS 16103 (Part 2) shall apply to the LED luminaire. The luminaire efficacy shall be calculated from the measured luminous flux divided by the measured input power. Luminaire efficacy shall not

Table 2 Performance Criteria of which Testing are Required
(*Clauses* 6.4 *and* 11)

Sl No.	Clause or Sub-clause of This Standard or Clause/Sub-clause of IS 16103 (Part 2)	Tests	LED Luminaire Using LED Module not in Compliance with IS 16103 (Part 2) (Type A) (*see* Note 1)	Luminaire Using LED Modules in Compliance with IS 16103 (Part 2) (Type B) (*see* Note 2)
(1)	(2)	(3)	(4)	(5)
i)	**7**	Power	x	x
ii)	**8.1**	Luminous flux	x	x
iii)	**8.2.3**	Luminous intensity distribution	x	x
iv)	**8.2.4**	Peak intensity value (s) (Note 3)	x	x
v)	**8.2.5**	Beam angle value (Note 3)	x	x
vi)	**8.3**	Efficacy	x	x
vii)	**9.1**	Chromaticity tolerence initial	x	—
viii)	**9.1**	Chromaticity tolerence maintained	x	—
ix)	**9.2**	Correlated colour temperture initial	x	—
x)	**9.3**	CRI initial	x	—
xi)	**9.3**	CRI maintained	x	—
xii)	**10.2**	Lumen maintenance	x	—
xiii)	**10.3.2**	Temperature cycling, energized	x	—
xiv)	**10.3.3**	Supply voltage switching	x	—
xv)	**10.3.4**	Accelerated operation life test	x	—
xvi)	Annex A	LED module temperature	x	x

NOTES

1 Where the LED manufacturers provide data according to IS 16103 (Part 2), the tests on the luminaire mabe carried out according to the column for Type B luminaires.

2 Testing requirements for Type B LED luminaires will depend on requirements of IS 16103 (Part 2). It is not the intention to remeasure the values of a product complying with its own standard. However where luminaires combine different modules in one luminaire, certain parameters may be required to be measured, that is if there is a mixing of colours the final CRI and CCT needs to be measured in the luminaire.

3 Applicable to luminaires which modify the light distribution of the light from the LED module.

be less than 90 percent of the rated luminaire efficacy.

9 CHROMATICITY COORDINATES, CORRELATED COLOUR TEMPERATURE AND COLOUR RENDERING

9.1 Chromaticity Coordinates

The provisions of **9.1** of IS 16103 (Part 2) shall apply to the LED luminaire. Where suitable component reliability data is available the test duration may be reduced from 6 000 h to 2 000 h and the measured chromaticity value coordinate values for initial and 2 000 h shall not exceed the rated colour variation category for initial and 6 000 h respectively.

9.2 Correlated Colour Temperature (CCT)

The provisions of **9.2** of IS 16103 (Part 2) shall apply to the LED luminaire.

9.3 Colour Rendering Index (CRI)

The provisions of **9.3** of IS 16103 (Part 2) shall apply to the LED luminaire. Where suitable component reliability data is available the test duration may be reduced from 6 000 h to 2 000 h. For all tested items in the sample, the measured CRI value shall not have decreased by more than:

a) 3 points from the rated CRI value (*see* Table 1) for initial CRI values; and

b) 4 points from the rated CRI value, when tested for 2 000 h for maintained CRI values.

10 LED LUMINAIRE LIFE

10.1 General

The provisions of **10.1** of IS 16103 (Part 2) shall apply to the LED luminaire.

Luminaire life, on the other hand, has to do with the reliability of the components of a LED luminaire as a system, including the electronics, materials, housing, wiring, connectors, seals, and so on. The entire system lasts only as long as the critical component with the shortest life, whether that critical component is a weather seal, an optical element, a LED, or something else. From this point of view, LED light sources are simply one critical component among many — although they are often the most reliable component in the whole lighting system.

If a LED luminaire is equipped with a replaceable LED module, luminaire life can be decoupled from the LED module and its life. This brings luminaire life closer to the current definition of luminaire life for conventional light sources.

NOTE — The useful life of a luminaire refers to the lumen maintenance projections of the LED light sources integrated into that luminaire or the number of hours that a LED luminaire will deliver a sufficient amount of light in a given application.

10.2 Lumen Maintenance

The provisions of **10.2** of IS 16103 (Part 2) shall apply to the LED luminaire.

Where suitable component reliability data is available the test duration may be reduced from 6 000 h to 2 000 h as per following:

a) The measured flux value at 2 000 h shall never be less than the maximum lumen maintenance value related to the rated life as defined and provided by the manufacturer or responsible vendor.

b) The measured lumen maintenance shall correspond with the 2 000 h lumen maintenance codes as defined and provided by the manufacturer or responsible vendor.

For all of the tested items in a sample, the measured values shall be of the same maintenance code as the provided values. All the LED modules in a sample shall pass the test.

10.3 Endurance Test

The provisions of **10.3** of IS 16103 (Part 2) shall apply to the LED luminaire. Endurance test shall be performed only on a LED luminaire using a LED module not in compliance with IS 16103 (Part 2). For accelerated operation life test, a LED luminaire using a LED module not in compliance with IS 16103 (Part 2) shall be operated at a temperature corresponding to 10 K above maximum t_q as declared by the manufacturer or responsible vendor.

11 VERIFICATION

The minimum sampling size for type testing shall be as given in Table 3. The sample shall be representative of a manufacturer's production. If the LED luminaire does not change the properties of single LEDs or LED packages or LED modules it should be allowed to reference to test data of the LED manufactures'.

The results of the test shall comply with the requirements given in Table 2. If the test results do not comply with these requirements, the manufacturer's test records shall be requested.

Explanation of recommended life time metrics are given in Annex B.

12 TESTS

12.1 Classification of Tests

12.1.1 *Type Tests*

The following shall constitute the type tests to be carried out on selected sample of LED luminaire, sample being drawn preferably from regular production lot:

a) Marking (*see* **5**);
b) Luminaire power (*see* **7**);
c) Luminous flux (*see* **8.1**);
d) Lighting intensity (*see* **8.2**);
e) Angular beam distribution (*see* **8.3**);
f) Luminaire intensity distribution (*see* **8.4**);
g) Luminaire efficacy (*see* **8.5**);
h) Chromaticity coordinates and correlated colour temperature (CCT) (*see* **9.1**);
j) Colour rendering index (CRI) (*see* **9.2**);
k) Life (*see* **10**);
m) Lumen maintenance (*see* **10.2**); and
n) Endurance test (*see* **10.3**).

12.2 Acceptance Test

The following shall constitute as acceptance tests:

a) Marking (*see* **5**);
b) Luminaire power (*see* **7**);
c) Luminous flux (*see* **8.1**);
d) Lighting intensity (*see* **8.2**);
e) Angular beam distribution (*see* **8.3**);
f) Luminaire intensity distribution (*see* **8.4**);
g) Luminaire efficacy (*see* **8.5**);
h) Chromaticity coordinates and correlated colour temperature (CCT) (*see* **9.1**); and
j) Colour rendering index (CRI) (*see* **9.2**).

Table 3 Sample Sizes
(*Clauses* 6.1 *and* 11)

Sl No.	Clause or Sub-clause of This Standard or Clause/Sub-clause of IS 16103 (Part 2)	Tests	Reliability Data of Components Available Minimum Sample Size (Units) for Testing at 10% of Lifetime (2 000 h *Max*)	No Reliability Data of Components Available Minimum Sample Size (Units) for Testing at 25% of Lifetime (6 000 h *Max*)	Family Sample Size (Units) for Testing at Reduced Test Duration After Changing Product Feature According to 6.3 (1 000 h)	LED Modules and in Compliance with Own Minimum Sample Size (Units) for Testing (0 h)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	**7**	Power	1	5	1	1
ii)	**8.1**	Luminous flux	1	5	1	1
iii)	**8.2.3**	Luminous intensity distribution	1	5	1	1
iv)	**8.2.4**	Peak intensity value(s)	1	5	1	1
v)	**8.2.5**	Beam angle value	1	5	1	1
vi)	**8.3**	Efficacy	1	5	1	1
vii)	**9.1**	Chromaticity tolerance initial	1	5	1	—
viii)	**9.1**	Chromaticity tolerance maintained	1	5	1	—
ix)	**9.2**	Correlated colour temperature initial	1	5	1	—
x)	**9.3**	CRI initial	1	5	1	—
xi)	**9.3**	CRI maintained	1	5	1	—
xii)	**10.2**	Lumen maintenance	1	5	1	—
xiii)	**10.3.2**	Temperature cycling, energized (*see* Note)	1	5	1	—
xiv)	**10.3.3**	Supply voltage switching (*see* Note)	1	5	1	—
xv)	**10.3.4**	Accelerated operation life test (*see* Note)	1	5	1	—
xvi)	Annex A	LED module temperature	1	5	1	1

NOTE — New samples required for each of these three tests.

ANNEX A
(*Clause* 8.1)

METHOD OF MEASURING LUMINAIRE CHARACTERISTICS

A-1 GENERAL

The provisions of **A-1** of IS 16103 (Part 2) shall apply to the LED luminaire.

Where a declared ambient air temperature other than 25 °C is declared by the manufacturer a correction factor will need to be established to correct the measured luminous flux value at 25 °C to the luminous flux value at the declared ambient. This shall be done using relative photometry in a temperature controlled cabinet.

For the luminaire designer, the information for luminaire design given in IS 16103 (Part 2), **B-1,** requires that it shall be safeguarded that the LED module performance temperature t_p is not exceeded with the declared maximum ambient temperature ($t_{q\ \mathrm{Max}}$). This will be checked. This will be checked. The t_p measurements shall to be made with a thermocouple of Type K or J.

All of the tested *n* LED luminaires shall have passed.

A-2 ELECTRICAL CHARACTERISTICS

The provisions of **A-2** of IS 16103 (Part 2) shall apply to the LED luminaire.

A-3 PHOTOMETRIC CHARACTERISTICS

The provisions of **A-3** of IS 16103 (Part 2) shall apply to the LED luminaire.

ANNEX B

(*Clause* 11)

EXPLANATION OF RECOMMENDED LIFE TIME METRICS

B-1 GENERAL

Life time of LED luminaire can be far more than what practically can be verified with testing. Furthermore the decrease in light output differs per manufacturer making general prediction methods difficult. This standard has opted for lumen maintenance categories that cover the initial decrease in luminous flux until an operational time as stated in **6.1**. Due to this limited test time the claimed life of a LED luminaire cannot be confirmed nor rejected in most cases.

B-2 LIFE TIME SPECIFICATION

It is recommended for LED luminaires to specify the lumen maintenance apart from the catastrophic failures in a standardized way giving more insight in light output behaviour. One can distinguish two types of failures as given below.

B-2.1 Gradual Failure Fraction (B_y)

Percentage *y* of a number of LED modules of the same type that at their rated live designates the percentage (fraction) of failures. This failure fraction expresses only the gradual light output degradation.

B-2.2 Abrupt Failure Fraction (C_y)

Percentage *y* of a number of LED ymodules of the same type that at their rated live designates the percentage (fraction) of failures. This failure fraction expresses only the abrupt light output degradation.

The recommended metrics for specifying LED luminaire life time is explained in Annex C of IS 16103 (Part 2) and differs from the pass/fail criterion of the life time test as given in **10.2**.

Bureau of Indian Standards

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices: *Telephones*

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002 — 2323 7617, 2323 3841

Eastern : 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi, KOLKATA 700054 — 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022 — 60 3843, 60 9285

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 — 2254 1216, 2254 1442, 2254 2519, 2254 2315

Western : Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400093 — 2832 9295, 2832 7858, 2832 7891, 2832 7892

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