

## **TECHNICAL REQUIREMENTS IN RESPECT OF LED LUMINAIRES FOR RAILWAY PLATFORM (UNCOVERED/ OPEN PORTION) AND STREET LIGHTS**

### **1. BACKGROUND:**

From time to time, concerns have been expressed on the quality of LED luminaires being procured on the railways for platforms (uncovered/ open portion) and street lighting. Keeping this in view, RDSO has evolved this present document as an interim measure. This document is intended for procurement of high quality market available LED luminaires which have already undergone all the relevant type tests/ certifications – the underlying idea is that the requirement of fresh testing by RDSO should be minimal and thereby, it should be possible for the material supply to be completed in a reasonably short time after the placement of P.O./ contract. Until further advice from RDSO, procurement of LED luminaires for railway platforms (uncovered/ open portion) and street lights shall be carried out exclusively on the basis of this document. It is necessary to clarify that this document is not intended for high mast LED luminaires. For luminaires of system (LED + Driver) wattage higher than 90W, dimming feature is highly recommended as an energy conservation measure and future versions of the RDSO spec. would address this aspect. In due course, the RDSO spec. no. RDSO/PE/SPEC/PS/0123(Rev. 0)-2009, Amdt. '1' (in respect of LED Based Luminaire Unit for Street Light and Platform Lighting) shall be revised by: (i) deleting its existing contents (which are irrelevant, not appropriate to platform/ street light application and have become outdated with the passage of time, due to fast evolving LED technology); (ii) including the technical requirements now laid down in the present document; and (iii) incorporating any further improvements.

As and when RDSO will issue a revision to Spec. no. RDSO/PE/SPEC/PS/0123(Rev. 0)-2009, Amdt. '1', this document shall be withdrawn and thereby it shall cease to be in force. While inviting tenders, this present document should be referred as follows: "RDSO Doc. No. RDSO/EM/ LED Norm/ 01 Version 1.0".

### **2. GENERAL TECHNICAL GUIDANCE:**

#### **2.1 *Electrical distribution system***

Before installing the LED luminaires on site, it is recommended to ensure that the earthing arrangements in the distribution system are functional and loose contacts, etc. are set right. If there are deficiencies on this account, then the same should be got rectified either departmentally or (after defining the scope of such work in adequate detail) through contractual means. If the railway desires to include such power supply distribution system related rectification/ improvement works in the tender for LED luminaires, then the tender's work schedule must include separate items for such works so that the contractor can be paid for the same. In absence of such specific mention in the work schedule of LED luminaire tender, it shall be deemed that the aforesaid power supply distribution system related rectification/ improvement works (if any) are not in contractor's scope of work.

#### **2.2 *Specifying a LED luminaire***

- (i) Luminaire's System (LED + Driver) Wattage: In inviting the tenders, railways shall not specify the luminaire system wattage. However, the tenderers on their part must state their proposed luminaire system wattage for achieving the lux requirements specified in the tender. In order to afford flexibility to the firms, the nominal system

wattage of luminaire finally supplied by a firm is permitted to vary by upto + 10%/ - 20% from the value proposed by the firm in its tender.

- (ii) Luminaire Mounting Height: Railways shall specify the height of mounting of luminaire w.r.t. ground level. The suggested height (w.r.t. ground level) of mounting of luminaire shall be approx. equal to width of the road/ platform. But if the luminaire is mounted in centre of road/ platform width, then the mounting height shall be approx. half of total road/ platform width.
- (iii) Contractor's scope of supply:
- Complete luminaire and bend pipes required for installation.
  - Supply of Pole (the tender inviting authority shall specify whether or not the supply of pole is required from the firm. In absence of any mention by the railways in their tender, it shall be deemed that supply of pole is not to be made by the firm).
  - Any other item(s), as specified by the tender inviting authority.
- (iv) Illuminance and uniformity ratio: The 9 point method shall be employed for measurement of average illuminance ( $E_{av}$ ) and uniformity ratio ( $E_{min}/E_{av}$ ). Such measurement can be carried out at manufacturer's premises or on railway site, as is feasible/ mutually convenient. In the tender, railways can specify the class of lighting application (Table 1) i.e. they can mention one of the following road/ street contexts: A1, A2, B1 or B2. Alternately, if railways find that the illuminance and uniformity ratio in Table 1 will not meet their specific requirements, then they can specify the illuminance and uniformity ratio as actually required by them. In case of Railway Platform, the railway shall mention the Lux requirement as per Rly Board's extant instructions (at present, Rly Board's letter no. 2004/Elect(G)/109/1 dated 18.05.2007 is in force). The said letter of Rly Board has laid down the following Illuminance standard for open/ uncovered Platform:

Model station:

A1/A Class Station : 50 Lux  
B, C, D & E Class Station : 30 Lux

Non- Model Station:

A1, A, B, C, D & E Class Station: 30 Lux

For the tenderer, the technical goal will to be offer a LED luminaire which can render the required Illuminance, Uniformity Ratios, Polar Curve and comply all the other technical requirements as laid down in this document.

Table 1: Lighting recommendation for different types of railway roads/ streets and platforms

Group	Application in railways	$E_{av}$ (Lux)	$E_{min}/ E_{av}$
A1	Roads from highways/ fly-overs leading to railway premises, roads leading to/ exiting from important railway stations and other important roads.	30	0.4
A2	Other main roads e.g. main roads in railway premises, arterial roads and throughway roads	15	0.4
B1	Secondary roads with considerable traffic	8	0.3

B2	Secondary roads with light traffic	4	0.3
P	Railway Platform	@	*

@ Railways shall in their tender mention the Illuminance required on open/ uncovered platform as per the aforementioned standards laid down by Rly Board.

\* For 'A1', 'A', 'B' and 'C' Class stations, please specify the uniformity ratios as for A1/ A2 class roads. In respect of 'D' & 'E' Class stations, please specify the uniformity ratios as for B1/ B2 class roads.

(v) Nominal input voltage: 220V, 50Hz

### 3.0 TECHNICAL REQUIREMENTS OF LED, LED DRIVER, ELECTRONIC COMPONENTS AND LED LUMINAIRE:

At several places in this document, certificate from 'NABL accredited laboratory' is called for. So, a clarification is required with regard to acceptability of certificates from laboratories outside India. It is clarified that wherever 'NABL accredited laboratory' certificate is called for, certificate from laboratories in foreign countries shall be acceptable if that laboratory is also existent and operational in India and if the same (i.e. the laboratory existent and operational in India) is accredited with NABL. In case of any other laboratory outside India, certificate issued by it can be accepted, if that laboratory is accredited with the national accreditation authority of the host country.

#### 3.1 Technical requirements of LED

- (i) LED efficacy shall be greater than 100 Lumens/Watt (for luminaire system wattage upto 45W)/ 120 Lumens/Watt (for luminaire system wattage above 45W) @ 350mA drive current (manufacturer shall submit the datasheet in support). In respect of LEDs of higher power ratings, drive current greater than 350mA can be accepted if the LED's LM 80/ IS: 16105 test reports support the same.
- (ii) The luminaire manufacturer shall submit proof of procurement/ receipt-on-delivery (at works) of LEDs. Generally, such proof should not be more than six months old.
- (iii) LED used should be of SMD type only.
- (iv) LM-80/ IS: 16105 Test Reports of specific LED at the soldering point temperature of 85°C for the driving current at which the LEDs shall be driven shall be submitted.
- (v) L<sub>70</sub> reported life Span of LEDs used in the Luminaire shall be greater than 50,000 Hrs at the soldering point temperature of 85°C and at the luminaire driving current (TM-21 extrapolation of the LED manufacturer shall be submitted in support of the lifespan).
- (vi) The LEDs shall comply Photobiological Safety norms as per IEC 62471/ EN 62471/ IS: 16108. Test certificate of accredited international/ national laboratory shall be submitted.
- (vii) Make of LEDs: Nichia, Osram, Seoul, Philips Lumileds, Cree and Lednium.
- (viii) View angle: Typical 120° (Manufacturer shall submit the datasheet in support).
- (ix) Color temperature of the proposed white color LED shall be 5700K (i.e. 5665K±355K, as per ANSI standard C78.377A). Color point should fall within the 7Step McAdam as per ANSI standard C78.377A. This shall be verified from the LED's datasheet.
- (x) Color Rendering Index (CRI): Greater than or equal to 65 (Manufacturer shall submit the data sheet in support).

### 3.2 Technical requirements of Driver

- (i) Min. efficiency of driver: 85% (for driver power output rating  $\leq$  100W); 90% (for driver power output rating  $>$  100W)
- (ii) Power factor of complete fitting: Greater than 0.90.
- (iii) Input Operating Voltage: 140V to 277V AC.
- (iv) In-built high and low voltage cut-offs: 140V (Low) and 277V (High)
- (v) Short circuit protection
- (vi) Open load protection
- (vii) Driver Surge Protection standard: Min 3kV (however, firms are encouraged to offer 4 kV). If a railway site/ location is prone to lightning and surges, in such case the purchaser should ask for 10 kV surge protection (external to the driver circuit) to be provided with the luminaire. The Surge Protection Device (SPD) should fail safe (i.e. without leading to fire hazard) and its failed status should be clearly visible through a flag/ indication.
- (viii) Total Harmonic Distortion (THD): Less than 20% at full load
- (ix)  $T_c$  (Maximum Driver case temperature) must be declared on the datasheet
- (x) Isolated driver should be used.
- (xi) Potting of LED Driver: For driver power output rating  $\leq$  50W, potted driver shall be preferable (but not mandatory). But for driver power output rating  $>$  50W, potted driver shall be a mandatory requirement.
- (xii) The power supply shall be connected to the LED PCBs through proper connectors.
- (xiii) EMI/ EMC compliance: Test certificate of NABL accredited laboratory is to be submitted in support of compliance to the following EMI/ EMC standards:
  - (a) CISPR 15/ IS: 6573,
  - (b) IEC: 61547 (reference standards are listed as follows)
    - IEC 61000-4-2/ IS:14700 Part 3: Sec 2
    - IEC 61000-4-3
    - IEC 61000-4-4/ IS:14700 Part 3: Sec 4
    - IEC 61000-4-5 3 kV (or 4 kV if so offered by the contractor)
    - IEC 61000-4-6
    - IEC 61000-4-11/ IS:14700 Part 3: Sec 11
  - (c) IEC: 61000-3-2 (Class C)/ IS:1534 Part 1
  - (d) IEC: 61000-3-3/ IS 14700: Part 3: Sec 2
- (xiv) Driver shall comply the safety requirements laid down in IEC: 61347-2-13/ EN: 61347-2-13/ IS: 15885-2-13. Test certificate of NABL accredited laboratory shall be submitted in respect of the offered model/ rating.
- (xv) Driver shall also comply the performance requirements as per IEC: 62384/ IS: 16104. Test certificate of NABL accredited laboratory shall be submitted in respect of the offered model/ rating.

### 3.3 Technical requirements of electronic components used

The circuit boards and electronic components to be used in the luminaire should be of rating/ type so as to provide reliable functioning. Following shall be the informational/ compliance requirements:

- (i) Junction temperature rating of I. C. shall be furnished for information.
- (ii) Capacitor type and temperature rating shall be furnished for information.

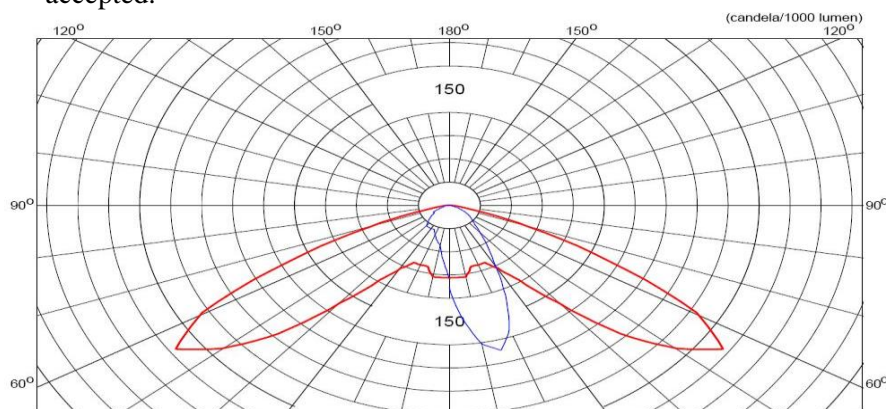
- (iii) Material of resister shall be furnished for information.
- (iv) Junction/ channel temperature rating of switching devices like MOSFET and transistor shall be furnished for information.
- (v) MCPCB is to be used for mounting of LEDs.
- (vi) FR4 grade PCBs of min. thickness of 1.6 mm shall be used in driver circuits.

### 3.4 Technical requirements of luminaire

- (i) Manufacturer shall submit the LM-79/ IS: 16106 test report from a NABL accredited laboratory. The manufacturer shall submit a declaration that the luminaire submitted for LM-79 testing was equipped with the LED Driver now being offered by the contractor.
- (ii) The min. system lumen efficacy of the luminaire shall be as follows:
  - (a) 80 lm/W (luminaire system wattage  $\leq$  45)
  - (b) 90 lm/W (luminaire system wattage  $>$  45)
- (iii) The luminaire must have secondary lens/ optics. Though the secondary lens/ optics does result in minor loss of lumens, it is nevertheless a must to distribute the light output of the LEDs so as to achieve the desired polar curve characteristics for the luminaire -- no exemption shall be permitted on this account. The material of lens should preferably be PMMA.
- (iv) Color temperature: 5700K (5665 $\pm$ 355K, as per ANSI standard C78.377A)
- (v) CRI: Greater than or equal to 65
- (vi) Housing of luminaire: Pressure die-cast LM6/ADC12/LM24 housing
- (vii) Cover type: Toughened glass or UV stabilized polycarbonate cover
- (viii) Housing protection: IP-65. If the LEDs and LED Driver are in different compartments, then the two compartments must be individually IP-65. For achieving IP-65, proper gaskets should be provided. Test certificate of NABL accredited laboratory is to be submitted for the luminaire model/ rating offered.
- (ix) Impact Resistance: IK-05
- (x) Temperature rise test: When the luminaire has stabilized thermally, soldering point temperature of the LEDs must be equal to or less than 85°C. Temperature rise (above ambient) of heat sink should generally remain within 20°C – relaxation on this account can be granted as long as the soldering point temperature limit of 85°C is not violated and there is no unacceptable outcome. The manufacturer shall submit a declaration that the temperature rise test was conducted on the luminaire with the LED Driver model/ rating now offered. For the temperature rise, test certificate of NABL accredited laboratory shall be required for the luminaire model/ rating offered by the firm.
- (xi) Typical Polar curve: Shall be at least of the type indicated in the following diagram.
- (xii) The luminaire manufacturer shall submit the photometric data report in respect of the luminaire offered (through DIALux, CALCULUX or other simulation software). IES Photometric File is also to be supplied in soft copy (i.e. on CD or by uploading/e-mailing the files, as per tender instructions). Firms are warned of serious consequences if they try to submit a tampered/ doctored report.
- (xiii) The luminaire shall comply safety requirements laid down in IEC: 60598-1/ IS: 10322: Part 1, IEC: 60598-2-3/ IS: 10322: Part 5: Sec 3. Test certificate of NABL accredited laboratory shall be submitted and the certificate must cover the luminaire model/ rating offered by the firm. If a firm substitutes the LED Driver with another make/ model, as long as the LED Driver meets the requirements laid down in Cl. 3.2, the past test



certificate of luminaire safety to the aforementioned standard shall continue to be accepted.



#### 4. WARRANTY:

The financial viability of LED luminaires is not possible without quality and thereby, life of the luminaire. Therefore it is absolutely essential and inescapable to specify the warranty in this technical document. The supply shall be covered by a warranty of 60 months from the date of commissioning or 72 months from the date of supply, whichever is earlier.

#### 5. INFORMATION TO BE MANDATORILY FURNISHED BY RAILWAYS IN THEIR INDENTS/ TENDERS:

In preparing the indent/ inviting tenders for supply of LED luminaires, it will be essential for railways to supply the following data:

- Class of Lighting application (alternately, the railway can specify the Illuminance and Uniformity ratio)
- Luminaire's approximate mounting height
- Scope of supply in detail (if the railway requires the contractor to supply the mounting pole, then it must specifically mention so in the tender)
- Requirement of 10 kV Surge Protection (if any) for the luminaire. This should be asked for only in case of lightning and surge prone locations.

#### 6. SUBMITTALS:

##### 6.1 Submittals to be made by the tenderer

The tenderer is mandatorily required to submit the following documents along with his tender:

- Model/ make of LED used in the luminaire - datasheet to be furnished.
- LM 80/ IS:16105 report with TM21 extrapolation in support of the  $L_{70}$  reported life in respect of the LED used in the offered luminaire
- If compliance to IEC 62471/ IS:16108 is not confirmed in the LED datasheet, then submit a test certificate issued by an internationally/ nationally accredited laboratory.
- LED Driver's datasheet showing at least the following attributes: make, model/ rating, THD, Efficiency, Power factor, Protections,  $T_c$ , Potted (or otherwise). If the datasheet is

not confirming one/ more of the said attributes, then submit the required data/ information from the LED Driver manufacturer.

- (v) If available, then submit the Driver manufacturer's detailed in-house test report in respect of the LED Driver offered (but this is not mandatory).
- (vi) The following EMI/ EMC test certificates from NABL accredited laboratory must be submitted in respect of the LED Driver: CISPR 15/ IS: 6573, IEC: 61547 (certificates are required in respect of all the IEC: 61547 pertinent reference standards as are mentioned in this RDSO document), IEC: 61000-3-2/ IS:1534 Part 1 & IEC: 61000-3-3/ IS 14700 : Part 3 : Sec 1.
- (vii) The following test certificates from NABL accredited laboratory must be submitted in respect of the LED Driver model/ rating offered: LED Driver Safety as per IEC: 61347-2-13/ EN: 61347-2-13/ IS: 15885-2-13 and LED Driver Performance as per IEC: 62384/ IS: 16104
- (viii) Test certificate from NABL accredited laboratory must be submitted in respect of LED luminaire safety compliance as per IEC: 60598-1/ IS: 10322: Part 1, IEC: 60598-2-3/ IS: 10322: Part 5: Sec 3. The test certificate should cover the model/ rating of the luminaire offered.
- (ix) Manufacturer's stated system (LED + Driver) wattage of luminaire
- (x) Sketch/ drawing indicating the luminaire's mechanical arrangement and key dimensions
- (xi) LM 79/ IS:16106 report in respect of the luminaire from NABL accredited laboratory.
- (xii) Photometric report print-out in respect of the offered luminaire (through Dialux/ Calculux or other simulation software)
- (xiii) Delivered Lumens declaration of Luminaire
- (xiv) IES Photometric file in soft copy (i.e. on CD or by uploading/e-mailing the files, as per tender instructions)
- (xv) Polar graph print-out
- (xvi) Manufacturer's in-house test report of the luminaire model/ rating offered by the tenderer
- (xvii) Test certificate from NABL accredited laboratory in support of IP-65 protection of luminaire.
- (xviii) Test certificate from NABL accredited laboratory in support of Impact Resistance IK-05
- (xix) Manufacturer's information on luminaire's thermal management. Temperature rise test report (if any).
- (xx) Summary clause-by-clause compliance report (by a simple mention 'complied' or 'not complied') in respect of the requirements laid down in this document.
- (xxi) If a tenderer himself is not the manufacturer of the LED luminaire, then he must furnish along with his offer, a letter from the offered luminaire's manufacturer authorizing the tenderer to quote in respect of luminaire of his (i.e. the manufacturer's) make. Such a letter of authorization must specifically mention the tender number. This is to safeguard Indian Railways from cheating/ fraud, if any.

## 6.2 Submittals to be made by the successful bidder to RDSO

The submittals to be made at tender stage are only a limited sub-set of the total set of documents actually required for verifying the conformity of the product to the requirements laid down in this document. In contracts wherein RDSO is required to carry out type testing, the successful contractor shall submit documents to RDSO in support of each and every requirement

laid down in this document. But in tenders wherein the Chief Electrical Engineer (CEE) has decided that type test shall not be carried out, in such cases, the said submittal to railway may or may not be required, depending on the contract conditions.

## 7. TECHNICAL EVALUATION OF TENDERS:

It is reiterated that the tenderers are mandatorily required to submit the documents as are listed in Cl. 6.1. Firms which fail to submit the aforesaid documentation along with their tender, are to be treated as technically unresponsive and their offer is to be summarily rejected. In respect of tenderers which have submitted the required documents, the railway officer responsible for technical evaluation of tenders shall examine the same. If the technical data and test results contained in the documents submitted by the tenderer are in conformity with the technical requirements laid down in this document, then the tenderer's offer shall be considered as technically suitable. Else, if the documents submitted by the tenderer contain data/ test results as are not in conformity with the technical requirements laid down in this document, then the offer shall be considered as technically unsuitable.

## 8. TESTS

Once a firm receives an order, its product shall be put through a rigorous process of verification for checking its compliance to the spec. Indian Railway's process of verification of the product to the spec. entails type and/ or acceptance tests. Unless the firm's product is able to pass this process of verification, supplies cannot be made. Tenderer must note that subsequent to receipt of the order, if the product eventually fails the type and/or acceptance test, then it will eventually lead to cancellation of the order along with other punitive actions as per contract conditions.

### 8.1 Type Tests

The luminaire shall be offered to RDSO for testing and approval. Type test shall encompass all the requirements as are laid down in this document. For verification of certain requirements of the spec., the type testing authority i.e. RDSO may choose to rely upon previous type test reports/ conformance certificates, as long as they pertain to similar design and comparable rating. However, the manufacturer cannot demand this as a matter of right. Until the railways are able to issue their vendor list, they may in the interim period invite tender/ place order with the provision of accepting the material on the basis of firm's written clause-by-clause confirmation of this spec. and acceptance test alone, wherever this is considered necessary by CEE.

### Type Test Methodology:

Sl. No.	Item to be inspected	Spec. Requirements (Clause no.)	Method
1.	LED	Cl. no 3.1 (i), (ii), (iv), (v), (vi), (vii), (viii), (ix), and (x)	Documents and test certificates are to be checked.
		Cl. no 3.1 (iii)	Visual inspection
2.	Driver	Cl. no 3.2 (vii), (ix), (xiii), (xiv), and (xv)	Test certificates and documents are to be checked.
		Cl. no 3.2 (i), (ii), (iii), (iv), (v), (vi) and (viii)	Witness of test at manufacturer's works.



		Cl. no 3.2 (ix), (x), (xi) and (xii)	Visual inspection
3.	Electronic devices	Cl. no. 3.3 (i), (ii), (iii) and (iv)	Checking of documents
		Cl. no.3.3 (v) and (vi)	Visual inspection
4.	Luminaire	Cl. no 2.2 (i)	Witness of test at manufacturer's works.
		Cl. no 2.2 (iv)	Check the Illuminance and Uniformity from manufacturer's photometric report
		Cl. no 2.2 (iv)	Physical check of Illuminance and Uniformity in field location (if nothing is specified in the contract, then railway should present the site condition suitable for 9-point method. Reason is that there are practical difficulties involved in firms arranging this test).
		3.4 (i), (ii), (iii), (iv), (v), (vi), (vii), (viii), (ix), (x), (xi), (xii), (xiii)	Test certificates and documents are to be checked.
		3.4 (iii), (viii)	Visual inspection

## 8.2 Routine Tests

The manufacturer shall carry out routine tests at his works and shall maintain records for the same. The set of routine tests shall at least include all the acceptance tests.

## 8.3 Acceptance Tests

Acceptance testing shall be carried out by the purchaser or his representative or by any agency deputed by the purchaser on his behalf. Following will be the list of acceptance tests:

- Visual check;
- Checking of luminaire model/ rating from the type test clearance report (in case there is no provision of type test clearance, then checking should be carried out vis-à-vis the model no. offered in the tender)
- 10% of the luminaires should be randomly picked and opened up to check if the LED Driver model/ rating is the same as was cleared during type test (in case there is no provision of type test clearance, then checking should be carried out vis-à-vis the model no. offered in the tender)
- Checking of documents of purchase of LED;
- Insulation resistance test of luminaire as per clause no. 10.2.1 of IEC 60598-1.
- Electric strength test of luminaire as per clause no. 10.2.2 of IEC 60598-1.

- (vii) Test measurement of Luminaire nominal system wattage (LED + Driver). The acceptability of the test result shall be in accordance with clause no. 2.2(i) of this document.
- (viii) Power factor of driver as per clause no. 3.2(ii) of this document.
- (ix) Driver Efficiency of driver as per clause no. 3.2(i) of this document.
- (x) Driver THD of driver as per clause no. 3.2(viii) of this document.
- (xi) Low/High voltage cut off of driver as per clause no. 3.2(iv) of this document.
- (xii) Power supply to the LED PCB is to be through proper connector.

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