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**Ballasts for tubular fluorescent
lamps—Performance requirements**

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard by Japan Electric Lamp Manufacturers Association (JELMA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

Consequently **JIS C 8118-2: 1999** has been withdrawn and replaced with this Standard.

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Ballasts for tubular fluorescent lamps— Performance requirements

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **IEC 60921** published in 2004 and Amendment 1 (2006) adding specification items and contents that are not given in the corresponding International Standard.

The portions with continuous sidelines and dotted underlines, and Annex JA to JC comprise the matters that are modified from or not given in the corresponding International Standard. A list of modifications with explanations is given in Annex JD.

1 Scope

This Standard specifies performance requirements for ballasts (hereafter referred to as “ballasts”) excluding resistance types, with the rated supply voltage up to a.c. 1 000 V at 50 Hz, 60 Hz or 50/60 Hz, and with the rated secondary voltage up to 1 000 V associated with fluorescent lamps specified in **JIS C 7601** and low-pressure mercury germicidal discharge tubes specified in **JIS C 7605** (hereafter referred to as “lamps”).

It applies to complete ballasts and their component parts such as reactors, transformers and capacitors.

This Standard may be applied also to the ballasts lighting fluorescent lamps which are not specified in **JIS C 7601** or **JIS C 7605**.

A.C. supplied electronic ballasts for tubular fluorescent lamps for high frequency operation specified in **JIS C 8147-2-3** are excluded from the scope of this Standard.

NOTE 1 For safety requirements, see **JIS C 8147-1** and **JIS C 8147-2-8**.

NOTE 2 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 60921:2004 *Ballasts for tubular fluorescent lamps—Performance requirements* and Amendment 1 (2006) (MOD)

The symbols which denote the degree of correspondence in the contents between **JIS** and the corresponding International Standard are IDT (identical), MOD (modified) and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS C 7601 *Fluorescent lamps for general lighting service*

JIS C 7605 *Low pressure mercury germicidal discharge lamps*

JIS C 7617-2 *Double-capped fluorescent lamps—Part 2: Performance specifications*

NOTE : Corresponding International Standard: IEC 60081:1997 *Double-capped fluorescent lamps—Performance specifications* (MOD)

JIS C 7618-2 Single-capped fluorescent lamps—Part 2: Performance specifications

NOTE : Corresponding International Standard: IEC 60901:1996 *Single-capped fluorescent lamps—Performance specifications*, Amendment 1 (1997) and Amendment 2 (2000) (MOD)

JIS C 8147-1 Lamp controlgear—Part 1: General and safety requirements

NOTE : Corresponding International Standard: IEC 61347-1:2000 *Lamp controlgear—Part 1: General and safety requirements* (MOD)

JIS C 8147-2-3 Lamp controlgear—Part 2-3: Particular requirements for a.c. supplied electronic ballasts for fluorescent lamps

JIS C 8147-2-8 Lamp controlgear—Part 2-8: Particular requirements for ballasts for fluorescent lamps

NOTE : Corresponding International Standard: IEC 61347-2-8:2000 *Lamp controlgear—Part 2-8: Particular requirements for ballasts for fluorescent lamps* (MOD)

JIS C 61000-3-2 Electromagnetic compatibility (EMC)—Part 3-2: Limits—Limits for harmonic current emissions (equipment input current ≤ 20 A per phase)

JIS Z 8113 Lighting vocabulary

3 Terms and definitions

For the purpose of this Standard, the terms and definitions specified in **JIS Z 8113** and **JIS C 8147-2-8** and the following apply.

3.1 (peak) lead circuit ballast

ballast having a leading lamp current with respect to the line voltage as a result of a capacitor which is connected in series with the lamp

4 General notes on tests

4.1 Tests according to this specification are type tests. The requirements and tolerances permitted by this Standard are based on testing of a type test sample submitted by the manufacturer for that purpose. In principle this type test sample should consist of units having characteristics typical of the manufacturer's production and be as close to the production centre point values as possible.

NOTE : It may be expected with the tolerances given in the standard that products manufactured in accordance with the type test sample will comply with the standard for the majority of the production. Due to the production spread, it is inevitable, however, that there may sometimes be ballasts outside the specified tolerances. For guidance of sampling plans and procedures for inspection by attributes, see **IEC 60410**.

4.2 The tests shall be carried out in the order of the clauses, unless otherwise specified.

4.3 One specimen shall be submitted to all tests.

4.4 In general all tests are made on each type of ballast or, where a range of similar ballasts is involved, for each rated wattage in the range or on a representative selection from the range as agreed with the manufacturer.

4.5 The tests shall be made under the conditions specified in Annex A.

4.6 All ballasts specified in this Standard shall comply with the requirements of **JIS C 8147-2-8**.

4.7 Though, in this Standard, the lamp characteristics standard including the “information for design of ballasts” is cited for the purpose of obtaining suitable lighting conditions, the lamp performance is not a required item in the type test given in this Standard.

5 Marking

The following information shall be included either on the ballast or be made available in the manufacturer’s catalogue or the like:

5.1 Circuit power-factor

For the ballast of a high power factor, “High power factor” or the value of circuit power factor (for example, $\lambda=0.85$) shall be marked. For the ballast of a low power factor, this marking is not necessary.

In addition, circuit power factor shall be marked on the body of the ballast.

5.2 Symbol $\overline{Z}$

The symbol $\overline{Z}$ which indicates that the ballast is designed to comply with the conditions for audio-frequency impedance (see clause 14).

5.3 Output ratio

The output ratio shall be in accordance with Annex JA.

6 Starting voltage

The starting voltage shall apply to the transformer type ballasts, and the test shall be carried out in accordance with the measuring conditions of **A.4**.

6.1 For lamps operated with a starter

The starting voltage of a lamp operated with a starter shall be as follows.

- a) The starting voltage shall not be less than the starting test voltage specified in **JIS C 7601** when the supply voltage of 94 % of the rated supply voltage for the transformer type ballast of which the rated supply voltage is 125 V or less or the supply voltage of 90 % of the rated supply voltage for the transformer type ballast of which the rated supply voltage exceeds 125 V is applied to the ballast. Furthermore, the starting voltage shall not be less than the starting test voltage specified in Annex A2 of **JIS C 7617-2** and **JIS C 7618-2** each when the supply voltage of 100 % of the rated supply voltage is applied to the ballast. However, for the ballast with special consideration on starting, the starting voltage may be lower than the specified value if it has the equivalent starting performance by connecting the applicable lamp.

- b) When ballasts are designed to operate lamps in parallel circuits, the relevant requirements shall be met for each separate lamp, even in the most adverse load conditions.

6.2 For lamps operated without a starter

The starting voltage of a lamp operated without a starter shall be as specified in **6.1**. However, among ballasts with special consideration on starting, for the peak lead circuit ballast for one 40 W rapid-start fluorescent lamp, crest factor (maximum value/r.m.s. value) of secondary voltage shall be 2.3 or less and the ratio of the starting voltage of the peak lead circuit ballast to the starting voltage of the lagging ballast (ratio of r.m.s. value) shall be not less than 1/1.09.

For the checking of starting voltage at lamp terminations, the maximum value of the four possible measurements between lamp terminals is taken.

NOTE : For ballasts with a step-up transformer it is likely that a capacitor is used in series to form lead circuit or peak lead circuit ballasts. A lead circuit ballast typically has an open circuit voltage crest factor of 1.55 to 2.0 and in a peak lead ballast it is 2.0 to 2.3.

6.3 For lamps operated without a starter (North American practice)

(not adopted)

6.4 Maximum (r.m.s.) voltage across starter terminals with lamp operating

When a ballast is operating with a reference lamp and is connected to any voltage between 92 % and 106 % of the rated supply voltage at rated frequency, the voltage across the starter terminations shall not exceed the maximum value given in **2.3** of **JIS C 7617-2** and **2.3** of **JIS C 7618-2** on the relevant lamp data sheet. These limits apply both when the lamp is first ignited and after it has warmed up.

When the ballasts are designed to operate lamps in parallel circuits, the relevant requirements shall be met for each separate lamp.

6.5 For lamps with integral means of starting

The starting voltage of lamps with integral means of starting shall be in accordance with **a)** of **6.1**.

7 Pre-heating conditions

The test shall be carried out in accordance with the measuring conditions of **A.5**.

NOTE : A marked capacitor tolerance of 10 %, which is typical for shunt connected capacitors, is unsuitable for series capacitors due to the summation of capacitor and ballast tolerances which, when unfavourable tolerances coincide, may lead to poor lamp performance.

Consequently, and in order to satisfy the requirements specified on the relevant lamp data sheets in **JIS C 7617-2** or **JIS C 7618-2**, depending on the tolerances of the series choke component of the ballast either the capacitor tolerances should be narrow or the series connected inductive reactance and capacitor should be selected so that unfavourable tolerances do not coincide.

7.1 For lamps operated with (integral) starter

The cathode preheating current when the rated supply voltage of the rated frequency is applied to the ballast shall be measured. The cathode dummy load resistance at this time shall be as given in table 1 and the cathode preheating current shall be as specified in table 2.

Table 1 Cathode dummy load resistance of starter type ballasts

Classification	Rated lamp power W	Dummy load resistance of both cathodes in total Ω	Classification	Rated lamp power W	Dummy load resistance of both cathodes in total Ω
Straight tube type	4	140	Compact type	4	160
	6	140		6	160
	8	140		9	70
	10	70		13	50
	15	50		18	50
	20	50		27	30
	30	30		30	30
	40	40		28	40
Circular type	30	30		36	40
	32	40		55	25
	40	40		—	—

Table 2 Cathode preheating current characteristics

Division of reference ballast to which applicable lamp belongs ^{b)}	Cathode preheating current A	Division of reference ballast to which applicable lamp belongs ^{b)}	Cathode preheating current A
6a	0.15 to 0.23	5c	0.19 to 0.30
8a	0.20 to 0.30	7c-1	0.18 to 0.28
10a ^{a)}	0.27 to 0.39	7c-2	0.19 to 0.30
15a ^{a)}	0.37 to 0.51	9c	0.19 to 0.30
20a	0.45 to 0.61	10c	0.18 to 0.28
30a	0.75 to 0.95	13c	0.30 to 0.43
32a	0.53 to 0.69	18c	0.23 to 0.35
40a	0.55 to 0.71	26c	0.35 to 0.50
55a	0.80 to 1.05	—	—
Notes ^{a)} Classification of reference ballast 10a includes GL10 and 15a includes GL15. ^{b)} The alphabetical letter after the figure of division of reference ballast indicates classification of lamp and “a” indicates the lamp operated with a starter and “c” indicates the lamp with integral means of starting (see table C.1).			

For lamps where such data are not given in **JIS C 7617-2** or **JIS C 7618-2**, the pre-heating current shall be as specified by the lamp manufacturer.

7.2 For lamps operated without starter

For the cathode winding characteristics of the ballast with a winding for cathode heating, when the dummy load resistance given in table 3 is connected to the cathode winding and the rated supply voltage of the rated frequency is applied to the ballast, the voltage of both ends of dummy load resistance shall be as specified in table 3. However, for the ballast with special consideration on starting, the upper limit of voltage of both ends of dummy load resistance may be set to be especially high.

Table 3 Cathode winding characteristics

Division of reference ballast to which applicable lamp belongs ^{a)}	Dummy load resistance per one cathode Ω	Terminal voltage of dummy load resistance V
20b	9.6 ± 0.1	3.4 to 4.2
40b		
110b	3.20 ± 0.05	
Note ^{a)} The alphabetical letter after the figure of division of reference ballast “b” indicates the lamp of rapid-start type (see table C.1).		

For those ballasts which are intended for use with high resistance cathode lamps and which present a voltage across each dummy load resistor which exceeds the maximum specified in the relevant lamp data sheet, the dummy load resistance shall be derived from the following equation.

$$R = \frac{11.0}{2.1 \times I_n}$$

where, R : dummy load resistance (Ω)

I_n : the nominal running current of the lamp specified
in the relevant lamp data sheet

With the ballast under test operated at any voltage between 92 % and 106 % of its rated supply voltage the current passed by each resistor shall not exceed 2.1 times the nominal running current of the lamp.

7.3 For lamps operated without starter (North American practice)

(Not adopted)

8 Lamp power and current

The test shall be carried out in accordance with the requirements of **A.6**.

8.1 For lamps operated with (integral) starter

Unless otherwise specified on the relevant lamp data sheet, the ballast under test shall limit the power and current of a reference lamp to not less than 92.5 % for the power and not more than 115 % for the current of the corresponding values delivered to the same lamp when operated with a reference ballast. Both the reference ballast and the ballast under test shall have the same rated frequency and each shall be operated at its rated voltage.

For ballasts intended for the additional application of operating lamps in series, each lamp not exceeding 20 W rating, the limits at rated voltage are widened by an additional 5 %, i.e. 87.5 % for power and 120 % for current at rated voltage instead of 92.5 % and 115 % respectively. The reference ballast data used for this test shall be the sum of the individual lamp powers.

NOTE : A summary of ballasts suitable for series operation of two fluorescent lamps and which do not need further testing, is given in Annex B.

8.2 For lamps operated without starter

The ballast shall limit the arc current delivered to the reference lamp to a value not exceeding 115 % of that delivered to the same lamp when it is operated with a reference ballast. However, for the slim-line type lamp, it shall be not more than 120 %.

The power supplied to the lamp shall be such that the luminous flux from a reference lamp shall be not less than 90 % of the luminous flux from the same reference lamp when operated on a reference ballast.

The circuit of the reference ballast may be either with or without separate cathode heating, as may be required by the measurement method being used (see Annex A). The manufacturer shall state the measurement method to be used using these lamps.

For these tests, the reference ballast shall have the same rated frequency as the ballast under test and each of them shall be operated at its rated voltage.

The measurement of electrical and luminous characteristics of lamps shall be performed in accordance with **JIS C 7601**.

8.3 For lamps operated without starter (North American practice)

(Not adopted)

9 Circuit power-factor

When measuring the circuit power-factor by lighting the lamp at the rated voltage and frequency, for ballasts marked "high power-factor", the measured value shall in no case be less than 0.85, and for ballasts marked with a power-factor value, the measured value shall not differ from the marked value by more than 0.05.

10 Supply current

At rated voltage, the supply current and supply power to the ballast shall not differ by more than 10 % (20 %, for ballasts with lamp power of 10 W or under) from the value marked on the ballast when the latter is operated with a reference lamp.

11 Maximum current of lamp terminal

This requirement applies only to ballasts for lamps operated without starter.

When the applicable lamp is lighted by applying the rated supply voltage of the rated frequency, the current passed through the lamp terminal shall not be more than the value given in table 4. The testing conditions shall be in accordance with **A.7**.

Table 4 Maximum current of lamp terminal

Classification of lamp	Maximum current of lamp terminal A
FLR20S	0.65
FLR40S, FLR40S/36	0.75
FLR110H, FLR110H/100	1.30

12 Current waveform

12.1 Supply current waveform

Harmonics of supply current shall be as specified in **JIS C 61000-3-2**.

Luminaires to be used together with ballasts the conformance of which with **JIS C 61000-3-2** has been confirmed by a test using a reference lamp are regarded to conform to **JIS C 61000-3-2** and therefore do not need to be tested themselves.

12.2 Lamp operating current waveform

The test shall be carried out in accordance with the requirements of **A.8**. The ballast shall be operated at its rated voltage of rated frequency with the specified number of reference lamp(s). After lamp stabilisation, the waveform of the lamp operating current shall comply with the following conditions.

- a) Successive half-cycles shall present similar forms on an oscilloscope and their peak values shall be equal to within 5 %.

If measurement with the oscilloscope leaves any doubt, the requirement shall be deemed as met if any harmonic component does not exceed 2.5 % of the fundamental current.

- b) The maximum ratio of peak value to r.m.s. value (crest factor) shall not exceed 1.7.

13 Magnetic screening

The ballast shall be effectively screened against the influence of adjacent ferromagnetic materials. Compliance is checked by the following test.

The ballast shall be operated at rated voltage with an appropriate lamp.

After stabilisation, a steel plate 1 mm thick and of length and breadth greater than those of the ballast under test shall be successively placed in direct contact with the bottom plate of the ballast and at a distance of 1 mm from each face of the latter.

During this operation, the lamp current shall be measured and shall not change by more than 2 % due to the presence of the steel plate.

14 Impedance at audio-frequencies

Ballasts marked with the audio-frequency symbol shall be tested using one of the circuits shown in **A.9**.

For every signal frequency between 400 Hz and 2 000 Hz, the impedance of the ballast when operated with a reference lamp supplied at its rated voltage and frequency shall be inductive in characteristic.

Its impedance in ohms shall be at least equal to the resistance of the resistor, which would dissipate the same power as the lamp/ballast combination when operated at its rated voltage and frequency.

The ballast impedance is measured with a signal voltage equal to 3.5 % of the rated supply voltage of the ballast. Between 250 Hz and 400 Hz, the impedance shall be at least equal to half the minimum value required for frequencies between 400 Hz and 2 000 Hz.

Radio interference suppressers consisting of capacitors of less than 0.2 μF (total value) which may be incorporated in the ballast may be disconnected for this test.

Annex A (normative)

Tests

Introduction

This Annex specifies the tests.

A.1 Conditions for tests

A.1.1 General

The general requirements of Annex H of **JIS C 8147-1** apply but, for certain tests, for example checking the requirements of **A.8**, considerably greater purity of waveform of the supply is necessary, particularly in cases where capacitors are connected directly or indirectly in parallel with the supply.

A.1.2 Magnetic effects

Unless otherwise specified, no magnetic object shall be allowed within 25 mm of any face of the reference ballast or the ballast under test.

A.1.3 Mounting and connections of reference lamps

- a) **Mounting** In order to ensure that the electrical characteristics of the reference lamps are consistent, they shall be mounted as indicated on the relevant lamp data sheet. Where no mounting instructions are given on the relevant lamp data sheet, lamps shall be mounted horizontally. It is recommended that lamps be allowed to remain permanently undisturbed in their lampholders.
- b) **Reference lamps operated with (integral) starter** The lamps shall be aged with one disposition of contact connections only, and shall be used in the same disposition so that the position of the hot spot on the cathode is not changed (see **A.6**).
- c) **Reference lamps operated without starter** The above conditions shall be complied with so far as the identification of the ballast terminations corresponding to the main circuit will permit.

A.1.4 Reference lamp stability

- a) A lamp shall be brought to a condition of stable operation before carrying out measurements. No swirling shall be present.
- b) The characteristics of a lamp shall be checked immediately before and immediately after each series of tests.

A.1.5 Reference ballasts and reference lamps

Reference ballasts and reference lamps shall comply with Annexes C and D respectively.