



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS D 5301 : 2019

(BAJ/JSA)

Lead-acid starter batteries

ICS 29.220.20;43.060.50

Reference number : JIS D 5301 : 2019 (E)

Date of Establishment: 1951-07-30

Date of Revision: 2019-03-20

Date of Public Notice in Official Gazette: 2019-03-20

Investigated by: Japanese Industrial Standards Committee
Standards Board for IEC area

JIS D 5301:2019, First English edition published in 2020-03

Translated and published by: Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

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Printed in Japan

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Battery Association of Japan (BAJ)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS D 5301:2006** is replaced with this Standard.

However, **JIS D 5301:2006** may be applied in the **JIS** mark certification based on the relevant provisions of Article 19 Clause 1, etc. of the Industrial Standardization Law until March 19, 2020.

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Lead-acid starter batteries

Introduction

This Japanese Industrial Standard has been prepared based on **IEC/FDIS 60095-1:2018**, **IEC 60095-2:2009**, Edition 4, and **IEC 60095-4:2008**, Edition 2 with some modifications of the technical contents, which have been made as a result of considerable technological and environmental changes and of the revision of corresponding International Standards over the past ten years since the last revision was made in 2006.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard is applicable to lead-acid batteries with a nominal voltage of 12 V (hereafter referred to as batteries), used for e.g. the starting of internal combustion engines, lighting, ignition of automobiles, etc. This Standard is not applicable to the valve-regulated lead-acid batteries and the lead-acid batteries used for the driving of rolling stock, two-wheeled vehicles, electric vehicles, etc.

NOTE 1 Automobiles, etc. mentioned above, to which this Standard is applicable, indicate industrial vehicles, construction vehicles, agricultural tractors and other vehicles for similar applications in addition to ordinary passenger vehicles.

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

IEC/FDIS 60095-1:2018 *Lead-acid starter batteries—Part 1: General requirements and methods of test*

IEC 60095-2:2009 *Lead-acid starter batteries—Part 2: Dimensions of batteries and dimensions and marking of terminals*

IEC 60095-4:2008 *Lead-acid starter batteries—Part 4: Dimensions of batteries for heavy vehicles* (overall evaluation: MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

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 B 7414 *Glass thermometers*

JIS B 7507 *Vernier, dial and digital callipers*

JIS B 7525-1 *Hydrometers—Part 1: Density hydrometers*

JIS C 1102-2 *Direct acting indicating analogue electrical measuring instruments and their accessories Part 2: Special requirements for ammeters and voltmeters*

JIS K 6999 *Plastics—Generic identification and marking of plastics products*

ISO 7010 *Graphical symbols—Safety colours and safety signs—Registered safety signs*

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions apply.

3.1

full charge

state of battery charge such that the charging produces no increase of capacity

NOTE It indicates the state of a battery charged in accordance with 9.2.

3.2

nominal voltage

voltage used to designate a battery voltage

NOTE Generally, a voltage slightly lower than the electromotive force at a full charge is applied. For the lead-acid batteries, it is 2 V per unit cell.

3.3

nominal reserve capacity, RC_n

period of time (in min) for which a fully charged battery can maintain a discharge current of 25 A to a cut-off voltage of 10.5 V at a temperature of $25\text{ °C} \pm 2\text{ °C}$

3.4

effective reserve capacity, RC_e

period of time (in min) for which a fully charged battery is continuously discharged with a constant current of $25\text{ A} \pm 1\%$ to a voltage of $10.50\text{ V} \pm 0.05\text{ V}$ at a steady temperature of $25\text{ °C} \pm 2\text{ °C}$

NOTE The resultant discharge time, in minutes, is generally used for the verification of RC_n .

3.5

20 h rate capacity, $C_{20,n}$

electric quantity that a fully charged battery can supply with the 20 h rate current to a cut-off voltage of 10.5 V at $25\text{ °C} \pm 2\text{ °C}$

3.6

effective 20 h rate capacity, $C_{20,e}$

product of the 20 h rate current and the period of time for which a fully charged battery can be continuously discharged with the 20 h rate current to a voltage of $10.50\text{ V} \pm 0.05\text{ V}$ at a steady temperature of $25\text{ °C} \pm 2\text{ °C}$

NOTE The resultant electric charge is used for the verification of $C_{20,n}$.

3.7

20 h rate current, I_{20}

current (A) which expresses the amount of charging current and discharging current of the battery, and is obtained by dividing 20 h rate capacity by 20

3.8

nominal cold cranking ampere, I_{cc}

current used as a scale expressing the engine cranking performance of battery, which is specified to be discharged at a temperature of $-18\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ with the voltage after 30 s being 7.2 V or over

3.9

cut-off voltage

voltage of a battery terminal at which the battery discharge is terminated

3.10

charge acceptance

characteristics of a discharged battery which shows the ease of increasing its state of charge

3.11

heavy load endurance

number of discharge/recharge cycles which is applied to Class B batteries (used mainly for trucks, buses, taxis, industrial vehicles, construction vehicles and similar applications) and is repeated until the endurance limit is reached, in the heavy load range where the discharge quantity at one time is 17 % or over of the 20 h rate capacity $C_{20,n}$

3.12

light load endurance

number of discharge/recharge cycles which is applied to Class A batteries (used mainly for passenger vehicles, light commercial vehicles and similar applications) and is repeated until the endurance limit is reached, in the light load range where the discharge quantity at one time is 9 % or under of the 20 h rate capacity $C_{20,n}$

3.13

water consumption

amount of battery electrolyte decreased during overcharge of a battery

3.14

low water loss battery

battery whose water consumption is less than 4 g/Ah

3.15

very low water loss battery

battery whose water consumption is less than 1 g/Ah

3.16

charge retention

cranking performance of a filled charged battery which has been stored on open circuit under specified temperature and time conditions

3.17

vibration resistance

ability of a battery to maintain service under periodic or irregular acceleration forces

3.18

electrolyte retention

ability of a battery to contain its electrolyte under specified mechanical conditions

3.19

dry charged battery

battery into which the appropriate electrolyte is transferred for activation, immediately prior to use (see Annex C)

3.20

5 h rate capacity, $C_{5,n}$

electric quantity that a fully charged battery can supply with the 5 h rate current to a cut-off voltage of 10.5 V at $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ (see Annex C)

3.21

5 h rate current, I_5

current (A) which expresses the amount of charging current and discharging current of the battery, and is obtained by dividing 5 h rate capacity by 5 (see Annex C)

3.22

high rate discharge characteristics

characteristics of a battery discharged at a current comparable to the cranking current of automobiles (see Annex C)

3.23

50 % DOD endurance test

number of discharge/recharge cycles which is applied to batteries having a 20 h rate capacity $C_{20,n}$ of at least 100 Ah and is repeated until the endurance limit is reached, at 5 times the 20 h rate current I_{20} (See Annex C)

3.24

corrosion test

number of repeated overcharge/storage periods performed until the battery voltage reaches 7.2 V or less at 30 s with a current of $0.6 I_{cc} (\pm 0.5 \%)$ and until the endurance limit is reached (see Annex C)

4 Classification

Classification of batteries are given in Table B.1 and Table B.2. Batteries classified into Class A are used mainly for passenger vehicles, light commercial vehicles and similar applications, and those classified into Class B are used mainly for trucks, buses, taxis, industrial vehicles, construction vehicles and similar applications. Major dimensions shall be as shown in Figure A.2.

5 Marking

The batteries shall carry the marking of the following information at a conspicuous place.

- a) **Type**, as given in Table B.1 and Table B.2.
- b) **Manufacturer's name or its abbreviation**
- c) **Year and month of manufacture, manufacturing date or its abbreviation**

Abbreviation for the manufacturing date shall be as follows.

Example: 30 06 17 (30 June 2017)
 (Day) (Month) (Year)

- d) **Safety labelling** The batteries shall be marked with six coloured symbols, as exemplified in Figure 1 a). The individual symbols shall have common dimensions, as shown in Figure 1 c), with minimum dimensions of 10 mm. The description of safety symbols shown in Figure 1 b) should be stated in the vicinity of the symbols. The symbols should be as specified in **ISO 7010**.

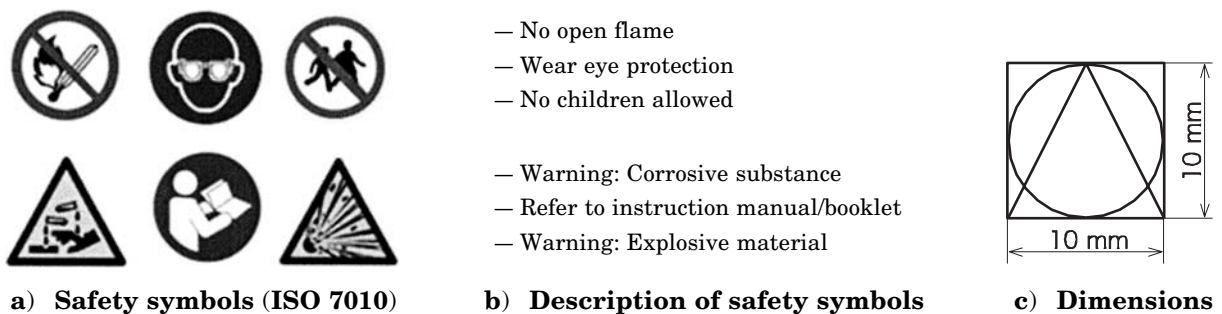


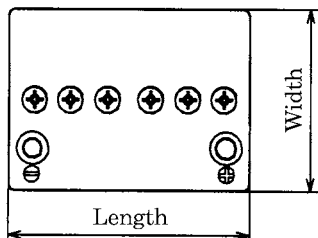
Figure 1 Safety labelling

- e) **Marking of material for recycling**, as specified in **JIS K 6999**.

Example: >PP/PE<

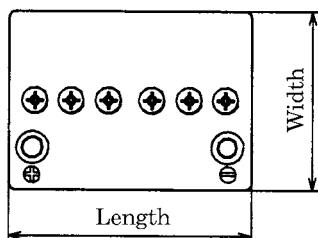
- f) **Marking of the polarity** The batteries shall carry the marking of polarity, at least of the positive terminal. The marking of positive polarity shall take the form of the symbol “+” either on the upper surface of the lid adjacent to the positive terminal or on the positive terminal. If the negative polarity is also marked, the marking shall take the form of the symbol “-” either on the upper surface of the lid adjacent to the negative terminal or on the negative terminal.

- g) **Polarity positions of terminals** For the indication of polarity positions of terminals, the letter “L” shall be suffixed to the type designation when terminals are arranged as shown in Figure 2, and, for reference, the letter “R” to the type designation when terminals are arranged as shown in Figure 3. For batteries of configuration type F to H, polarity positions shall be as shown in Figure 4.



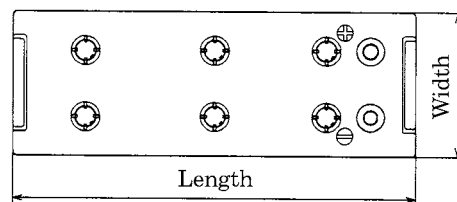
NOTE Top view with terminals in sight
⊕: position of positive terminal
⊖: position of negative terminal

Figure 2
Type designation suffixed with L



NOTE Top view with terminals in sight
⊕: position of positive terminal
⊖: position of negative terminal

Figure 3
Type designation suffixed with R (reference)



NOTE Top view with terminals in sight
⊕: position of positive terminal
⊖: position of negative terminal

Figure 4
Type designation ending without L or R

6 Designation of starter batteries

Batteries are designated according to their name and type.

Example: Lead-acid starter battery 28B17L

7 Condition on delivery

New batteries may be supplied in either of the following states.

- a) In a state filled with appropriate electrolyte up to the maximum level and ready for use. The density of the electrolyte in fully charged batteries shall be $1.277 \text{ g/cm}^3 \pm 0.010 \text{ g/cm}^3$ at 25°C , unless otherwise recommended by the manufacturer. Conversion of the density of electrolyte to 25°C conditions shall be according to the following equation.

$$D_{25} = D_t + 0.0007(t - 25)$$

where, D_{25} : density of the electrolyte at 25°C (g/cm^3)

D_t : density of the electrolyte at $t^\circ\text{C}$ (g/cm^3)

t : temperature of the electrolyte when its density is measured ($^\circ\text{C}$)

- b) In a dry charged state not filled with electrolyte. The density of the electrolyte to fill these batteries before use shall be as given in a), unless otherwise recommended by the manufacturer.

8 Performance

The batteries shall satisfy the requirements for performance given in Table 1 when tested in accordance with Clause 10 and Annex A.

Table 1 Performance

Item		Performance	Applicable subclause for test methods
Dimensions ^{a)}	External dimensions	Within the range given in Table A.2	Annex A
	Terminal dimensions	Within the range given in Table A.1	
Capacity ^{b)}	20 h rate capacity	$C_{20,e}$ is 95 % or more of the $C_{20,n}$ value given in Table B.1 and Table B.2.	10.1
	Reserve capacity	RC_e is not less than the value given in Table B.1 and Table B.2.	10.2
Cold cranking ampere		The battery is discharged at a current I_{cc} given in Table B.1 and Table B.2, and the voltage after a discharge period of 30 s is not less than 7.2 V.	10.3
Charge acceptance ^{b)}	Test 1	Charge acceptance rate i_{ca1} is not less than 2.	10.4
	Test 2	Charging current I_{ca2} after 10 min is not less than the value given in Table B.1 and Table B.2.	
Endurance ^{b)}	Light load endurance (Class A)	The number of endurance cycles is not less than 80 % of the value given in Table B.1 and Table B.2.	10.5
	Heavy load endurance (Class B)	The number of endurance cycles is not less than 95 % of the value given in Table B.1 and Table B.2. For a battery without a glass mat, the number of endurance cycles is not less than 80 % of the value given in these tables.	
Vibration resistance		No cracking or fissure of electrolytic container, excessive overflow of electrolyte, or abnormal voltage drop due to e.g. internal short circuit, falling of plate and break of cell post	10.6
Terminal strength		No twist off of the terminal, loosening in fitting of the terminal and lid, or damage on the lid	10.7
Robustness to fastening		No deformation or the like detrimental to the use of the battery	10.8
Electrolyte retention		No leakage of electrolyte after being tilted	10.9
Charge retention (reference)		After the specified storage period, the battery is discharged at a current of 0.6 I_{cc} . The voltage after 30 s is not less than 8.0 V for low water loss batteries and not less than 8.5 V for very low water loss batteries.	10.10
Water consumption (reference)		Low water loss battery: 4 g/Ah max. Very low water loss battery: 1 g/Ah max.	10.11
Notes ^{a)} The battery is required to satisfy requirements for dimensions of both configuration and terminals.			
^{b)} The battery is required to satisfy either requirement described above.			

9 General test conditions

9.1 Sampling of batteries

All tests shall be performed with new battery samples. Samples are considered as new batteries when used:

- within 30 days after the shipping date from the manufacturer in the case of filled batteries or;
- within 60 days after the shipping date from the manufacturer in the case of dry charged batteries.

9.2 Charging method

Batteries shall be charged by either of the following methods. The electrolyte temperature while charging shall be in the range from 15 °C to 45 °C.

- Constant current charging method** Batteries are charged with the current $2I_{20}$ that is twice 20 h rate current I_{20} , until the terminal voltage or the electrolyte density converted to the specified temperature condition shows a constant value three consecutive times on every 15 min measurements.
- Constant voltage — constant current charging method** Batteries are charged by either method 1) or 2) given in Table 2. The period of battery charge after cold cranking ampere test and prior to the first capacity test, shall be limited to 16 h.

Table 2 Constant voltage — constant current charging method

	Voltage	Current	Time
1)	16.00 V $\pm$ 0.05 V	$5I_{20}$	24 h
2)	16.00 V $\pm$ 0.05 V	$5I_{20}$	20 h
	No limitation	I_{20}	4 h

9.3 Electrolyte level

All tests shall be performed with batteries filled with electrolyte to the maximum level.

9.4 Measuring instruments

Unless otherwise specified, measuring instruments shall be as follows.

- Temperature measurement** The instrument for measuring temperature shall be a thermometer with an accuracy of ± 1 °C as specified in **JIS B 7414** or at least equivalent to this.
- Length measurement** The instrument for measuring length shall be a calliper specified in **JIS B 7507** or a measuring instrument with an accuracy at least equivalent to this.
- Density measurement** The instrument for measuring density shall be a hydrometer with an accuracy of ± 0.005 g/cm³ as specified in **JIS B 7525-1** or a densimeter with an accuracy at least equivalent to this.

- d) **Voltmeter and ammeter** The instruments for measuring voltage and electric current shall be a voltmeter and an ammeter, respectively, with an accuracy of at least Class 1 as specified in **JIS C 1102-2** or an instrument with an accuracy at least equivalent to this.
- e) **Time measurement** The instrument for measuring time shall be a timer graduated in hours, minutes and seconds, or in hours and centihours (1/100 h), with an accuracy of at least $\pm 1 \%$.

9.5 Test sequence

The test sequence shall be as given in Table 3. All tests shall be performed with batteries charged according to **9.2**. When a battery does not satisfy the specified values for capacity and cold cranking performances, the test may be carried out further two times, namely three times in total. When the specified values are met for these performances, proceed to the tests specified in **10.5** to **10.11**.

These tests shall be carried out not later than one week after completion of the cold cranking ampere test. The tests specified in **10.7** and **10.8** can be carried out in any sequence.

Table 3 Test sequence

Test		Battery				
Item	Reference	No. 1	No. 2	No. 3	No. 4	No. 5
20 h rate capacity test or reserve capacity test	10.1 or 10.2	○	○	○	○	○
Cold cranking ampere test	10.3	○	○	○	○	○
Charge acceptance test	10.4	○				
Endurance test	10.5		○			
Vibration resistance test	10.6			○		
Electrolyte retention test	10.9				○	
NOTE Five batteries are to be prepared. Battery No. 5 may be used for any test.						

10 Test methods

10.1 20 h rate capacity ($C_{20,e}$) test

20 h rate capacity test shall be carried out as follows.

- a) Throughout the duration of the tests, the battery shall be placed in a water bath at a temperature of $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. The terminal base of the battery shall be at least 15 mm but not more than 25 mm above the water surface level. If several batteries are in the same water bath then the distance between them and also the distance to the walls of the bath shall be at least 25 mm.
- b) After a lapse of about 1 h since the completion of charging according to **9.2**, the electrolyte temperature, measured in one of the middle cells, shall be $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ before the discharge begins. With this electrolyte temperature, the battery shall be discharged with the 20 h rate current I_{20} until the terminal voltage falls to 10.50 V ± 0.05 V. The duration t (h) of the discharge shall be recorded.