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**Lead-acid starter batteries**

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## Foreword

This translation has been made based on the original Japanese Industrial Standard 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** : 1999 is replaced with this Standard.

This revision has been made based on **IEC 60095-1** : 2000 *Lead-acid starter batteries—Part 1: General requirements and methods of test*, **IEC 60095-2** : 1984 *Lead-acid starter batteries Part 2: Dimensions of batteries and dimensions and marking of terminals*, Amendment 1 (1991) and Amendment 2 (1993), and **IEC 60095-4** : 1989 *Lead-acid starter batteries Part 4: Dimensions of batteries for heavy trucks* and Amendment 1 (1996) for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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## Lead-acid starter batteries

**Introduction** This Japanese Industrial Standard has been prepared based on the sixth edition of **IEC 60095-1** *Lead-acid starter batteries—Part 1: General requirements and methods of test* published in 2000, the third edition of **IEC 60095-2** *Lead-acid starter batteries Part 2: Dimensions of batteries and dimensions and marking of terminals* published in 1984, Amendment 1 published in 1991 and Amendment 2 published in 1993, and the first edition of **IEC 60095-4** *Lead-acid starter batteries Part 4: Dimensions of batteries for heavy trucks* published in 1989 and Amendment 1 published in 1996 with some modifications of the technical contents.

The portions given continuous sidelines and dotted underlines are the matters in which the contents of the original International Standards have been modified. A list of modifications with explanations is given in Annex 2 (informative).

**1 Scope** This Standard specifies lead-acid batteries with a nominal voltage of 12 V (hereafter referred to as “batteries”) used for starting of internal combustion engine, lighting, ignition, etc. of automobiles, etc. However, the valve-regulated lead-acid batteries for automobile, and batteries for rolling stock, for electric automobiles, and for motorcycle are excluded.

NOTES 1 In this Standard, automobiles, etc. mean, in addition to ordinary automobile, industrial vehicles (eliminating motor-driven vehicles such as forklift trucks, tow tractors, carrying vehicles), machinery used for public works and agricultural vehicles (such as tire rollers, tractors) and other vehicles for similar applications, or power supply use in incidental facilities (such as audio, wiper) of internal combustion engine-driven vehicles.

2 The International Standards corresponding to this Standard are as follows.

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**.

IEC 60095-1:2000 *Lead-acid starter batteries—Part 1: General requirements and methods of test* (MOD)

IEC 60095-2:1984 *Lead-acid starter batteries Part 2: Dimensions of batteries and dimensions and marking of terminals, Amendment 1 (1991) and Amendment 2 (1993)* (MOD)

IEC 60095-4:1989 *Lead-acid starter batteries Part 4: Dimensions of batteries for heavy trucks and Amendment 1 (1996)* (MOD)

**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 7411 *Solid-stem general purpose liquid-in-glass thermometers*

JIS B 7507 *Vernier, dial and digital callipers*

JIS B 7525 *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 C 60068-1 *Environmental testing Part 1: General and guidance*

**3 Terms and definitions** For the purposes of this Standard, the following definitions apply.

a) **nominal voltage** the voltage used to designate a battery voltage

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

b) **nominal reserve capacity  $C_{r,n}$**  the duration (in min) in which the full charged battery at  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  is capable of discharging successively with 25 A by the cut-off voltage of 10.5 V

c) **effective reserve capacity  $C_{r,e}$**  the actual duration (in min) in which the full charged battery held at  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  has discharged successively with the current of  $25\text{ A} \pm 1\%$  by the voltage of  $10.50\text{ V} \pm 0.05\text{ V}$

The obtained discharging time expressed in min is used to ensure  $C_{r,n}$ .

d) **5 h rate capacity  $C_{5,n}$**  the electric quantity that the full charged battery at  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  is capable of supply by the cut-off voltage of 10.5 V at 5 h rate current

e) **effective 5 h rate capacity  $C_{5,e}$**  the product of time in which the full charged battery held at  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  is capable of discharging successively by  $10.50\text{ V} \pm 0.05\text{ V}$  with 5 h rate current, and the current

The obtained electric quantity is used to ensure  $C_{5,n}$ .

f) **5 h rate current  $I_5$**  the 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

g) **20 h rate capacity  $C_{20,n}$**  the electric quantity that the full charged battery at  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  is capable of supply by the cut-off voltage 10.5 V at 20 h rate current

h) **20 h rate current  $I_{20}$**  the 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

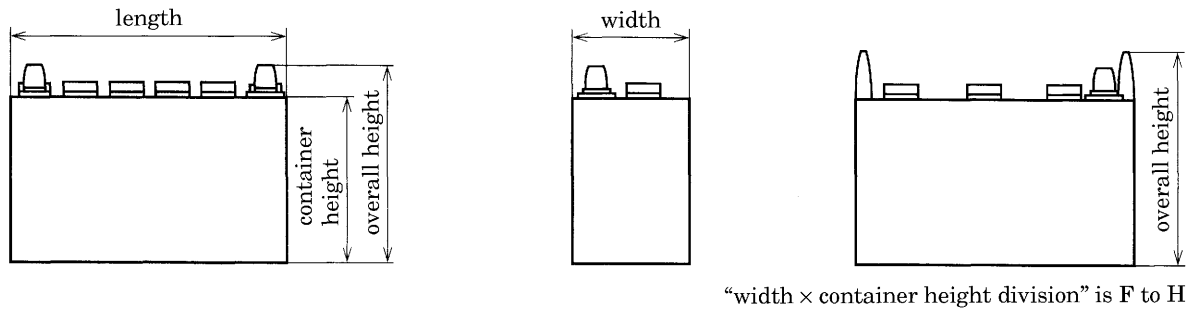
i) **nominal cold cranking ampere  $I_{cc}$**  the discharging current which expresses the scale of the engine cranking performance of the battery, and is specified so that the discharging voltage at a temperature of  $-18\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$  after 30 s shall be 7.2 V or over

- j) **high rate discharge characteristics** the characteristics discharged with the current comparable to the cranking current of automobile
- k) **cut-off voltage of discharging** the terminal voltage of the battery when discharging is ceased
- l) **charge acceptance** the characteristics which shows the ease of charging to the discharged battery
- m) **heavy load endurance** applied for Class B battery (mainly for trucks, buses, taxis, industrial vehicles, machinery used for public works and similar applications), and the number of runs of the charging and discharging cycle until the endurance in the heavy load range in which the discharged quantity of one time is 20 % or over of the 5 h rate capacity
- n) **light load endurance** applied for Class A battery (mainly for passenger vehicles, light commercial vehicles and similar applications), and the number of runs of the charging and discharging cycle until the endurance in the light load range in which the discharged quantity is 10 % or under of the 5 h rate capacity
- o) **water consumption** the amount of battery electrolyte decreased by over-charging
- p) **small water consumption battery** the battery whose water consumption is less than 4 g/Ah in clause 2 of Annex 1 (informative)  

The capacity used for the calculation of water consumption shall be 20 h rate capacity  $C_{20,n}$  obtained by the conversion formula with the effective reserve capacity  $C_{r,e}$ .
- q) **very small water consumption battery** the battery whose water consumption is less than 1 g/Ah in clause 2 of Annex 1 (informative)  

The capacity used for the calculation of water consumption shall be 20 h rate capacity  $C_{20,n}$  obtained by the conversion formula with the effective reserve capacity  $C_{r,e}$ .
- r) **charge retention** the cranking performance of the charged battery filled with electrolyte after conserved in open circuit under the specified condition of temperature and time
- s) **dry charged battery** the battery which is immediately activated and capable of being used by filling proper electrolyte, and satisfies the requirements in clause 4 of Annex 1 (informative)
- t) **vibration resistance** the battery ability to hold the working condition under the periodic or irregular accelerating force
- u) **electrolyte retention** the battery ability to hold the electrolyte under the specified mechanical condition

**4 Classification** The classifications of batteries shall be as shown table 1 and table 2 and divided into Class A which is mainly for passenger vehicles, light commercial vehicles and similar applications, and Class B which is mainly for trucks, buses, taxis, industrial vehicles, machinery used for public works and similar applications. Major dimensions shall be as shown in figure 1.



**Figure 1 Shape of battery**

**Table 1 Classification of battery (type and performance)**

Class	Type	External dimension mm (figure 1)				Capacity		Cranking performance				Endurance		Charge acceptance A (test 2)	Arrangement of terminals applicable figure	Division of terminal	(Informative) Mass (including electrolyte) Approx. kg
		Overall height (max.)	Container height	Width	Length	Nominal reserve capacity (RC) min.	5 h rate (5 HR) Ah	Nominal cold cranking ampere (CCA) A	Discharging current A	High rate discharge characteristics (-15 °C)	Duration min	Voltage after 5 s V	Voltage after 30 s V				
A	26B17L	227	203 <sup>0</sup> <sub>-5</sub>	127 <sup>0</sup> <sub>-4</sub>	167 <sup>0</sup> <sub>-4</sub>	29	21	185	150	1.8	8.4	—	800	—	Figure 2 or figure 3	T <sub>1</sub> or T <sub>2</sub>	7.5
	28B17L					32	24			2.3	9.0		900				8.0
	34B17L	187 <sup>0</sup> <sub>-4</sub>	129 <sup>0</sup> <sub>-4</sub>	197 <sup>0</sup> <sub>-4</sub>	38	27	240	300	3.0	9.2	1.000	3.3	3.3	Figure 2 or figure 3	T <sub>1</sub> or T <sub>2</sub>	8.5	
	34B19L				43	28			3.0	9.5	1.100					9.5	
	38B19L	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	51	34	300	300	3.5	9.5	1.200	5.0	3.3	Figure 2 or figure 3	T <sub>1</sub> or T <sub>2</sub>	10.0
	38B20L					56	36			4.0	—	1.300					3.5
	44B20L	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	64	40	370	300	4.2	8.6	1.400	6.0	4.0	Figure 2 or figure 3	T <sub>1</sub> or T <sub>2</sub>	11.5
	46B24L					63	40			2.0	8.6	1.500					4.5
	55B24L	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	90	52	450	300	2.9	8.9	1.800	8.0	3.3	Figure 2 or figure 3	T <sub>1</sub> or T <sub>2</sub>	13.5
	50D20L					74	48			1.9	8.0	2.200					5.0
55D23L	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	95	52	465	300	3.5	9.2	3.100	6.0	3.5	Figure 2 or figure 3	T <sub>1</sub> or T <sub>2</sub>	15.5	
65D23L					98	52			2.5	8.5	3.400					6.5	16.5
75D23L	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	103	55	490	300	4.3	9.1	3.800	8.0	3.3	Figure 2 or figure 3	T <sub>1</sub> or T <sub>2</sub>	17.0	
75D26L					125	64			3.5	8.9	3.800					8.0	18.0
80D26L	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	132	64	565	300	4.4	9.1	4.700	8.0	3.3	Figure 2 or figure 3	T <sub>1</sub> or T <sub>2</sub>	19.0	
95D31L					170	88			4.3	9.3	4.700					8.0	21.5
105D31L	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	195	92	655	300	2.6	8.3	5.000	11.0	4.85	Figure 4	T <sub>1</sub> or T <sub>2</sub>	22.5	
115E41L					234	213 <sup>0</sup> <sub>-7</sub>			176 <sup>0</sup> <sub>-5</sub>	410 <sup>0</sup> <sub>-5</sub>	170					88	610
130E41L	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	225	112	735	300	3.0	8.8	600	14.0	600	Figure 4	T <sub>1</sub> or T <sub>2</sub>	30.0	
115F51					257	182 <sup>0</sup> <sub>-5</sub>			182 <sup>0</sup> <sub>-5</sub>	505 <sup>0</sup> <sub>-5</sub>	195					92	680
145F51	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	240	120	685	300	3.4	8.8	785	15.0	785	Figure 4	T <sub>1</sub> or T <sub>2</sub>	36.0	
145G51					270	222 <sup>0</sup> <sub>-5</sub>			222 <sup>0</sup> <sub>-5</sub>	508 <sup>0</sup> <sub>-5</sub>	300					136	710
165G51	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	320	140	930	300	4.8	9.5	700	20.0	785	Figure 4	T <sub>1</sub> or T <sub>2</sub>	47.0	
195G51					370	160			5.4	9.0	785					20.0	785
190H52	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	380	176	1.170	300	6.0	9.3	800	22.0	800	Figure 4	T <sub>1</sub> or T <sub>2</sub>	62.0	
210H52					405	176			7.8	9.9	800					22.0	800
245H52	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	202 <sup>0</sup>	405	176	1.170	300	7.8	9.9	800	22.0	800	Figure 4	T <sub>1</sub> or T <sub>2</sub>	70.0	
245H52					405	176			7.8	9.9	800					22.0	800



**Table 2 Classification of battery to be withdrawn in future (type and performance)**

Class	Type	External dimension mm (figure 1)			Capacity		Cranking performance			Endurance		Charge acceptance A (test 2)	Arrangement of terminals applicable figure	Division of terminal	(Informative) Mass (including electrolyte) Approx. kg	
		Overall height (max.)	Container height	Width	Length	Nominal reserve capacity (RC) min	5 h rate (5 HR) Ah	Nominal cranking ampere (CCA) A	Discharging current A	High rate discharge characteristics (-15 °C)	Light load endurance runs (Class A)					Heavy load endurance runs (Class B)
								Durability min	Voltage after 5 s V	Voltage after 30 s V						
A	28B19L	227	203 <sup>0</sup> <sub>-5</sub>	127 <sup>0</sup> <sub>-4</sub>	187 <sup>0</sup> <sub>-4</sub>	32	24	2.3	8.9	—	1 000	—	Figure 2	T <sub>1</sub>	9.0	
	36B20L			129 <sup>0</sup> <sub>-4</sub>	197 <sup>0</sup> <sub>-4</sub>	39	28	3.5	9.2	—	1 300	—	or figure 3	or T <sub>2</sub>	10.5	
	50B24L				238 <sup>0</sup> <sub>-4</sub>	60	36	4.2	9.7	—	1 500	—			12.5	
A or B	32C24L	232	207 <sup>0</sup> <sub>-5</sub>	135 <sup>0</sup> <sub>-4</sub>		40	32	3.0	8.6	—	1 600	—		T <sub>2</sub>	11.5	
	70D23L	225	204 <sup>0</sup> <sub>-6</sub>	173 <sup>0</sup> <sub>-5</sub>	232 <sup>0</sup> <sub>-4</sub>	92	52	2.7	8.8	—	3 400	320			17.0	
	48D26L				260 <sup>0</sup> <sub>-4</sub>	72	40	4.0	9.0	—	2 500	285			15.5	
	55D26L					82	48	1.9	7.8	—	3 100	315			16.5	
	65D26L					89	52	2.5	8.4	8.3	3 400	330			17.0	
	65D31L				306 <sup>0</sup> <sub>-5</sub>	97	56	2.8	—	8.2	4 100	345			19.5	
	75D31L					116	60	3.3	—	8.7	4 400	375			20.5	
	95E41L	234	213 <sup>0</sup> <sub>-7</sub>	176 <sup>0</sup> <sub>-5</sub>	410 <sup>0</sup> <sub>-5</sub>	150	80	4.0	4.0	8.8	—	415	415			25.5
	105E41L					160	83	4.5	4.5	9.1	—	430	430			26.5
	B	150F51	257		182 <sup>0</sup> <sub>-5</sub>	505 <sup>0</sup> <sub>-5</sub>	230	108	3.3	3.3	9.0	600	600	Figure 4		36.0
170F51						245	120	4.4	4.4	9.4	700	700			40.0	
180G51				222 <sup>0</sup> <sub>-5</sub>	508 <sup>0</sup> <sub>-5</sub>	295	128	4.8	4.8	—	—	—			45.0	

NOTES 1 The meaning of numeral and symbol used for the type is as follows.

First numeral: performance ranking

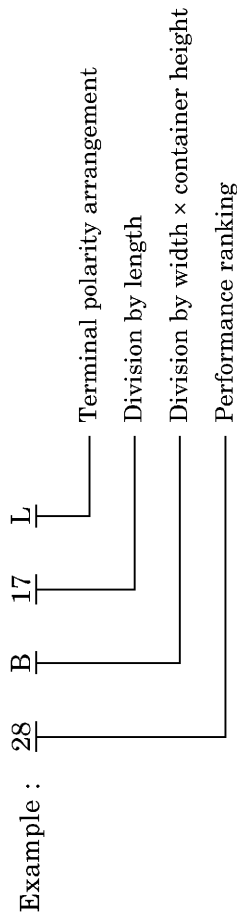
Performance ranking shall be obtained by the formula shown below.

$$\text{Performance ranking} = (CCA \times RC)^{1/2} / 2.8$$

Symbol next to numeral: Division of B to H by width × container height of battery

Numeral next to symbol: Approximate numeral of battery length in cm

Symbol at end: Division by the terminal polarity arrangement



2 Those of which “width × container height classification” is B to E have two types of terminal polarity arrangement. When the symbol at end is L, the arrangement shall be as shown in figure 2.

In the reverse case, L is changed with R and the arrangement is as shown in figure 3. Those of R in the symbol at end are to be withdrawn in the future.

3 Those with no symbol at end and the division of width × container height is F to H shall be as shown in figure 4.

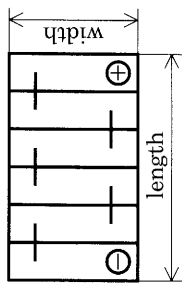
4 All performance values are those at an electrolyte density of 1.280 g/cm<sup>3</sup> (20 °C).

5 Terminal arrangement symbols T<sub>1</sub> and T<sub>2</sub> shall be as shown in table 4.

The type in which the terminal division is indicated shall be as follows.

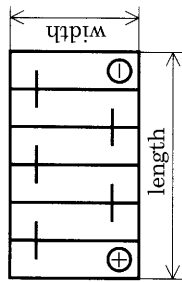
When using T<sub>2</sub> of types expressed as T<sub>1</sub> or T<sub>2</sub>, they shall be identified by adding “(S)” at end.

Example: 28B17L(S)



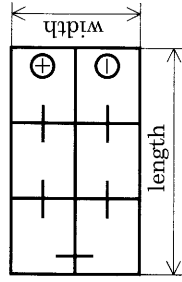
Note: ⊕ is the position of positive terminal.  
⊖ is the position of negative terminal.

**Figure 2 Battery of L in the symbol at end**



Note: ⊕ is the position of positive terminal.  
⊖ is the position of negative terminal.

**Figure 3 Battery of R in the symbol at end**



Note: ⊕ is the position of positive terminal.  
⊖ is the position of negative terminal.

**Figure 4 Battery with no symbol at end**

**5 Condition on delivery** Batteries can be delivered under either of the following conditions.

- a) The state of ready for use, filled with the appropriate electrolyte to the maximum level. After an initial charge [according to **9.4.2 a)**, **b)** and **c)**], the electrolyte density shall be as follows (unless otherwise the density recommended by the manufacturer).
- b) The dry charged state not filled with electrolyte. The electrolyte density to be filled to the battery before use shall be as follows (unless otherwise the density recommended by the manufacturer).
  - The electrolyte density shall be usually  $1.280 \text{ g/cm}^3 \pm 0.010 \text{ g/cm}^3$  at  $20 \text{ }^\circ\text{C}$  at full charge.
  - The temperature conversion shall be as follows.

$$D_{20} = D_t + 0.0007 (t - 20)$$

where,  $D_{20}$  : electrolyte density at  $20 \text{ }^\circ\text{C}$  ( $\text{g/cm}^3$ )

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

$t$  : electrolyte temperature at the measurement of density ( $^\circ\text{C}$ )

**6 Performance** The performance shall be as shown in table 3 when tested in accordance with **9.5**.

**Table 3 Performance**

Item	Performance	Applicable subclause for test methods
Dimensions	Shall satisfy the following dimensions.	<b>9.5.1</b>
External dimensions	Within the range shown in table 1 and table 2.	
Terminal dimensions	Within the range shown in table 5.	
Capacity	Shall satisfy either of the following.	<b>9.5.2</b>
RC	$C_{r,e}$ shall be not less than the value shown in table 1 and table 2.	
5 h rate	$C_5$ shall be not less than 95 % of the value shown in table 1 and table 2.	
Cranking performance	Shall satisfy either of the following.	<b>9.5.3</b>
CCA	Discharged with the current shown in table 1 and table 2 and the voltage after 30 s shall be not less than 7.2 V.	
High rate discharge characteristics	The voltage after duration, 5 s and 30 s shall be not less than the value shown in table 1 and table 2.	
Charge acceptance	Shall satisfy either of the following.	<b>9.5.4</b>
Test 1	Charge acceptance rate $i_{ca1}$ is not less than 2.	
Test 2	Charging current $I_{ca2}$ after 10 min is not less than the value shown in table 1 and table 2.	

**Table 3** (concluded)

Item	Performance	Applicable subclause for test methods
Endurance	Shall satisfy either of the following.	<b>9.5.5</b>
Light load endurance (Class A)	The number of runs until the endurance shall be not less than 80 % of the value shown in table 1 and table 2.	
Heavy load endurance (Class B)	The number of runs until the endurance shall be not less than 95 % of the value shown in table 1 and table 2. However, the duration of battery without glass mats shall be not less than 80 % of the value shown in table 1 and table 2.	
Vibration resistance	There shall be no abnormal voltage drop due to internal short circuit, falling of plate, break of cell post, and so on, and be free from cracking or fissure of container or excessive overflow of electrolyte.	<b>9.5.6</b>
Strength of terminals	There shall be no twist off of the terminal, loosening in fitting of the terminal and cover or damage in the cover.	<b>9.5.7</b>
Robustness to fastening	There shall be no deformation or the like detrimental to service on battery.	<b>9.5.8</b>

## 7 Structure

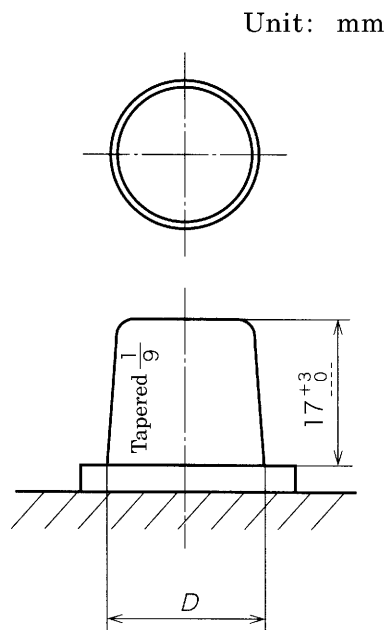
**7.1 Structure general** A battery is composed of a container, a cover, a positive plate, a negative plate, electrolyte and so on. The container and the cover are sealed by welding or adhesion with sealing material, unit cells are connected and one positive terminal and one negative terminal respectively are equipped. The maximum level indicator shall be provided for the one capable of water filling.

**7.2 Terminal** Terminals shall be made of lead alloy as divided in table 4.

$T_1$  and  $T_2$  shall be the tapered terminals and the shapes and dimensions are as shown in figure 5 and table 5.

**Table 4 Division of terminal**

Division		Symbol
Tapered terminal	Thin type	$T_1$
	Thick type	$T_2$



**Figure 5 Tapered terminal  $T_1$ ,  $T_2$**

**Table 5 D dimension of terminals  $T_1$ ,  $T_2$**

Unit: mm

Classification of terminals	D dimension	
	Positive terminal	Negative terminal
$T_1$	$14.7 \begin{smallmatrix} 0 \\ -0.3 \end{smallmatrix}$	$13.0 \begin{smallmatrix} 0 \\ -0.3 \end{smallmatrix}$
$T_2$	$19.5 \begin{smallmatrix} 0 \\ -0.3 \end{smallmatrix}$	$17.9 \begin{smallmatrix} 0 \\ -0.3 \end{smallmatrix}$

**7.3 Vent plug** When the screwed-type vent plug is used, nominal dimensions of the screw are 18 mm, 22 mm and 30 mm and usually the pitch shall be 2.5 mm.

**8 External dimensions** The external dimensions are as shown in table 1 and table 2.

## 9 Tests

**9.1 Sampling of battery for testing** All tests shall be carried out on the specimen of the new battery. The specimen shall be considered as new when

- a) within 30 days after the manufacturer shipping date for the charged battery filled with electrolyte;
- b) within 60 days after the manufacturer shipping date for the dry charged battery.

**9.2 Testing states** The testing states shall be 15 °C to 35 °C in temperature and 25 % to 75 % in relative humidity as specified in **JIS C 60068-1** unless otherwise specified. The electrolyte temperature while charging shall be keep at 15 °C to 45 °C.

**9.3 Activation of dry charged battery** The dry charged battery shall be filled with the appropriate electrolyte to the maximum level indicated by internal or external marks of the battery or in accordance with the manufacturer's instructions.

#### 9.4 Testing conditions

**9.4.1 Instruments** The instruments shall be as follows unless otherwise specified.

- a) **Temperature measurement** The thermometer shall be of the one with tolerance of  $\pm 1$  °C specified in **JIS B 7411** or the one with the same or better accuracy.
- b) **Length measurement** The length meter shall be callipers specified in **JIS B 7507** or the measuring apparatus with the same or better accuracy.
- c) **Density measurement** The hydrometer shall be the hydrometer with tolerances of  $\pm 0.005$  g/cm<sup>3</sup> specified in **JIS B 7525** or the one with the same or better accuracy.
- d) **Voltmeter and ammeter** The voltmeter and ammeter shall be the instruments having accuracy of Grade 1 or better specified in **JIS C 1102-2** or the one with the same or better accuracy.
- e) **Time measurement** The timer shall be graduated in hours, minutes, seconds or in hours and centihours (= 1/100 h), and they shall have an accuracy of at least  $\pm 1$  %.

**9.4.2 Charging** Charging shall be performed in either of the following methods. The condition of completed charging is called as the full charge. All tests shall be performed in full charge condition, and the height of electrolyte shall be the maximum level.

- a) **Constant current charging method 1** The battery is charged with 5 h rate current  $I_5$  until the terminal voltage or the electrolyte density converted to temperature shows a constant value three times consecutively on every 15 min measurement.
- b) **Constant current charging method 2** The battery is charged with current  $2 I_{20}$  that is twice 20 h rate current  $I_{20}$  until the terminal voltage or the electrolyte density converted to temperature shows a constant value three times consecutively on every 15 min measurement.

$I_{20}$  shall be calculated from nominal reserve capacity  $C_{r,n}$  by the following conversion formula.

$$\text{Conversion formula: } I_{20} = 1.2429 C_{r,n}^{0.8455/20}$$

where,  $I_{20}$  : 20 h rate current (A)

$C_{r,n}$  : nominal reserve capacity (min)

The value,  $I_{20}$ , obtained from the conversion formula is shown in table 6.

**Table 6**  $I_{20}$  current for each battery type

Unit: A

Type	$I_{20}$	Type	$I_{20}$	Type	$I_{20}$	Type	$I_{20}$	Type	$I_{20}$
26B17	1.1	50D20	2.1	130E41	5.4	28B19	1.2	75D31	3.5
28B17	1.2	55D23	2.4	115F51	5.0	36B20	1.4	95E41	4.3
34B17	1.3	65D23	2.8	145F51	6.1	50B24	2.0	105E41	4.5
34B19	1.3	75D23	2.9	145G51	6.4	32C24	1.4	150F51	6.2
38B19	1.5	75D26	3.0	165G51	7.7	70D23	2.8	170F51	6.5
38B20	1.5	80D26	3.1	195G51	8.2	48D26	2.3	180G51	7.6
44B20	1.7	95D31	3.7	190H52	9.2	55D26	2.6		
46B24	1.9	105D31	3.9	210H52	9.4	65D26	2.8		
55B24	2.1	115E41	4.8	245H52	10.0	65D31	3.0		

- c) **Constant voltage—constant current charging method** After charging with constant voltage 14.8 V and with the current  $5 I_{20}$  that is fivefold  $I_{20}$  as the limit current for 18 h, charging shall be kept with current  $I_{20}$  for 6 h.

## 9.5 Testing methods

**9.5.1 Dimensions** The external dimensions (overall height, container height, width and length) shown in table 1 and table 2, and the maximum point of terminal dimensions shown in figure 4 and table 5 shall be measured with the calliper specified in **JIS B 7507** or measuring apparatus having the same or better accuracy.

**9.5.2 Capacity test** The capacity test shall be performed in either of the following methods. However, when the capacity does not reach the performance specified in table 3, the test may be carried out further two times, namely three times in total.

It is preferable to perform the reserve capacity test preferentially, because 5 h rate capacity test is planned to be withdrawn in the future.

### a) Reserve capacity (RC) test $C_{r,e}$

- 1) Throughout the test, the battery shall be placed in a water bath at  $25\text{ °C} \pm 2\text{ °C}$ . The water surface shall be 15 mm to 25 mm below the upper surface of the battery. 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.
- 2) After the completion of charging according to **9.4.2** and between 1 h to 5 h lapse, confirm that the temperature of the electrolyte of either cell in the centre position is  $25\text{ °C} \pm 2\text{ °C}$ . Then the battery shall be discharged with current of  $25\text{ A} \pm 1\%$  until the terminal voltage falls to  $10.50\text{ V} \pm 0.05\text{ V}$ . The duration  $t$  (min) of discharging shall be recorded.
- 3) Record the electrolyte temperature  $T\text{ °C}$  at the end of discharging, and calculate the effective reserve capacity  $C_{r,e}$  by the following formula.

$$C_{r,e} = t [1 - 0.009 (T - 25)] \text{ (min)}$$

where,  $C_{r,e}$ : effective reserve capacity (min)



$t$  : duration of discharging (min)

$T$  : electrolyte temperature (°C)

b) **5 h rate capacity test  $C_{5,e}$**

- 1) Throughout the test, the battery shall be placed in a water bath at  $25\text{ °C} \pm 2\text{ °C}$ . The water surface shall be 15 mm to 25 mm below the upper surface of the battery. 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.
- 2) After the completion of charging according to **9.4.2** and approximately 1 h lapse, confirm that the temperature of the electrolyte of either cell in the centre position is  $25\text{ °C} \pm 2\text{ °C}$ . Then the battery shall be discharged with current of 5 h rate current  $I_5$  until the terminal voltage falls to  $10.50\text{ V} \pm 0.05\text{ V}$ . The duration  $t$  (h) of discharging shall be recorded.
- 3) Calculate the 5 h rate capacity  $C_{5,e}$  by the following formula.

$$C_{5,e} = I_5 \times t \text{ (Ah)}$$

where,  $C_{5,e}$  : 5 h rate capacity (Ah)

$I_5$  : 5 h rate current (A)

$t$  : duration of discharging (h)

**9.5.3 Cranking performance test** The cranking performance test shall be performed in either of the following methods. However, when the performance does not reach the one specified in table 3, the test may be carried out further two times, namely three times in total.

It is preferable to perform the cold cranking ampere test preferentially, because the high rate discharge characteristics test is planned to be withdrawn in the future.

a) **Cold cranking ampere (CCA) test**

- 1) After the completion of charging according to **9.4.2** and approximately between 1 h to 5 h lapse, the battery shall be placed in a cooling chamber at a temperature of  $-18\text{ °C} \pm 1\text{ °C}$  for a minimum of 24 h or until the temperature of the electrolyte of either cell in the centre position has reached  $-18\text{ °C} \pm 1\text{ °C}$ .
- 2) The battery shall then be discharged within 2 min after the cooling with nominal cold cranking current  $I_{cc}$  for 30 s as shown in table 1 and table 2. This discharging current shall be kept constant to within  $I_{cc} \pm 0.5\%$  while discharging.
- 3) The terminal voltage after 30 s from the start of discharging shall be recorded.

Information : The following subsidiary test may be performed for reference.

- The voltage after 10 s is also recorded in the cold cranking ampere test.
- The voltage after 10 s is 7.5 V or over.

- After the cold cranking ampere test, the battery is left for  $20 \text{ s} \pm 1 \text{ s}$ .
- The duration  $t$  (s) of discharging is recorded when the battery is discharged with the discharge current of  $0.6 I_{cc}$  until the voltage falls to 6 V. This discharging current shall be kept constant to within  $0.6 I_{cc} \pm 0.5 \%$  while discharging.
- The duration  $t$  (s) of discharging is 40 s or over, and the total duration  $t$  (s) of discharging is 90 s ( $30/0.6 \text{ s} + 40 \text{ s}$ ) or over.

b) **High rate discharge characteristics test ( $-15 \text{ }^\circ\text{C}$ )**

- 1) After the completion of charging according to **9.4.2**, the battery shall be placed in a cooling chamber at a temperature of  $-15 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$  at least for 16 h.
- 2) After confirming that the temperature of the electrolyte of either cell in the centre position is  $-15 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$ , the battery shall be discharged with current as shown in table 1 and table 2 until the terminal voltage falls to 6 V.
- 3) The terminal voltage after 5 s or 30 s and the duration  $t$  (min) of discharging until the terminal voltage falls to 6 V shall be recorded.

**9.5.4 Charge acceptance test** For the charge acceptance test, the charge acceptance test 1 shall be performed when “reserve capacity test” is chosen in **9.5.2**, and the charge acceptance test 2 when “5 h rate capacity test” is chosen.

a) **Charge acceptance test 1**

- 1) After confirming the temperature of battery electrolyte is  $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ , the battery shall be discharged with the discharge current  $I$  which is obtained by the following formula for 5 h.

For  $C_{r,e}$ , use the value measured in **9.5.2**.

$$I = 1.2429 C_{r,e}^{0.8455} / 10 \text{ (A)}$$

where,  $I$ : discharging current (A)

$C_{r,e}$ : effective reserve capacity (min)

- 2) Immediately after discharging, the battery shall be moved to the cooling chamber at a temperature of  $0 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$ , and placed until the temperature of either cell in the centre position has reached  $0 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$ .
- 3) After cooling, the battery shall be charged with the constant voltage of  $14.4 \text{ V} \pm 0.1 \text{ V}$  at the same temperature, and the charging current  $I_{ca1}$  shall be recorded after 10 min from the start of charging.
- 4) Charge acceptance shall be specified with the charge acceptance ratio  $i_{ca1}$  and obtained by the following formula.

$$i_{ca1} = 20 I_{ca1} / 1.2429 C_{r,e}^{0.8455}$$

where,  $i_{ca1}$ : charge acceptance ratio

$I_{ca1}$  : charging current after 10 min from the start of charging (A)

$C_{r,e}$  : effective reserve capacity (min)

b) **Charging acceptance test 2**

- 1) After confirming that the temperature of either cell in the centre position is  $25\text{ °C} \pm 2\text{ °C}$ , the battery shall be discharged with 5 h rate current  $I_5$  for 2.5 h.
- 2) Immediately after discharging, the battery shall be moved to the cooling chamber at a temperature of  $0\text{ °C} \pm 1\text{ °C}$ , and placed until the temperature of either cell in the centre position has reached  $0\text{ °C} \pm 1\text{ °C}$ .
- 3) After confirming the temperature of battery electrolyte is  $0\text{ °C} \pm 2\text{ °C}$ , the battery shall be charged with the constant voltage of  $14.4\text{ V} \pm 0.1\text{ V}$  at the same temperature, and the charging current  $I_{ca2}$  shall be recorded after 10 min from the start of charging.

**9.5.5 Endurance test** The endurance test shall be performed in either of the following methods according to the class.

a) **Light load endurance test** Applied for the Class A battery and shall be performed by the following method using the nominal cold cranking current  $I_{cc}$  as shown in table 1 and table 2.

- 1) Throughout the test, the battery shall be placed in a water bath at  $41\text{ °C} \pm 3\text{ °C}$ . The water surface shall be 15 mm to 25 mm below the upper surface of the battery. 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.
- 2) Connect the battery to the endurance test equipment and repeat the discharging and charging cycles as follows successively. This discharging and charging cycle comprises one turn until the endurance.

**Discharging:** discharging current  $25.0\text{ A} \pm 0.1\text{ A}$  for  $240\text{ s} \pm 1\text{ s}$

**Charging:** charging voltage  $14.80\text{ V} \pm 0.03\text{ V}$  (limit current  $25.0\text{ A} \pm 0.1\text{ A}$ ) for  $600\text{ s} \pm 1\text{ s}$

- 3) During the test, the battery is left for 56 h at every 480 cycles, and after that, it is discharged successively with the nominal cold cranking current  $I_{cc}$  for 30 s, and the voltage after 30 s shall be recorded. Then the charging of 2) shall be performed.

This discharging and charging cycle shall be counted as the number of runs until the endurance.

- 4) The end of test shall be the timing when the voltage after 30 s in the test of 3) becomes 7.2 V or under and is confirmed that the voltage does not increase again.
- 5) The number of runs until the endurance is defined as the number of runs in which the voltage after 30 s in the test of 3) becomes 7.2 V. This number of runs until the endurance is obtained by the relation curve between the number of runs and the voltage after 30 s.

- 6) Water filling shall be done appropriately with purified water, however, shall not be done immediately before the tests of **3**).
- b) **Heavy load endurance test** Applied for the Class B battery and shall be performed by the following method using 5 h rate capacity  $C_5$  as shown in table 1 and table 2.
- 1) Throughout the test, the battery shall be placed in a water bath at  $41 \text{ }^\circ\text{C} \pm 3 \text{ }^\circ\text{C}$ . The water surface shall be 15 mm to 25 mm below the upper surface of the battery. 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.
  - 2) Connect the battery to the endurance test equipment and repeat the discharging and charging cycles as follows successively. This discharging and charging cycle comprises one turn until the endurance.

**Discharging:** discharging current as shown in table 7 for 1 h

**Charging:** charging current as shown in table 7 for 5 h

**Table 7 Discharging current and charging current**

Unit: A

Battery capacity (5 h rate)	48 Ah or over up to and incl. 72 Ah	Over 72 Ah up to and incl. 176 Ah
Discharging current	20	40
Charging current	5	10

NOTE : When the capacity is expressed by 20 h rate ( $C_{20}$ ), 5 h rate ( $C_5$ ) is obtained by the this formula.  $C_5 = 0.8 C_{20}$

- 3) During the test, the battery is discharged successively at every 25 cycles with the discharging current shown in table 7 until the terminal voltage of battery falls to 10.2 V. The duration of discharging shall be recorded. After this, the battery is charged with the charging current shown in table 7 until the terminal voltage or the electrolyte density (converted to the value at  $20 \text{ }^\circ\text{C}$ ) measured at every 15 min shows a constant value throughout three consecutive measurements.

This discharging and charging cycle shall be counted as the number of runs until the endurance.

- 4) The end of test shall be the timing when the capacity (Ah) obtained by the product of the discharging time and the discharging current measured in the test of **3**) decreases to 50 % or less of the 5 h rate capacity  $C_{5,n}$ , and is confirmed that the capacity does not increase again.
- 5) The number of runs when the capacity decreases to 50 % of 5 h rate capacity shall be taken as the number of runs until the endurance.

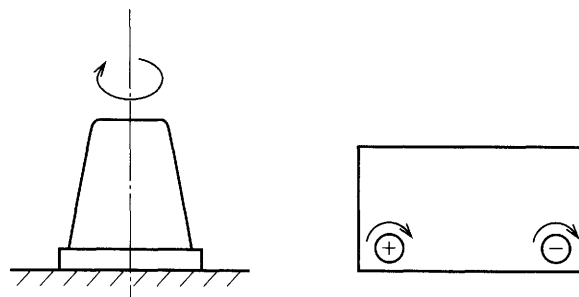
The number of runs until the endurance is obtained by the relation curve between the number of runs and the capacity.

- 6) Water filling shall be done appropriately with purified water, however, shall not be done immediately before the tests of **3**).

**9.5.6 Vibration resistance test** The vibration resistance test shall be carried out under the following conditions and abnormality of the battery shall be examined.

- a) **Discharging current** 5 h rate current  $I_5$ , or the current of  $0.8 C_{20}/5$
- b) **Direction of vibration** vertical simple harmonic motion
- c) **Peak to peak amplitude** 2.3 mm to 2.5 mm
- d) **Acceleration**  $29.4 \text{ m/s}^2$
- e) **Duration of vibration** 2 h

**9.5.7 Terminal strength test** The terminal strength test shall be performed in such a way that appropriate adapters are fitted to positive and negative terminals, a torque is applied to the adapter using a torque wrench in the direction of rotation illustrated in figure 6 while the torque being  $11.8 \text{ N}\cdot\text{m}$  for a thin type tapered terminal  $T_1$ , and  $14.7 \text{ N}\cdot\text{m}$  for a thick terminal  $T_2$ , and the abnormality on the terminal part is examined.



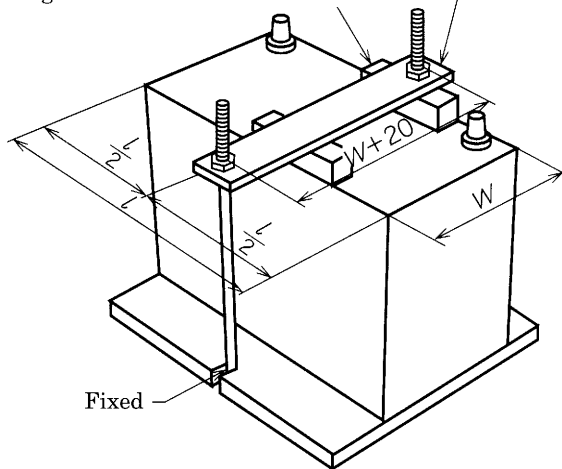
**Figure 6 Rotation direction of torque wrench**

**9.5.8 Fastening robustness test** The fastening robustness test shall be carried out in accordance with the following method and abnormality of the battery shall be examined.

- a) The battery is fastened vertically, diagonally or horizontally as illustrated in figure 7. The fastening conditions shall be as shown in table 8.
- b) The ambient temperature during the test shall be  $60 \text{ }^\circ\text{C}$  to  $65 \text{ }^\circ\text{C}$ .
- c) The test shall be performed for 5 h after fastening, and the states of battery during test period and after test shall be examined.

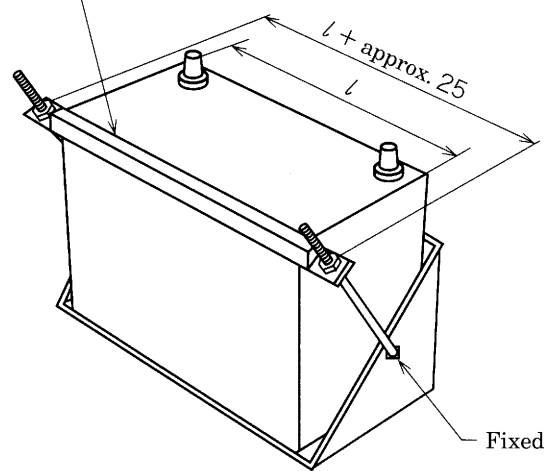
Unit: mm

Length  $(W + \text{approx. } 60) \times \text{width } 30 \times \text{thickness } 5$   
Length  $50 \times \text{width } 15 \times \text{thickness } 15$

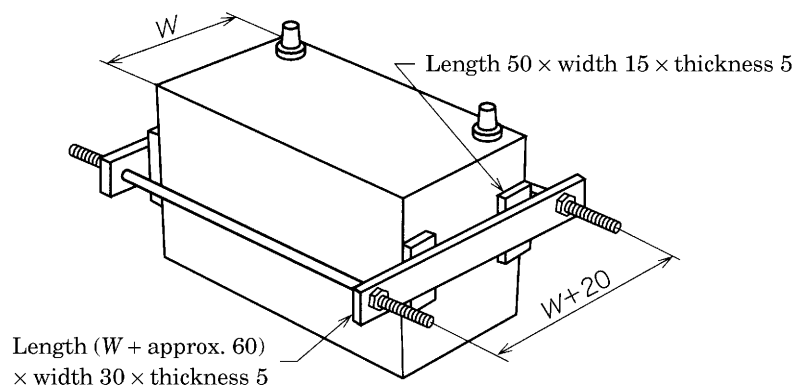


a) Vertical fastening

Stiffening plate of equal leg angle  
Length  $(l + \text{approx. } 60) \times \text{leg } 30 \times \text{thickness } 5$



b) Diagonal fastening



c) Horizontal fastening

**Figure 7 Fastening method**

**Table 8 Fastening condition**

5 h rate capacity as shown in table 1 and table 2 Ah	Fastening method	Fastening load per one bolt N
72 or under	Vertical or horizontal	980
Over 72	Diagonal or horizontal	1 960

NOTE : Fastening is performed at 15 °C to 35 °C.

**9.5.9 Other tests** The charge retention test, water consumption test, electrolyte retention test and cranking performance test for dry charged batteries after activation which are specified in **IEC 60095-1** shall be as shown in Annex 1.

**9.6 Sequence of tests** The sequence of tests shall be as shown in table 9. However, when a battery can not satisfy the specified performance of capacity and cranking performance, the test may be carried out further two times, namely three times in

total. When the performance satisfies the specification, **9.5.4** to **9.5.6** shall be carried out subsequently.

These tests shall be started within one week after the completion of the cranking performance test. The sequence of **9.5.7** and **9.5.8** shall be optional.

**Table 9 Sequence of test**

Test		Battery				
Items	Subclause	1	2	3	4	5
Capacity test	<b>9.5.2</b>	○	○	○	○	○
Cranking performance test	<b>9.5.3</b>	○	○	○	○	○
Charge acceptance test	<b>9.5.4</b>	○				
Endurance test Light load endurance test or Heavy load endurance test	<b>9.5.5</b>		○			
Vibration resistance test	<b>9.5.6</b>			○		

NOTE : Five batteries shall be prepared. Batteries 4 and 5 may be used for any test.

**10 Inspection** The battery shall comply with the provisions of clause **6** and clause **8** when the test is carried out in accordance with clause **9**. When agreed between the parties concerned with delivery, a part of these items may be omitted.

- a) Dimension
- b) Capacity (reserve capacity or 5 h rate)
- c) Cranking performance [cold cranking current or high rate discharge characteristics (-15 °C)]
- d) Charge acceptance (test 1 and test 2)
- e) Endurance (light load endurance or heavy load endurance)
- f) Vibration resistance
- g) Strength of terminals
- h) Robustness to fastening

**11 Designation of product** The product shall be designated by the name and type.

Example : Lead-acid starter battery 28B17L

**12 Marking** The following items shall be marked on a clearly visible place of each battery.

- a) **Marking of rating**
  - 1) Type

2) **Polarity** The polarity shall be marked for at least the positive terminal. For this marking, “+” mark shall be shown on the upper surface of the lid near the positive terminal or on the positive terminal. When showing also the negative polarity, “-” mark shall be shown on the upper surface of the lid near the negative terminal or on the negative terminal.

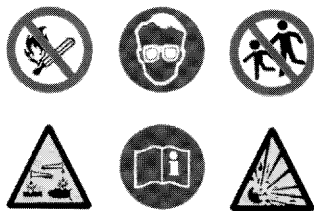
3) **Manufacturer’s name or abbreviation**

4) **Year and month of manufacture, manufacturing date or its abbreviation**

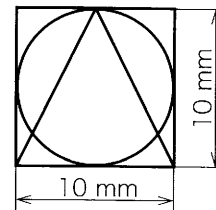
Information : Abbreviation for the manufacturing date shall be as follows.

Example : 21 11 06 (Nov/21/2006)  
(day) (month) (year)

b) **Marking for safety** On batteries, six coloured symbols as shown in figure 8 shall be marked. The symbol size shall be common as shown in figure 9, and the minimum size shall be 10 mm. The meaning of the symbols is preferably expressed close to the symbols.



**Figure 8**



**Figure 9**

- **No smoking, no open fire, no sparking**
- **Protect naked eyes**
- **Keep off children**
- **Electrolyte**
- **Pay attention to instruction manual**
- **Explosive gas**



## Annex 1 (informative)

### General requirements and test methods

**Introduction** The testing methods in this Annex have been deliberated for **IEC** revision next time, however, there are no practical usage in Japan. Therefore, Annex 1 this time of **JIS D 5301** shows the testing methods and requirements as a reference, and is not to constitute the provisions of this Standard. In the next revision of **JIS D 5301**, the contents will be submitted for the next revision of **IEC 60095**.

#### 1 Charge retention test

- a) A battery with its vent plugs firmly in place and a clean, dry surface shall be stored at  $40\text{ °C} \pm 2\text{ °C}$  for the following period in open circuit. No connecting clamps or cables shall be attached to the terminals during storage.

Small water consumption battery ..... 14 days

Very small water consumption battery ..... 49 days

- b) After this storage period the battery, without recharge, shall be placed in a cooling chamber at a temperature of  $-18\text{ °C} \pm 1\text{ °C}$  for a minimum of 20 h or until the temperature of either cell in the centre position has reached  $-18\text{ °C} \pm 1\text{ °C}$ .
- c) The battery shall be discharged within 2 min after the cooling with  $0.6 I_{cc}$  that is 0.6 times the nominal cold cranking current. This discharging current shall be kept constant to within  $0.6 I_{cc} \pm 0.5\%$  while discharging.
- d) The terminal voltage after 30 s from the start of discharging shall be 8.0 V or over.

#### 2 Water consumption test

- a) After the completion of charging according to **9.4.2** of the text, clean and dry the surface of the battery, and weigh the mass of battery ( $W_1$ ) to an accuracy of  $\pm 0.05\%$  or better.
- b) The battery shall be placed in a water bath at  $40\text{ °C} \pm 2\text{ °C}$ . The water surface shall be 15 mm to 25 mm below the upper surface of the battery. 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.
- c) Charge the battery with  $14.40\text{ V} \pm 0.05\text{ V}$  (measured across the battery terminals) for a period of 500 h.
- d) Immediately after this overcharging, clean and dry the surface of the battery, and weigh the battery mass ( $W_2$ ) using the balance the same in **a**).
- e) Water consumption shall be calculated as follows.

$$(W_1 - W_2) / 1.2429 C_{r,e}^{0.8455} \text{ (g/Ah)}$$

- f) The water consumption shall be the value shown below or under.
- |  |        |
|--|--------|
| Small water consumption battery .....      | 4 g/Ah |
| Very small water consumption battery ..... | 1 g/Ah |

### 3 Electrolyte retention test

- a) After the completion of charging according to **9.4.2** of the text, the battery shall be placed in open circuit at a temperature of  $25\text{ °C} \pm 5\text{ °C}$  for 4 h.
- b) If required, the electrolyte level of each cell shall be adjusted to the maximum level with pure water. The surface of battery shall be cleaned and dried.
- c) The battery shall be tilted in back and forth and both sides directions. Each test shown below shall be performed at the interval of not less than 30 s.
- 1) The battery shall be tilted at  $45^\circ$  to the upright in the maximum period of 1 s.
  - 2) The battery shall be maintained in this position for 3 s.
  - 3) The battery shall be back to the upright position in the maximum period of 1 s.
- d) After this test, no evidence of liquid shall visible on the vent plugs.

### 4 Cranking performance test for dry charged battery after activation

- a) The dry charged battery and the electrolyte of which amount is specified by the manufacturer shall be placed at  $25\text{ °C} \pm 5\text{ °C}$  for at least 12 h without filling electrolyte.
- b) The dry charged battery shall be filled with the appropriate electrolyte to the maximum level indicated by internal or external marks of the battery or in accordance with the manufacturer's instructions.
- c) After a rest period of 20 min at the same temperature, the battery shall be discharged with rated cold cranking current  $I_{cc}$  for 30 s.
- d) The terminal voltage after 30 s from the start of discharging shall be 7.2 V or over.

**Annex 2 (informative)**  
**Comparison table between JIS and corresponding International Standards**

<b>JIS D 5301 : 2006</b> <i>Lead-acid starter batteries</i>		<b>IEC 60095-1 : 2000</b> <i>Lead-acid starter batteries—Part 1: General requirements and methods of test</i>		<b>(V)</b> Justification for the technical deviation and future measures
<b>(I)</b> Requirements in <b>JIS</b>		<b>IEC 60095-2 : 1984</b> <i>Lead-acid starter batteries Part 2: Dimensions of batteries and markings</i>		
<b>(II)</b> International Standard numbers		<b>IEC 60095-4 : 1989</b> <i>Lead-acid starter batteries Part 4: Dimensions of batteries for heavy trucks</i>		<b>(IV)</b> Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause Location of deviation: text, Annex Indication method: continuous sidelines or dotted underlines
<b>(III)</b> Requirements in International Standards		Detail of technical deviation		
Clause	Content	Clause	Content	Classification by clause
1 Scope	Lead-acid batteries with a nominal voltage of 12 V used for starting of internal combustion engine, lighting, ignition, etc. of automobiles, etc. are specified.	1.1	Lead-acid batteries with a nominal voltage of 12 V used primarily as a power source for the starting and igniting of internal combustion engines, lighting and for auxiliary equipment of internal combustion engine vehicles are specified.	<b>MOD/</b> alteration
			Lead-acid batteries with a nominal voltage of 12 V used for starting, lighting and ignition of passenger automobiles and light commercial vehicles are specified.	<b>JIS</b> is specified by unifying three <b>IEC</b> Standards.
				Changed for the convenience of the user of this Standard.

(I) Requirements in <b>JIS</b>		(II) International Standard numbers	(III) Requirements in International Standards		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause		(V) Justification for the technical deviation and future measures
Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation		
1 Scope (concluded)		<b>IEC 60095-4</b>	1	Lead-acid batteries used for starting, lighting and igniting of heavy trucks are specified.			
2 Normative references	Five <b>JIS</b> s are referred to. <b>JIS B 7411</b> <b>JIS B 7507</b> <b>JIS B 7525</b> <b>JIS C 1102-2</b> <b>JIS C 60068-1</b>	<b>IEC 60095-1</b>	1.2	Two <b>IEC</b> s are referred to. <b>IEC 60050 (486) : 1991</b> <b>IEC 60095-2 : 1984</b>	MOD/alteration	—	Normative references are changed to those necessary for <b>JIS</b> .
3 Terms and definitions	Definitions of 21 terms are specified.	<b>IEC 60095-1</b>	1.3	The definitions in <b>IEC</b> for terms are referred to.	MOD/alteration	—	Definitions of terms necessary for <b>JIS</b> are explained respectively.
			5	Functional characteristics are explained.			
4 Classification	Divisions by type, performance, dimensions, polarity and applications (Class A and Class B). B to E of "width × container height division" have two terminal polarity symbols, L and R.	<b>IEC 60095-1</b>	2.1	According to the application Class A, Class B and Class C	MOD/deletion	In <b>JIS</b> , Class C is deleted.	Deleted because the specification of Class C is not defined.
			2.2	According to the type Vented battery and valve-regulated battery	MOD/deletion	Valve-regulated lead-acid battery for automobile is deleted.	In Japan, the market size of valve-regulated lead-acid battery for automobile is small, therefore, it is determined that standardization is too early and deleted for this time.

(I) Requirements in <b>JIS</b>		(II) International Standard numbers	(III) Requirements in International Standards		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
4 Classification (concluded)		<b>IEC 60095-1</b>	2.3	Division of electrolyte density by the climate	MOD/deletion	Not divided in <b>JIS</b> .	In Japan, products for subtropics and tropics use are not produced.
		<b>IEC 60095-2</b>	17	Dimensions and terminal polarity for series AS Class A. The terminal polarity is one type and one classification (L or R).	MOD/addition	There are no classification by performance ranking in <b>IEC</b> Standards.	Performance ranking, as well as dimensions, is the important information for users and consumers when selecting, buying the battery, therefore it shall be persisted. In <b>IEC</b> Standards, only terminal polarity L is defined for type B19 to E41, therefore, the terminal polarity R is planned to be withdrawn in future.
		<b>IEC 60095-4</b>	A.2	Dimensions and terminal polarity for series AS Class B.	MOD/deletion	In <b>JIS</b> , batteries for subtropics and tropics use, and valve-regulated batteries are deleted.	In Japan, batteries for subtropics and tropics use are not produced. The valve-regulated batteries are excluded from <b>JIS</b> , therefore it is deleted.
5 Condition on delivery	Delivery conditions for the vent type battery are specified.	<b>IEC 60095-1</b>	3	Delivery conditions for the vent type battery and the valve-regulated type battery are specified.	MOD/deletion	In <b>JIS</b> , batteries for subtropics and tropics use, and valve-regulated batteries are deleted.	In Japan, the design of 20 °C is conventionally adopted, therefore it is changed.
					MOD/alteration	The reference temperature of electrolyte density is specified at 25 °C in <b>IEC</b> , however 20 °C in <b>JIS</b> .	

(I) Requirements in JIS		(II) International Standard numbers	(III) Requirements in International Standards		(IV) Classification and details of technical deviation between JIS and the International Standards by clause	(V) Justification for the technical deviation and future measures
Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation	
5	Condition on delivery (concluded)			MOD/addition	The temperature conversion formula is added.	The temperature at measuring is not always the reference temperature, therefore it is added. It is planned to be added at the next revision of IEC Standard.
6	Performance			MOD/addition		For the conformity assessment, they are necessary for JIS. Testing methods for performance and suitable values are planned to be specified at the next revision of IEC Standard.
7	Structure			MOD/addition		
7.2	Terminal	IEC 60095-2	12 13	The tapered terminal (thick type only) is specified.	In JIS, the thin type terminal is added. The dimensional tolerances on the thick terminal are changed in JIS.	The thin terminal is planned to be added, and the dimensional tolerances on the thick terminal are also planned to be changed at the next revision of IEC Standard.
					<p style="text-align: center;"><b>JIS IEC Standard</b></p> <p>Positive terminal diameter <math>19.5_{-0.3}^0</math> <math>19.5_{-0.2}^0</math></p> <p>Negative terminal diameter <math>17.9_{-0.3}^0</math> <math>17.9_{-0.2}^0</math></p> <p>Height <math>17_{-0}^{+3}</math> <math>17_{-0}^{+1}</math></p>	

(I) Requirements in <b>JIS</b>		(II) International Standard numbers	(III) Requirements in International Standards		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause		(V) Justification for the technical deviation and future measures
Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation		
7.3 Vent plug	The nominal dimension and the pitch of the screw of the screwed-type vent plug are specified.	—	—	MOD/addition	—	Dimensions of parts necessary as <b>JIS</b> are specified.	
8 External dimensions	The external dimensions for each class and type are specified.	<b>IEC 60095-2</b> <b>IEC 60095-4</b>	Main dimensions are specified.	MOD/addition	—	Normative items and their contents necessary as <b>JIS</b> are specified.	
9 Tests							
9.1 Sampling of battery for testing	Conditions of the specimen applied for the test is specified.	<b>IEC 60095-1</b>	Identical with <b>JIS</b> .	IDT	—	—	—
9.2 Testing states	The temperature and the relative humidity of the testing environment are specified.	—	—	MOD/addition	—	Normative items and their contents necessary as <b>JIS</b> are specified.	
9.3 Activation of dry charged battery	Electrolyte filling of dry-charged batteries is specified.	<b>IEC 60095-1</b>	Identical with <b>JIS</b> .	IDT	—	—	—

(I) Requirements in <b>JIS</b>		(II) International Standard numbers	(III) Requirements in International Standards		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
9.4 Testing conditions		<b>IEC 60095-1</b>					
9.4.1 Instruments	Instruments, etc. used for the test are specified.		6.4	Almost identical with <b>JIS</b> .	MOD/addition	Callipers, etc. are added as for the measuring instruments.	Instruments necessary as <b>JIS</b> are added.
9.4.2 Charging	The full charged condition of the battery applied for the test is specified. a) Constant current charging method 1 b) Constant current charging method 2 c) Constant voltage—constant current charging method		6.2	—	—	—	Charging conditions necessary as <b>JIS</b> are specified.
			6.2.1	Constant current charging of vent type battery	MOD/alteration	Charging cut-off condition is changed.	It is planned to be changed to <b>JIS</b> contents at the next revision of <b>IEC</b> Standard by the proposal from Japan.
			6.2.2	Constant voltage charging of vent type battery	MOD/alteration	The charging voltage is 16 V in <b>IEC</b> Standard, however, it is set to 14.8 V in <b>JIS</b> and the end of charging is specified as constant current charging.	It is planned to be added at the next revision of <b>IEC</b> Standard by the proposal from Japan.
			6.2.3	Charging of valve-regulated battery	MOD/deletion	Valve-regulated batteries are deleted.	The valve-regulated batteries are excluded from <b>JIS</b> , therefore it is deleted.



(I) Requirements in <b>JIS</b>		(II) International Standard numbers		(III) Requirements in International Standards		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause		(V) Justification for the technical deviation and future measures	
Clause	Content	Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation		
9.5 Testing methods		<b>IEC 60095-1</b>	Almost identical with <b>JIS</b> .	7		MOD/alteration MOD/deletion			They are specified corresponding to "6 Performance" in <b>JIS</b> . The charge retention test, water consumption test, electrolyte retention test and cranking performance for dry charged batteries after activation which have no practical usage in Japan are deleted.
9.5.1 Dimensions	Measuring methods of external dimensions are specified.	—	—	—	—	MOD/addition	—	—	Normative items and their contents necessary as <b>JIS</b> are specified.
9.5.2 Capacity test	a) Reserve capacity $C_{r,e}$	<b>IEC 60095-1</b>	20 h rate capacity $C_e$	7.1		MOD/deletion	Either $C_e$ or $C_{r,e}$ is selected in <b>IEC</b> Standard. $C_{r,e}$ is selected in <b>JIS</b> .		Considering the conformity with not only <b>IEC</b> Standard but also <b>SAE</b> , $C_{r,e}$ is selected in <b>JIS</b> as the reference capacity.
			Reserve capacity $C_{r,e}$	7.2		IDT			
	$C_{r,e} = t[1 - 0.009(T - 25)]$	—	—	—	—	MOD/addition	Temperature conversion formula is added.	—	It is planned to be added at the next revision of <b>IEC</b> Standard.
	b) 5 h rate capacity $C_{5,e}$	—	—	—	—	MOD/addition	—	—	Normative items and their contents necessary as <b>JIS</b> are specified.

(I) Requirements in JIS		(II) International Standard numbers	(III) Requirements in International Standards		(IV) Classification and details of technical deviation between JIS and the International Standards by clause		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
9.5.3 Cranking performance test	a) Cold cranking amperere (CCA) test Discharged with $I_{cc}$ and the voltage after 30 s is 7.2 V or over.	<b>IEC 60095-1</b>	7.3	Discharged with $I_s$ and the voltage after 60 s is 8.4 V or over.	MOD/alteration	The discharging current, time and voltage are different.	It is planned to be changed to <b>JIS</b> contents at the next revision of <b>IEC</b> Standard by the proposal from Japan.
	b) High rate discharge characteristics test (-15 °C)		—	—	MOD/addition	—	
9.5.4 Charge acceptance test	a) Charge acceptance test 1 Discharging current and necessary value from $C_{r,e}$ value are obtained.	<b>IEC 60095-1</b>	7.4	Discharging current and necessary values from $C_{r,e}$ or $C_e$ value are obtained.	MOD/alteration	Either $C_e$ or $C_{r,e}$ is selected in <b>IEC</b> Standard. $C_{r,e}$ is selected in <b>JIS</b> .	Considering the conformity with not only <b>IEC</b> Standard but also <b>SAE</b> , $C_{r,e}$ is selected in <b>JIS</b> as the reference capacity.
	b) Charge acceptance test 2		—	—	MOD/addition	—	
9.5.5 Endurance test	a) Light load endurance test	—	—	—	MOD/addition	—	It is planned to be added at the next revision of <b>IEC</b> Standard by the proposal from Japan.
	b) Heavy load endurance test		—	—	MOD/addition	—	

(I) Requirements in <b>JIS</b>		(II) International Standard numbers	(III) Requirements in International Standards		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause		(V) Justification for the technical deviation and future measures
Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation		
9.5.6 Vibration resistance test	Discharging current: 5 h rate current Direction of vibration: vertical simple harmonic motion Peak to peak amplitude: 2.3 mm to 2.5 mm Acceleration: 29.4 m/s <sup>2</sup> Duration of vibration: 2 h	<b>IEC 60095-1</b>	7.10	Discharge current: none Direction of vibration: vertical simple harmonic motion Frequency: 30 Hz to 35 Hz Acceleration: 30 m/s <sup>2</sup> (Class A) 50 m/s <sup>2</sup> (Class B) Duration of vibration: 2 h (Class A) 8 h (Class B)	MOD/alteration	Testing conditions are different. Especially normative values of <b>IEC</b> Standard of Class B applied for trucks are strict.	Presently, <b>IEC</b> Standard for vibration endurance test is under review. After settled, it will be adopted into <b>JIS</b> .
9.5.7 Terminal strength test	A certain torque is applied to the terminal.	—	—	—	MOD/addition	—	Normative items and their contents necessary as <b>JIS</b> are specified.
9.5.8 Fastening robustness test	The fastening robustness test is carried out in accordance with the actual loading method to automobiles.	—	—	—	MOD/addition	—	Normative items and their contents necessary as <b>JIS</b> are specified.

(I) Requirements in <b>JIS</b>	(II) International Standard numbers		(III) Requirements in International Standards		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause Location of deviation: text, Annex Indication method: continuous sidelines or dotted underlines	(V) Justification for the technical deviation and future measures	
	Clause	Content	Clause	Content			Classification by clause
9.5.9 Other tests	The charge retention test, water consumption test, electrolyte retention test and cranking performance for dry charged batteries after activation are specified in Annex 1.	<b>IEC 60095-1</b>	7.5 7.9 7.11 7.12	The charge retention test, water consumption test, electrolyte retention test and cranking performance for dry charged batteries after activation are specified in the text.	MOD/ deletion	Specifications of <b>IEC</b> Standard are deleted, however described as reference.	Testing methods which have no practical usage in Japan are not specified in this Standard, however described in Annex 1 (informative).
9.6 Sequence of tests		<b>IEC 60095-1</b>	6.5.1	Almost identical with <b>JIS</b> .	MOD/ alteration	In <b>IEC</b> Standard, it is necessary to perform the capacity and cranking performance test for three times, however, in <b>JIS</b> it is possible to perform at most three times.	The contents of <b>IEC</b> Standard is planned to be revised to the same specification of <b>JIS</b> at the next revision.
						The charge retention test, water consumption test, electrolyte retention test and cranking performance for dry charged batteries after activation which have no practical usage in Japan are deleted because they are not specified in this time revision. In the case where the test methods are specified in future, the test sequence is also specified.	

(I) Requirements in <b>JIS</b>		(II) International Standard numbers	(III) Requirements in International Standards		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause		(V) Justification for the technical deviation and future measures
Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation		
10 Inspection	Testing methods for each performance item and suitable values are specified.	—	—	MOD/ addition	—	Specification items and contents necessary for <b>JIS</b> are added. Testing methods for each performance item and suitable values are planned to be specified at the next revision of <b>IEC</b> Standard.	
11 Designation of product	Designation by the name and type are specified.	—	—	MOD/ addition	—	Normative items and their contents necessary as <b>JIS</b> are specified.	
12 Marking	a) Marking of rating 1) Type	<b>IEC 60095-1</b>	4.1.1 4.1.2 4.1.4	Class of battery Nominal voltage Nominal cranking current	MOD/ alteration	—	Changed to the expression of type necessary as <b>JIS</b> . The contents including the expression of type of <b>JIS</b> will be added at the next revision of <b>IEC</b> Standard.
	2) Polarity		4.2	Almost identical with <b>JIS</b> .	IDT	—	—
	3) Manufacturer's name or abbreviation 4) Year and month of manufacture, manufacturing date, or its abbreviation	—	—	MOD/ addition	—	Normative items and their contents necessary as <b>JIS</b> are specified.	

(I) Requirements in <b>JIS</b>		(II) International Standard numbers	(III) Requirements in International Standards		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standards by clause		(V) Justification for the technical deviation and future measures
Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation		
12 Marking (concluded)	b) Marking for safety The size of markings are specified in six symbols.	<b>IEC 60095-1</b>	4.1.5 Identical with <b>JIS</b> . According to Annex B.	MOD/alteration	Annex B of <b>IEC</b> Standard is specified in the text.	The indication of the symbol meaning close to it improves the convenience for the user.	
			4.1.6 Indication of valve-regulated battery	MOD/deletion	Deleted in <b>JIS</b> .	Deleted because the valve-regulated battery is excluded from <b>JIS</b> .	
			4.3 Additional designation	MOD/deletion	Deleted in <b>JIS</b> .	<b>4.3</b> of <b>IEC</b> Standard is not normative items, therefore deleted.	
			4.4 Fastening of the battery	MOD/deletion	Deleted in <b>JIS</b> .	Deleted because the contents do not fit to <b>JIS</b> .	
Annex 1		<b>IEC 60095-1</b>	7.5 7.9 7.11 7.12 The charge retention test, water consumption test, electrolyte retention test and cranking performance for dry charged batteries after activation are specified in the text.	MOD/deletion	In <b>JIS</b> , storage period, discharging current after storage, terminal voltage, etc. are altered and referred.	The contents of <b>IEC</b> Standard will be revised to the same specification of <b>JIS</b> at the next revision. The contents will be specified in the text at the next revision of <b>JIS</b> .	

Designated degree of correspondence between **JIS** and International Standards : MOD

NOTES 1 Symbols in sub-columns of classification by clause in the comparison table indicate as follows:

- IDT: Identical in technical contents.
  - MOD/deletion: Deletes specification item(s) or content(s) in International Standard.
  - MOD/addition: Adds the specification item(s) or content(s) which are not included in International Standard.
  - MOD/alteration: Alters the specification content(s) which are included in International Standard.
- 2 Symbol in column of designated degree of correspondence between **JIS** and International Standards in the comparison table indicates as follows:
- MOD: Modifies International Standards.

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