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**Electrical characteristic test methods of
electric double layer capacitors for use in
hybrid electric vehicles**

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard submitted from Japan Automobile Research Institute (JARI) with a draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

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Electrical characteristic test methods of electric double layer capacitors for use in hybrid electric vehicles

Introduction

There are some Japanese Industrial Standards for fixed electric double layer capacitors used in electronic equipment; however, their contents are not applicable to electric double layer capacitors used in hybrid electric vehicles for which rapid charge-discharge specifications are required. This Japanese Industrial Standard has been established in response to the need for a standard for test methods which specifies the electrical characteristics of such capacitors.

No International Standard corresponding to this Standard has been established at this point.

1 Scope

This Standard specifies the test methods for electrical characteristics of a unit cell of electric double layer capacitor (hereafter referred to as "capacitor") used in peak-power assistance for hybrid electric vehicles.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitutes provisions of this Standard. For the standard indicated below, only the edition of the indicated year shall be applied and any revisions (including amendments) made thereafter shall not be applied.

JIS C 60068-1 : 1993 *Environmental testing Part 1 : General and guidance*

NOTE : Corresponding International Standard : IEC 60068-1 : 1988 *Environmental testing. Part 1 : General and guidance* (IDT)

3 Terms and definitions

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

3.1 reference temperature

temperature (°C) of $25\text{ °C} \pm 2\text{ °C}$ specified in 5.2 of JIS C 60068-1 : 1993 which shall be referred at tests

3.2 ambient temperature

temperature (°C) of surroundings in which capacitors are placed

3.3 category upper temperature

highest use temperature (°C) determined at the time of designing

3.4 category lower temperature

lowest use temperature (°C) determined at the time of designing

3.5 applied voltage

voltage (V) applied between capacitor terminals

3.6 rated voltage U_R

maximum voltage (V) at which the capacitor satisfies the specified requirements after the voltage has been applied to the capacitor continuously for a specified period of time at the category upper temperature

This voltage is the setting voltage when designing the capacitor.

NOTE : The content of the durability test with which the rated voltage is obtained is given in Annex A.

3.7 charge current

current (A) at the time of charging a capacitor

3.8 discharge current

current (A) at the time of discharging a capacitor

3.9 stored energy

electric energy (J) stored in a capacitor

3.10 charge accumulated electric energy

accumulated amount of electric energy (J) applied to a capacitor for charging from the start to the finish of charging

3.11 discharge accumulated electric energy

accumulated amount of electric energy (J) discharged from a capacitor from the start to the finish of discharging

3.12 calculation start voltage

voltage (V) which is set as a starting point in calculating characteristics such as capacitance among voltage drop characteristics during discharge from a capacitor

3.13 calculation finish voltage

voltage (V) which is set as a finishing point in calculating characteristics such as capacitance among voltage drop characteristics during discharge from a capacitor

3.14 capacitance

electric charge storage capacity (F) of a capacitor

3.15 internal resistance

summed resistance (Ω) of the specific resistance of constituent materials and the internal connection resistance of a capacitor

3.16 nominal internal resistance R_N

nominal value (Ω) of internal resistance used at the time of designing and used for setting of measurement conditions

Generally, a value at the reference temperature.

3.17 constant voltage charging

charging method to apply the voltage continuously to a capacitor after the specified voltage has been reached

3.18 constant current charging

charging method to charge a capacitor at a constant current

3.19 constant current discharging

discharging method to discharge a capacitor at a constant current

3.20 pre-conditioning

storage under a measurement environment (temperature, humidity and atmospheric pressure) and discharge treatment of a capacitor before testing

Generally, storage until the internal temperature of capacitor reaches the temperature (thermal) stability and discharge treatment before measuring the electrical characteristics of the capacitor.

3.21 recovery

storage under a measurement environment (temperature, humidity and atmospheric pressure) and discharge treatment of a capacitor after the test such as a durability test, etc. in which an ambient temperature is changed

Generally, storage until the capacitor internal temperature reaches the temperature (thermal) stability and discharge treatment before measuring the electrical characteristics of the capacitor.

3.22 charge efficiency

efficiency when charging a capacitor under the specified conditions, which is expressed by the ratio (%) obtained by dividing the stored energy by the charge accumulated electric energy

3.23 discharge efficiency

efficiency when discharging a capacitor under the specified conditions, which is expressed by the ratio (%) obtained by dividing the discharge accumulated electric energy by the stored energy

3.24 energy efficiency

ratio (%) obtained by dividing the discharge accumulated electric energy by the charge

accumulated electric energy when a capacitor is charged and discharged under the specified conditions

3.25 maintain voltage characteristics

characteristics of a voltage maintained between capacitor terminals when the terminals are opened after the capacitor has been charged

3.26 maintain voltage rate

ratio (%) obtained by dividing the voltage between terminals by the charged voltage after lapse of a specified period of time when terminals are opened after the capacitor has been charged

3.27 power density

electric power per unit mass or unit volume (W/kg or W/L) which can be taken out from a charged capacitor

3.28 maximum power density

power density (W/kg or W/L) of the largest which can be taken out from a charged capacitor

Generally, it is calculated by means of the internal resistance and the rated voltage.

4 Test methods

4.1 Capacitance and internal resistance, and maximum power density

4.1.1 Test circuit

The capacitance and internal resistance test shall be carried out by means of the constant current charging and discharging. The basic circuit shall be in accordance with figure 1.

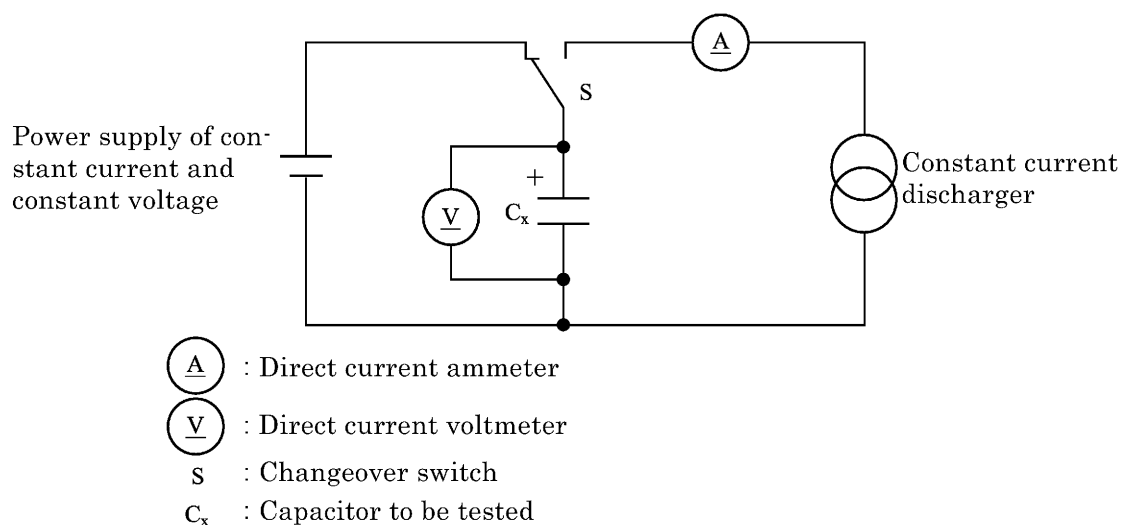


Figure 1 Basic circuit for constant current charging and discharging