JEITA

Explanation of the Act on Rationalizing Energy Use (Energy-Saving Act)

—Magnetic Disk Unit Edition—

(Target Standards for FY 2023)

April 2021

Japan Electronics and Information Technology Industries Association

Magnetic Storage Energy-Conservation Subcommittee

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Introduction

In recent years, energy-conservation policies have been established as countermeasures to not only the issue of resources but also the problem of global warming, and interest in such policies has grown both domestically and abroad. The industrial world's efforts to tackle these problems have been recognized as extremely important. As you are aware, the Energy-Saving Act (official name: Act on Rationalizing Energy Use), which covers factories, transportation, residences and other buildings, machinery and tools, and similar areas, was created to strengthen these initiatives.

The adoption of the Kyoto Protocol in December 1997 established reduction targets for greenhouse gases. As part of the movement to reinforce energy-conservation policies, the Energy-Saving Act was revised in June 1998 with the goal of introducing a top-runner formula and achieving stronger standards for making energy-consuming devices more efficient. Existing energy-efficiency standards for computers and magnetic disk units, which are under the purview of the Japanese Electronic Industry Development Association, were also reconsidered from the ground up; a notice from the Ministry of International Trade and Industry dated March 31, 1999, stipulated criteria that products shipped to domestic destinations in 2005 should meet.

A notice published by the Ministry of Economy, Trade and Industry on March 29, 2006, added criteria that products shipped to domestic destinations in or after 2007 should meet.

A notice published by the Ministry of Economy, Trade, and Industry on March 31, 2010, added criteria that products shipped to domestic destinations in or after 2011 should meet.

A notice published by the Ministry of Economy, Trade, and Industry on April 19, 2021, added criteria that products shipped to domestic destinations in or after 2022 should meet.

This explanation was created to promote an understanding among member companies of the above notices concerning magnetic disk units.

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It is our hope that this document is widely used by concerned parties so that the industry can contribute to solving the problems of resource depletion and global warning through compliance with the Energy-Saving Act.

Magnetic Storage Energy-Conservation Subcommittee
Japan Electronics and Information Technology Industries Association

April 2021

This document applies to products for which are shipped on or after April 19, 2021.

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1. Energy-Saving Act

"Energy-Saving Act" refers to the Act on Rationalizing Energy Use.

The following laws and ordinances are related to magnetic disk units.

(1) Laws: Act on Rationalizing Energy Use (Energy-Saving Act)

(2) Cabinet Orders: Enforcement Ordinance for the Act on Rationalizing Energy Use (Energy-Saving Act)

(3) Ministry Ordinances: Enforcement Regulations for the Act on Rationalizing Energy Use (Energy-Saving Act)

(4) Notices: Evaluation criteria related to improving the energy efficiency of magnetic disk units for the manufacturers of power-consuming devices

(5) Related Documents: Evaluation Standards for Specific Devices: Computers and Magnetic Disk Units

2. Terminology

The following terminology and definitions related to magnetic disk units are used in this document.

(1) Magnetic Disk Unit

A "magnetic disk unit" (52131) as defined by the Japan Standard Commodity Classification. Specifically, a device used as auxiliary (external) storage for a computer and that is equipped with disk drives that employ magnetic disks as a data-storage medium; performs random-access read/write operations on stored data via a direct or network connection with a computer. Typically comprised of a controller and one or more disk drives.

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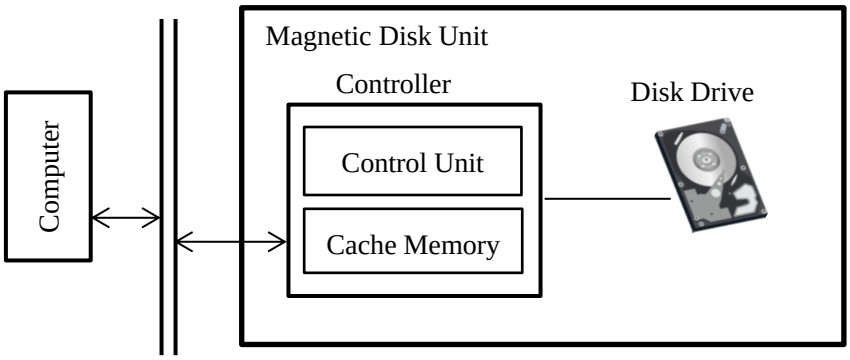
(2) Disk Drive

Hard disk drives (559183) as defined by the Japan Standard Commodity Classification; also referred to as HDD. Specifically, an electronic component that is inserted into a magnetic disk unit (an external auxiliary storage device for computers) and uses magnetic disks to store data.

(3) Single Disk

A category of magnetic disk unit defined in the “Evaluation criteria related to improving the energy efficiency of magnetic disk units for the manufacturers of power-consuming devices” (a government notice); refers to a single disk drive installed in a housing that bears the name of the form factor.

Figure 1 — Construction of a Typical Single Disk



(4) Subsystem

A category of magnetic disk unit defined in the “Evaluation criteria related to improving the energy efficiency of magnetic disk units for the manufacturers of power-consuming devices” (a government notice); refers to multiple disk drives installed in a housing that bears the name of the form factor.

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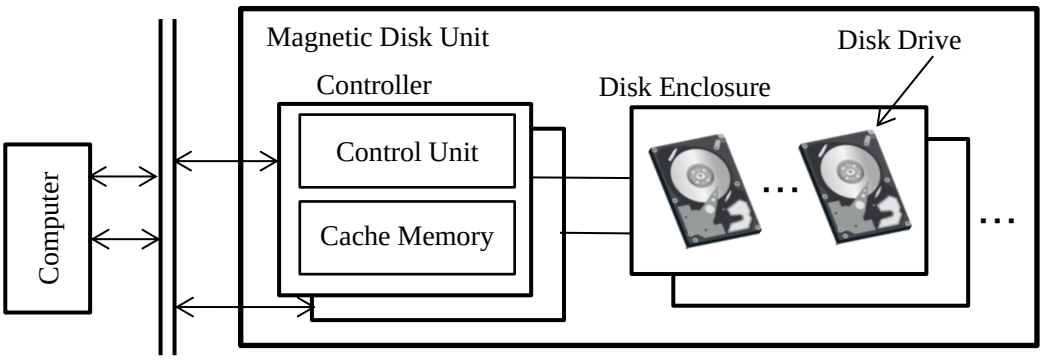
Figure 2 — Construction of a Typical Subsystem



(5) Semiconductor Disk

An electronic component that is inserted into a magnetic disk unit (an external auxiliary storage device for computers) and uses semiconductor memories to store data. SSD (Solid State Drive) is known as a typical component.

(6) Hybrid System

Subsystem that can install not only disk drives but also semiconductor disks

3. Scope of target magnetic disk units

The target magnetic disk units are the “magnetic disk units” (52131) defined by the Japan Standard Commodity Classification. Specifically, those devices used as auxiliary (external) storage for a computer; that are equipped with disk drives which employ magnetic disks as a data-storage medium; and that perform random-access read/write operations on stored data via a direct or network connection with a computer. Hybrid system is included in the magnetic disk units.

One of a computer’s peripherals, magnetic disk units consume large amounts of electricity and also satisfy the conditions listed below. This is why they were selected as devices that need better energy efficiency, along with computers.

(1) A large amount of units are shipped domestically each year

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(2) A significant amount of power is annually comsumed for their use

(3) There is still room to improve their energy efficiency, technologically speaking

The following magnetic disk units are not covered by this document:

(1) Those with a storage capacity below 1 GB

(2) Those that are only powered via direct current (USB cables etc.) and not through alternating current

Regarding (1), the market demand for these devices is expected to decline rapidly due to the strong trend of increasing capacities, and there is not much room for making them more energy efficient. As for (2), they consume relatively little electricity, plus there are no measurement methods established in international standards. For these reasons, such devices were excluded here. Of the existing exclusion criteria, “installed disk drives with disk diameters of 40 mm or less” was removed because such devices do not currently exist on the market, and “devices with maximum data-transmission speeds exceeding 270 GB/s” was removed since this is no longer a remarkable feat due to the advancement of technology.

Devices corresponding with the following examples were also excluded. (Names in the examples were sourced from company websites. Also, “special purpose” refers to devices that have features and usages other than the magnetic disk units used as a computer’s auxiliary storage.)

(1) Applied devices equipped with disk drives that are designed or optimized for special purposes

Examples: backup devices, data compression devices, data warehouse appliances, HDDs installed in TVs for recording, HDDs used in digital consumer electronics, NAS used for network audio, HDDs used for video editing, etc.

(2) Magnetic disk units included in a special-purpose device

Examples: Factory automation devices

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(3) Consumer electronics

Examples: Blu-ray players, video-game consoles etc.

(4) Used products that are resold

However, this is limited to items that are not manufactured or imported.

Here, “manufacturing” refers to performing action that reclassifies an item or affect its energy efficiency. For example, ① changes to capacity that make it exceed the previous maximum storage capacity, ② changes to the controller, ③ changes to the power unit (including the AC adapter), ④ changes to the form factor, or similar changes will make the item subject to the Energy-Saving Act, even if it is a used product.

The auxiliary (external) storage devices for a computer that install only semiconductor disks such as solid-state drives (SSDs) are not covered here, but their proliferation is being observed closely.

4. Evaluation Criteria

4.1. Classification

Regarding magnetic disk units equipped with a single disk drive, the vast majority of target products have a form factor of 3.5”, so they are classified not by their external dimensions but by their number of internal disks: 1 disk, 2–3 disks, or 4+ disks (Categories I through III). For magnetic disk units capable of holding 2 to 11 disk drives, the existing two categories of subsystems have been combined (Category IV). Magnetic disk units capable of holding 12 or more disk drives, such as those used in data centers, fall into one of two categories depending on the external dimensions of their disk drives (Categories V and VI).

(1) External dimensions of disk drive

For the 3.5” form factor, the length of the second-longest side of the disk drive’s rectangular box exceeds 75 mm.

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For the 2.5” form factor, the length of the second-longest side of the disk drive’s rectangular box is 75 mm or less.

(2) Number of disks

The number of disks used to store data in a disk drive equipped with single disks. While increasing the number of disks increases power consumption, the electricity required to rotate the spindle is fixed and does not depend on the number of disks; therefore, energy efficiency can be improved by increasing storage capacity with a proportionally lower increase in power consumption. As with the previous guidelines, magnetic disk units equipped with a single disk drive are classified according to their number of disks (Categories I through III).

(3) Revolutions per minute

The steady rotational speed of a disk drive installed in a magnetic disk unit is stated in units of revolutions per minute (rpm). The energy required to rotate a disk drive is positively correlated with the rotational speed of its disks, and since there is strong demand for improved read/write speeds, a functional expression of rotational speed has been used to set the standard. However, because most magnetic disk units capable of holding 12 or more 3.5” disk drives (Category 5) have a rotational speed of 7200 rpm, a fixed value rather than a functional expression is used.

Table 1 — Classification of magnetic disk units (single disk) based on product characteristics and capacity

Disks Per Magnetic Disk Unit Maximum Installed Drives	Drive Form Factor and Capacity		Category
	Disk Drive External Dimensions	Number of Disks	
1	—	1	I
		2 or 3	II
		4 or more	III
2 to 11	—	—	IV

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12 or more	Includes 3.5” (width > 75 mm)	—	V
	2.5” only (width ≤ 75 mm)	—	VI

4.2. Target Year

To improve the energy efficiency of magnetic disk units, we must aim to increase capacity and decrease power consumption by creating more rational designs and using magnetic technology that achieves higher storage density. Taking into account the time it will take to develop such improvements to energy efficiency, the target year is FY 2023.

4.3. Energy Efficiency

The term "Energy Efficiency" is used instead of power efficiency in order to keep a consistency in the expression of the other categories’ Energy-Saving Acts. Energy efficiency is equivalent to the power consumption when idling (expressed in watts) divided by the storage capacity (expressed in gigabytes). In other words, it is calculated using the formula below.

Expressing energy efficiency using at least three significant digits and rounding values such as power consumption and storage capacity to the nearest whole number are also recommended. Lower energy efficiency values are better.

$$\text{Energy Efficiency (E)} = \frac{\text{Power Consumption(P)}}{\text{Storage Capacity (C)}}$$

E: Energy Efficiency (units: watts/gigabyte (W/GB))

P: Power Consumption (units: watts (W))

The power consumption when the disk is spinning and capable of immediately reading or writing data (ready idle mode). While the power consumption of a magnetic disk unit is usually highest when writing data,

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write operations are performed very infrequently during operation, so the power consumption during the ready idle mode is used instead. However, “maintain rotation of the spindle motor” refers to either regular rotation (the rpm that allows seek/write/read operations to be performed) or a low-rpm standby mode that does not stop rotation.

C: Storage Capacity (units: gigabytes (GB))

The maximum capacity of data that can be physically stored. Typically, this is the total of the storage capacities of each disk drive used to store data in the magnetic disk unit. This includes the storage capacity of sections of the disk array used for mirroring or redundancy, but does not include theoretical capacity created via optimization technologies.
As the storage capacity for hybrid system, the total of the storage capacities of each disk drive is used. The storage capacities of each semiconductor disk is excluded.

4.4. Target Criteria

Regarding magnetic disk units shipped to domestic destinations in or after the target year (the year beginning April 1, 2023, and ending March 31, 2024), manufacturers shall ensure that the energy efficiency (weighted by the number of units shipped) of each category in the following table does not exceed the standard energy efficiencies listed in the same table (also weighted by the number of units shipped).

However, due to design and development cycles as well as other factors, products that do not sufficiently reflect energy-efficient designs must also be considered. Therefore, products that have already passed their sales peak are excluded, and the regulations “do not apply to models whose number of shipped units in the above-mentioned year is 10% or less of the maximum number of shipped units in one of the previous years.”

As for single disks, the vast majority of target products have a form factor of 3.5” due to the transition of 2.5” drives to bus-powered solutions, so such disks are classified not by their external dimensions but by their number of internal disks: 1 disk, 2–3 disks, or 4+ disks (Categories I through III).

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Table 2 — Magnetic disk unit categories and target criteria

Installable Disks Per Magnetic Disk Unit	Drive Form Factor and Capacity		Category	Standard Energy Efficiency Formula
	Disk Drive External Dimensions	Number of Disks		
1	—	1	I	E = exp(2.98 * ln(N) − 30.8)
		2 or 3	II	E = exp(2.98 * ln(N) − 31.2)
		4 or more	III	E = exp(2.11 * ln(N) − 23.5)
2 to 11	—	—	IV	E = exp(1.56 * ln(N) − 17.7)
12 or more	Includes 3.5” (width > 75 mm)	—	V	0.00170
	2.5” only (width ≤ 75 mm)	—	VI	E = exp(0.952 * ln(N) − 14.2)

Note 1: The letters E and N in the formulas for standard energy efficiency are defined as follows.

E: standard energy efficiency (units: watts/gigabyte (W/GB))

N: steady rpm of disk drive (units: revolutions per minute (rpm))

Note 2: ln is a logarithm with e as the base.

Note 3: If the installed disk drives have different rotational speeds, make N the average of the rotational speeds weighted by the installed number of each drive.

Note 4: Width is the length of intermediate side of external dimensions

Note 5: For subsystem which can be configured in both Categories V and VI, standard energy efficiency for the category of shipped configuration is applicable. (See 4.4 (3)5)

(1) Counting the number of disks

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When counting disks, either the number of physical disks or the number of effective disks can be used.

① Number of physical disks

This is the number of disks that are actually installed in the disk drive.

② Number of effective disks

This is the number of disks that are used for data storage. In this case, count disks that use both sides for data storage as 1 disk, disks that use a single side as 0.5 disks, and round the total up to the nearest whole number to obtain the number of effective disks.

Examples:

If a disk drive contains two disks, each of which use only a single side for data storage, the number of effective disks is 0.5 + 0.5 = 1.

If a disk drive contains four disks, and the same calculation produces a total of 3.5, that number is rounded up to obtain a number of effective disks of 4.

(2) Estimation method if the diameter, number, or rpm of disks is unknown

If the diameter, number, or rpm of the disk drives in a single disk is unknown, assume the following categories and rpm.

Table 3 — Estimated categories and rpm for disk drives (single disk)

Form Factor	Category (Estimated)	RPM (Estimated)
3.5” Disk Drives	I	5,400
	II	
	III	
2.5” Disk Drives	I	
	II	
	III	

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If the rpm of the disk drives in a subsystem (two or more units) is unknown, assume the following rpms (rpm is not used in a formula for Category V, so it has been omitted from the table).

Table 4 — Estimated categories and rpm for subsystems (two or more disks)

Form Factor	Category	RPM (Estimated)
3.5” Disk Drives	IV	7,200
2.5” Disk Drives	IV	5,400
	VI	10,000

(3) Definitions and example calculations for the standard energy efficiency formula

A different formula is used to calculate the standard energy efficiency for each category; the formulas contain a variable (N) which represents revolutions per minute. Since the standard energy efficiencies of magnetic disk units equipped with disk drives of varying rpms differ, manufacturers must calculate those values using the rpms of the disk drives installed in the magnetic disk units. The variables and functions used in the formula are defined below.

① Variables

N: The steady rotational speed of the magnetic disk unit (the speed at which its installed disk drives can seek/read/write data), expressed in revolutions per minute (rpm).

For the rotational speed (N) of subsystems equipped with multiple disk drives, use the steady rpm of the disk drives if they all have an identical value. If the subsystem contains a mix of disk drives with different steady rotational speeds, make N the average of the rotational speeds weighted by the installed number of each drive.

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Example:

The rotational speed (N) of a subsystem with a maximum configuration of five 7,200-rpm disk drives and three 10,000-rpm disk drives is:

rotational speed (N) = (7,200 × 5 + 10,000 × 3) ÷ (5 + 3) = 8,250 rpm

Example:

If a subsystem has multiple maximum configurations of magnetic disk units, such as twelve 7,200-rpm disk drives, twelve 10,000-rpm disk drives, or twelve 15,000-rpm disk drives, then any of those maximum configurations can be used. In this case, the rotational speed of the subsystem is:

rotational speed (N) = 7,200 rpm or 10,000 rpm or 15,000 rpm

② Functions

exp(x): This is an exponential function with e as its base. Mathematically, it is e to the x power, so it can also be written as e^x. Here, e is defined as

$$e = 1 + 1 + (2!)^{-1} + (3!)^{-1} + \ldots = 2.7182818\ldots$$

ln(x): This is a logarithmic function with e as its base, known as a natural logarithm. Can also be written as $\log_e(x)$.

③ Example calculations

Here is how to calculate the standard energy efficiency for Category I if N = 10,000 rpm.

Formula for calculating the standard energy efficiency of Category I:

$$E = \exp(2.98 \times \ln(N) - 30.8)$$

$$\text{standard energy efficiency} = \exp(2.98 \times \ln(10{,}000) - 30.8)$$

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$$= 0.034973\ldots$$

Therefore, the standard energy efficiency for Category I at 10,000 rpm is 0.0350 W/GB (with three significant digits).

④ Example calculation of weighted average

Here is how to calculate a case in which Company X ships the following number of Category-I units domestically in FY 2023.

Number of Category-I units shipped

Model	Rotational Speed (N)	Energy Efficiency	Units
A01	7,200	0.0132	400,000
A02	7,200	0.0976	3,000
A03	10,000	0.0303	700,000

The Category-I energy efficiency weighted by the number of units shipped is:

$(0.0132 \times 400{,}000 + 0.0976 \times 3{,}000 + 0.0303 \times 700{,}000) \div (400{,}000 + 3{,}000 + 700{,}000) = 0.0243$

The standard energy efficiencies for Category I are:

Category-I standard energy efficiency at 7,200 rpm

$$\exp(2.98 \times \ln(7{,}200) - 30.8) = 0.01314\ldots$$

Category-I standard energy efficiency at 10,000 rpm

$$\exp(2.98 \times \ln(10{,}000) - 30.8) = 0.03497\ldots$$

The Category-I standard energy efficiency weighted by the number of units shipped is:

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(0.01314 × (400,000 + 3,000) + 0.03497 × 700,000) ÷ (400,000 + 3,000 + 700,000) = 0.02699…

Therefore, the weighted standard energy efficiency for Category I is 0.0270 W/GB (with three significant digits).

Since Company X's weighted energy efficiency for Category I (0.0243 W/GB) is less than the weighted standard energy efficiency (0.0270 W/GB), the company has met the criteria.

⑤ Weighted average of subsystems

A subsystem which consists of a case with controller (referred to as base enclosure) and a case without controller (referred to as expansion enclosure) is counted as one unit.

The number of units shipped is calculated considering category of each shipment (V or VI) baed on each shipped configuration. Category of subsystems conisting of enclosure which contains 3.5 inch disk drives and enclsoure with 2.5 inch disk drives only is summarized in the table below. Weighted average is calculated in accorance with ④. However, standard energy efficiency for category V is 0.00170 and does not depend on rotational speed.

No.	Case		Category
1	Base enclosure: contains 3.5 inch disk drives (including mixture of 2.5 and 3.5 inch disk drives)		V
2	Base enclosure: contains 2.5 inch disk drives only Expansion enclosure: 2.5 inch enclosure only		VI
3	Base enclosure: contains 2.5 inch disk drives only Expansion enclosure:	Configuration of each shipment is traceble.	Calculate the number of shipment for each category (V and VI) based on the actual configuration of each

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	2.5 inch enclosure and/or 3.5 inch enclosure depending on shipping configuration		shipment.
4		Configuration of each shipment is not traceable and only the number of each enclosure shipped is traceable.	Calculate the number of shipment for each category (V and VI) in proportion with the number of 3.5 inch enclosure and 2.5 inch enclosure shipments. *2

*1: 3.5 inch enclosure means expansion enclosure which contains 3.5 inch disk drives (including mixture of 2.5 and 3.5 inch drives). 2.5 inch enclosure means expansion enclosure which contains 2.5 inch drives only.

*2: Example of calculation

Base enclosure with 2.5 disk drives only 100 units, 3.5 inch enclosure 200 units, 2.5 inch enclosure 50 units

Shipment of category V 100 x 200÷(200+50) = 80 units

Shipment of category VI 100x50÷(200+50) = 20 units

Hybrid systems: Subsystems which contain solid state disks only in base enclosure and can connect expansion enclosure with hard disk drives will be in scope of this act when the expansion enclosure(s) is connected.

Each company should decide whether or not to include hybrid systems in the number of shipment, considering sales form.

Sales of eapansion enclosure alone for the purpose of connection to already shipped system. The number of expansion enclosure shipped alone should be traced and not to be included in the calculation *2 above,

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5. Indication

5.1. Information Indicated

The following information should be indicated on the magnetic disk units.

(1) Product and form name

Example: Product Name: Magnetic Disk Unit

Form Name: Series Name or Model Name (Name or Number)

(2) Category

(3) Energy efficiency

If the Category is V or VI, list the energy efficiency when the magnetic disk unit is configured for its maximum storage capacity (the "**maximum configuration**").

(4) Storage capacity, types of disk drives, rotational speed, and number of installed drives for each external dimension under the maximum configuration (Categories V and VI only).

(5) Name of manufacturer

(6) A note that the listed energy efficiency is equivalent to the power consumption as measured in accordance with the methods stipulated in the Energy-Saving Act divided by the storage capacity as defined in that law.

5.2. Implementation

As indication is used to provide consumers with information for making purchase decisions, materials that contain information about features and are used for this purpose are subject to these regulations. This includes, for example, the catalogs (either paper or Web-based) that are typically used by consumers for selecting products and that list storage capacities and other information about those products. However, it does not include image catalogs that do not contain feature information, catalogs used to introduce systems, or materials used by consumers after making a purchase.

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The indication must be placed in an easy-to-find location on the materials presented by the manufacturer or other concerned party for consumers to use when selecting a product, and must be written using a method that prevents it from being erased.

(1) Express energy efficiency using at least three significant digits (we recommend rounding numbers).

(2) For Categories V and VI, note that the listed energy efficiency is the value under the maximum configuration.

(3) Note that the magnetic disk unit's storage capacity, types of disk drives, rotational speed, and number of installed drives for each external dimension described in section 5.1(4) are values under the maximum configuration.

Example Indication:

Category V (mix of 2.5" and 3.5" disk drives)

Storage capacity, types of disk drives, rotational speed, and number of installed drives under the maximum configuration Storage Capacity: ● TB Disk Drive Type and Number: 2.5" 2.4 TB 10,000 rpm △ drives; 2.5" 600 GB 15,000 rpm □ drives; 3.5" 14 TB 7200 rpm ◇ drives Rotational Speed: xxx rpm

Category VI (only 2.5" disk drives)

Storage capacity, types of disk drives, rotational speed, and number of installed drives under the maximum configuration Storage Capacity: ○ TB Disk Drive Type and Number: 2.5" 2.4 TB 10,000 rpm △ drives

* If the installed disk drives have different rotational speeds, use the average rpm weighted by the installed number of each drive.

(4) For Categories V and VI, add a note stating that the listed energy efficiency is the value under the maximum configuration.

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(5) For the hybrid system that has to install semiconductor disks, the configuration and the values of installed disk drives are indicated to meet the section 5.1.(4). The information about the installed semiconductor disks is Not indicated.
(6) For subsystems that can be configured both in category V and VI, indications for both categories shall be indicated.
(7) Bus-powered USB 2.5 inch disk units for consumers has become out of scope of this act and either of below is applicable:
Not to include indication regarding this act
To indicate that the product is outnouf scope of this act.

5.3. Grace Period

Indication should be replaced as soon as possible to allow users to select magnetic disk units with superior energy efficiency.

In consideration of the time required to take measurements and replace the information in catalogs, however, the indication rules defined in the FY 2011 standards can continue being used until March 31, 2022.

When the information of products that will not be sold after April 1, 2023 due to end of sales is indicated to provide information for products still in the market, indication for 2023 criteria is not required but below is required.

To indicate that the product is end of sales

To indicate the information for 2011 criteria

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6. Measurement method

6.1. Circuit configuration

Using an appropriate measuring instrument[1] that is regularly calibrated, perform measurements at the rated input voltage and rated frequency[2] while referring to the measurement circuit examples.

Figure 3 1— Measurement circuit example of magnetic disk unit connected to AC power (with power unit)

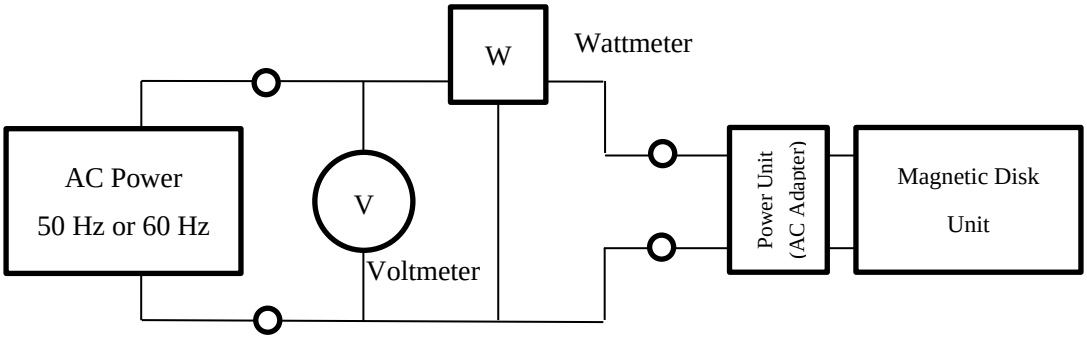

Figure 4 2— Measurement circuit example of magnetic disk unit connected to AC power

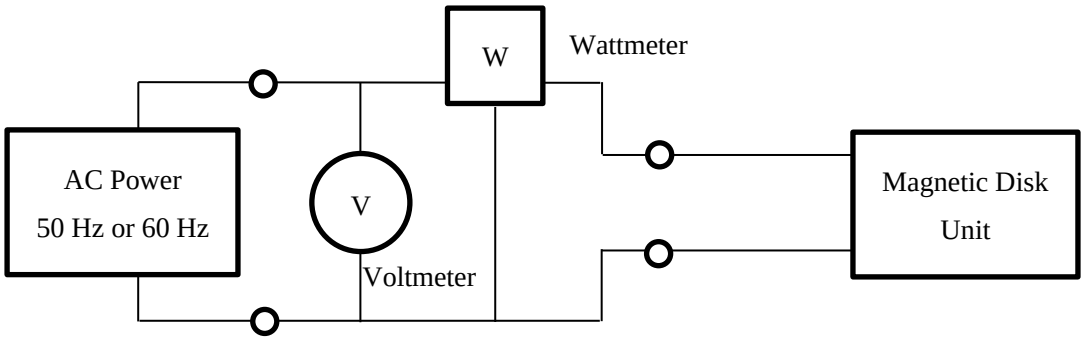

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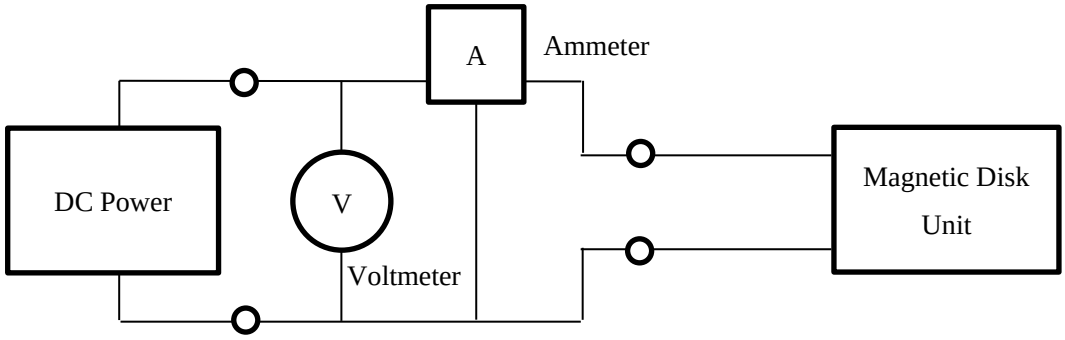
Figure 5 3— Measurement circuit example of magnetic disk unit connected to DC power



[1] If the measured power consumption of the magnetic disk unit is 10 W or less, it is desirable to use a wattmeter capable of measuring high-order harmonics up to the 50th order.

[2] DC-powered magnetic disk units include drives whose power rating is displayed in DC; drives that operate via equipment that distributes direct current (DC-48V) as a power source, such as telephone switchboards; drives that operate via the high-voltage direct current (HVDC) which is now being introduced within data centers and single disk drives supplied via power adaptor. If the magnetic disk unit can be configured to run through either AC or DC power, treat it as a magnetic disk unit connected to AC power.

6.2. Measuring conditions

Energy efficiency must be measured under the following conditions.

(1) Ambient temperature of 18 °C to 28 °C and humidity of 15% to 80%

(2) Voltage

Nameplate capacity of 1500 W or less: Rated voltage ± 1%

Nameplate capacity greater than 1500 W: Rated voltage ± 5%

(3) Frequency: Rated frequency ± 1%

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(4) For single disks, perform measurements with the internal controller, the cache memory used for buffering, and the disk drive.

(5) For subsystems, perform measurements with the internal controller, the cache memory used for buffering, the power needed to operate the magnetic disk unit, the maximum number of disk drives that can be connected to the controller (the maximum configurable storage capacity in the case of Categories V and VI), and the maximum number of input/output signal paths.

① If a redundancy setup is possible, perform the measurement in that configuration. (controller, power source, fan, etc.)

② Interface, cache memory, disk drives, etc. should be under the maximum configuration.
At the measurements of hybrid system that has to install semiconductor disks, the maximum number of disk drives and the minimum number of semiconductor disks for system running are installed.

(6) If it is difficult to take physical measurements under the maximum configuration for Categories V or VI, manufacturers should calculate them using a formula and explicitly state the computational method used. (Power consumption under the maximum configuration can be obtained by subtracting the power consumption of the base enclosure (a case with a controller) from the power consumption of the total configuration consisting of the base enclosure and expansion enclosures (cases without controllers), multiplying that result by the number of expansion enclosures under the maximum configuration, then adding the power consumption of the base enclosure.)

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E (units: W/GB): energy efficiency $=$

$$\frac{P_T}{C_T}$$

P_T (units: W): average power consumption

$$P_T = P_A + P_B \times N$$

P_A (units: W): average power consumption of base enclosure

P_B (units: W): average power consumption of expansion enclosures

N: number of expansion enclosures

C_T (units: GB): physical memory capacity of the product

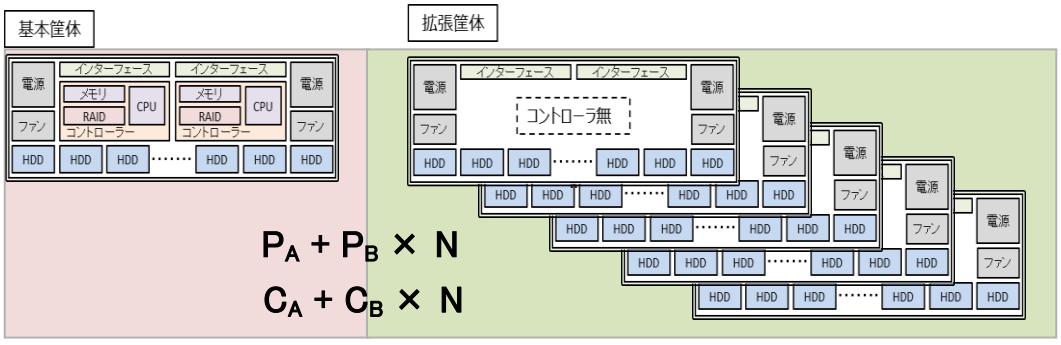
$$C_T = C_A + C_B \times N$$

C_A (units: GB): physical memory capacity of base enclosure

C_B (units: GB): physical memory capacity of expansion enclosures

N: number of expansion enclosures

Magnetic Disk Unit



(7) If the magnetic disk unit can be configured as either a Category V or a Category VI, measure it under each of those maximum configurations.

(8) Perform the measurements when the drive is powered, its disks are spinning, and it is capable of immediately reading and writing data.

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(9) Power is the average of the power consumption in watts measured at intervals of 5 seconds or less over the course of 7,200 seconds.

$$\text{average power consumption (P)} = \frac{(\sum(\text{power consumption (WS)}))}{(\text{number of measurements (n)})}$$

P: average power consumption (units: W) during the measurement period (7,200 seconds)

W_S: power consumption (units: W) measured at each interval of 5 seconds or less over the course of 7,200 seconds

n: number of measurements taken with a wattmeter over the course of 7,200 seconds

(10) For Categories I through IV, the measurement period may be set to 60 seconds under the following conditions. In such cases, however, the manufacturer must explicitly clarify how they measured the energy efficiency.

- If the device cannot be maintained in a ready idle mode for the duration of the measurement period because the time it takes to transition from ready idle mode to spin-down mode is 7,200 seconds or less in its factory configuration
- If it is a magnetic disk unit that connects to a single computer and its power consumption's rate of fluctuation falls to within 10% immediately after it is connected to a power source.

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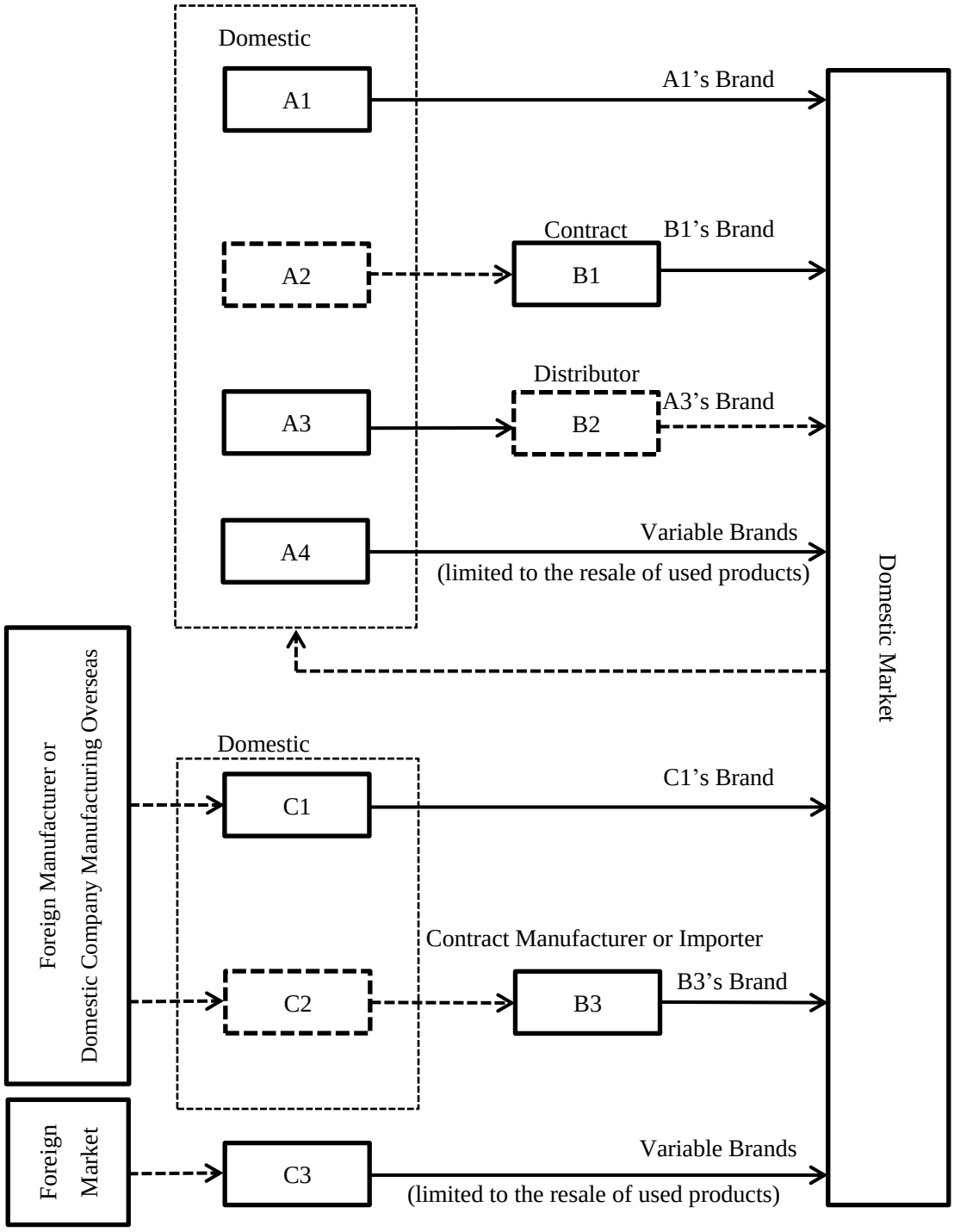
7. Approach to contract manufacturing (assignment of responsibility)

Below is the approach to contract work involving manufacturing or importing. The entities enclosed in solid boxes are responsible for counting and indicating units.

Figure 6 — Counting and Indication of magnetic disk units



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Companies B1 and B3 contract Companies A2 and C2 to manufacture or import products, but they specify themselves as the manufacturers of those products. In this case, B1 and B3 are unequivocally responsible under the Energy-Saving Act.

Company B2 is not manufacturing products covered by the Act, but is instead selling products that specify Company A3 as the manufacturer. Therefore, A3 bears responsibility under the Energy-Saving Act, and B2 has no obligation to indicate the products.

If Company A4 takes used products from the domestic market, manufactures them in some way, then resells them to the domestic market, it bears responsibility under the Energy-Saving Act. If Company C3 imports used products from a foreign market and resells them, it bears responsibility under the Energy-Saving Act.

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