

# **IS&C SPECIFICATIONS**

## **IMAGE SAVE AND CARRY**

130 mm magneto-optical disk drive

(Version 1.0)

**IS&C COMMITTEE / February, 1993**

## List of Contributors

<b>Kunimaro Tanaka</b>	<b>Teikyo University of Technology</b>
<b>Nobutake Imamura</b>	<b>Tosoh Corporation</b>
<b>Takehiko Shibata</b>	<b>Canon Inc.</b>
<b>Yoshio Nishizawa</b>	<b>Asaca Corporation</b>
<b>Kazuyoshi Itagaki</b>	<b>Asahi Chemical Industry Co., Ltd.</b>
<b>Yoshihiko Masakawa</b>	<b>Olympus Optical Co., Ltd.</b>
<b>Kunimichi Nagato</b>	<b>Optical Storage Corporation</b>
<b>Mamoru Sugimoto</b>	<b>Seiko Epson Corporation</b>
<b>Takeyuki Fuse</b>	<b>Sony Corporation</b>
<b>Masaru Satoh</b>	<b>Tosoh Corporation</b>
<b>Tokuya Kaneda</b>	<b>Hitachi, Ltd.</b>
<b>Minoru Fukazawa</b>	<b>Hitachi Maxell, Ltd.</b>
<b>Nobuo Tsutsumi</b>	<b>Matsushita Electric Industrial Co., Ltd.</b>
<b>Shigeki Mochizuki</b>	<b>Mitsui Petrochemical Industries, Ltd.</b>
<b>Fumio Orito</b>	<b>Mitsubishi Kasei Corporation</b>
<b>Yasuyuki Iwatani</b>	<b>Mitsubishi Electric Corporation</b>
<b>Hiroshi Takemoto</b>	<b>Ricoh Company, Ltd.</b>
<b>Yasuji Shima</b>	<b>The Medical Information System Development Center</b>
<b>Akiyoshi Oride</b>	<b>The Medical Information System Development Center</b>

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# IS&C SPECIFICATIONS

## Image Save And Carry

### - Magneto-Optical Disk Drive Specifications -

#### 1. Purpose of specifications

For the hierarchical IS&C system shown in Fig.1, interchangeability of portable cartridges and drives is an indispensable requirement. At the beginning of standardizing IS&C, we found that although the ISO/IEC 10089 Standard for cartridges existed, the appropriate standard was not available for corresponding drives. Consequently sufficient interchangeability could not be ensured. For that reason, it was necessary to establish IS&C specifications for cartridges, drives and host interfaces.

This document describes specifications related to cartridge interchangeability and recorded-data retention for the drives, and basic specifications (physical and logical) for plug compatibility.

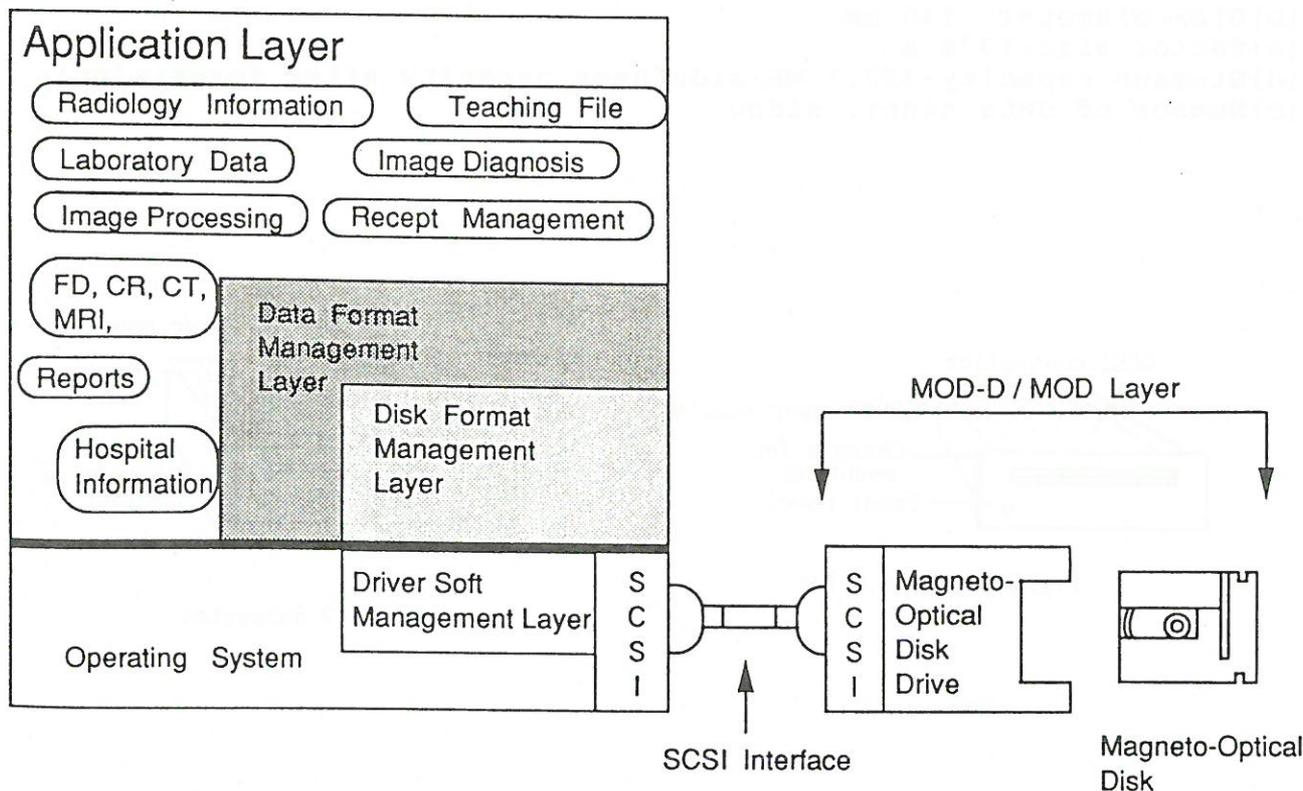


Fig.1 Hierarchical Structure of IS&C System

## 2. Definitions and scope

### 2.1 Definition

#### (1) Bare drive

It means a drive in the 'bare' condition, that is, without a cabinet. A bare drive includes its SCSI controller and is supplied with DC power from a variety of host computers. In the case of a library unit a bare drive is incorporated. See Fig.2.1-1.

#### (2) Subsystem

It means a system incorporating the above bare drive in a cabinet which can be supplied with a commercial AC power. See Fig.2.1-2. In general a subsystem is equipped with a cooling fan.

#### (3) IS&C service mark

It guarantees that drives are in conformance with this specifications. In order to represent IS&C drives this mark should be put on the front panel of the unit.

#### (4) IS&C cartridge

It is in conformance with [IS&C SPECIFICATIONS, IMAGE SAVE AND CARRY, 130mm magneto-optical disk cartridge for IS&C information interchange]. Main specifications are as follows.

(a) The base standard: ISO/IEC 10089 Format A (CCS)

(b) Disk diameter : 130 mm

(c) Sector size: 1024 B

(d) Storage capacity: 322.1 MB/side (user capacity after formatting)

(e) Number of data side: 2 sides

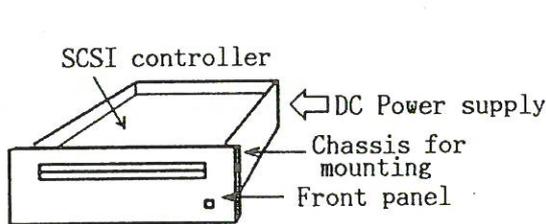


Fig.2.1-1 Bare drive

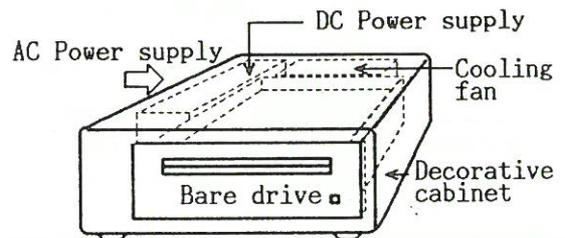


Fig. 2.1-2 Subsystem

## 2.2 Scope

- (1) Scope of this specifications: Magneto-optical disk drive for IS&C system
- (2) Scope of products: Subsystems and bare drives

## 3. Outline of specification

- (1) Operating environment: See 4.1.
- (2) Cartridge used: IS&C cartridge
- (3) Rotational system: CAV system
- (4) Rotational speed: 2400 rpm to 3600 rpm
- (5) Host interface: See [SCSI Interface Specifications for IS&C Magneto-optical Disk Drive <Ver.1.0>].
- (6) Bit error rate: Less than  $10^{-12}$
- (7) Type of product: Subsystem or bare drive
- (8) Appearance: The conformance mark of the IS&C Specifications shall be indicated on the front panel.

#### 4. Interchangeability Specifications

IS&C drives must fullfil all of the following interchangeability specifications.

##### 4.1 Operating environment

###### (1) Temperature in operation

(a) Temperature range: 10 °C to 35 °C

It applies only to subsystem. The operating environment of a disk inside a drive shall be 5 °C to 55 °C.

For bare drives, see 5.1(1).

(b) Maximum rate of temperature change: 10 °C/h

###### (2) Humidity in operation

(a) Relative humidity: 20% to 80%

(b) Wet bulb temperature: 29 °C max.

(c) Relative humidity gradient: 10 %/h max.

###### (3) Condensation

No condensation shall be allowed to occur.

(4) Atmospheric pressure: 75 kPa to 105 kPa

###### (5) Air cleanliness

The particle count shall not exceed a total of 35 000 000 particles per cubic meter of a size 0,5 µm and larger.

[Equal to class 1 000 000]

###### (6) Power supply: Commercial AC current

It applies only to subsystems.

For bare drives, see 5.1(2).

##### 4.2 Cartridge used: IS&C cartridge

##### 4.3 Rotational system: CAV (Constant Angular Velocity)

##### 4.4 Spindle motor revolution

(1) Revolution: 2400 rpm to 3600 rpm

###### (2) Accuracy of revolution

Accuracy of rotation of a spindle motor shall be ±0.5% or less of the rating.

##### 4.5 Magnetic field intensity (Bias Magnetic Field)

IS&C drives shall record and erase with a magnetic field strength of 18 000 A/m to 32 000 A/m (225 Oe to 400 Oe) on the recording layer.

#### 4.6 Servo control

The servo control error of an IS&C drive shall be

- (a) Axial direction (Focusing):  $\pm 1,0 \mu\text{m}$  or less.
- (b) Radial direction (Tracking):  $\pm 0,1 \mu\text{m}$  or less.

In addition, even when a tracking deviation happens to occur during writing or erasure, data on contiguous tracks shall not be destroyed.

#### 4.7 Write power

IS&C drive shall meet the following specifications regarding write power.

##### (1) Test conditions

- (a) Cartridge used: IS&C cartridge
- (b) Recording area: User area of the disk
- (c) Environmental conditions: See 4.1.
- (d) Recording conditions:  
The recording signal shall be the signal with the maximum single frequency (3T). In this connection, the  $W_p \text{ typ}$  shall be the value compensated with the operating temperature.

##### (2) Write power

The relationship between the byte error rate (B.E.R.) and write power (See Fig. 4.7-1) shall be

$$W_p \text{ min} \leq W_p \text{ typ} \leq W_p \text{ max} .$$

In Fig. 4.7-1 symbols are as follows.

WH point: High power point at which a byte error rate of  $10^{-4}$  occurs, or the maximum write power applies.

WL point: Low power point at which a byte error rate of  $10^{-2}$  occurs.

$$W_L \times 1,2 = W_p \text{ min}$$

$$W_H \times 0,8 = W_p \text{ max}$$

$$W_p \text{ max} - W_p \text{ min} \geq 0,0$$

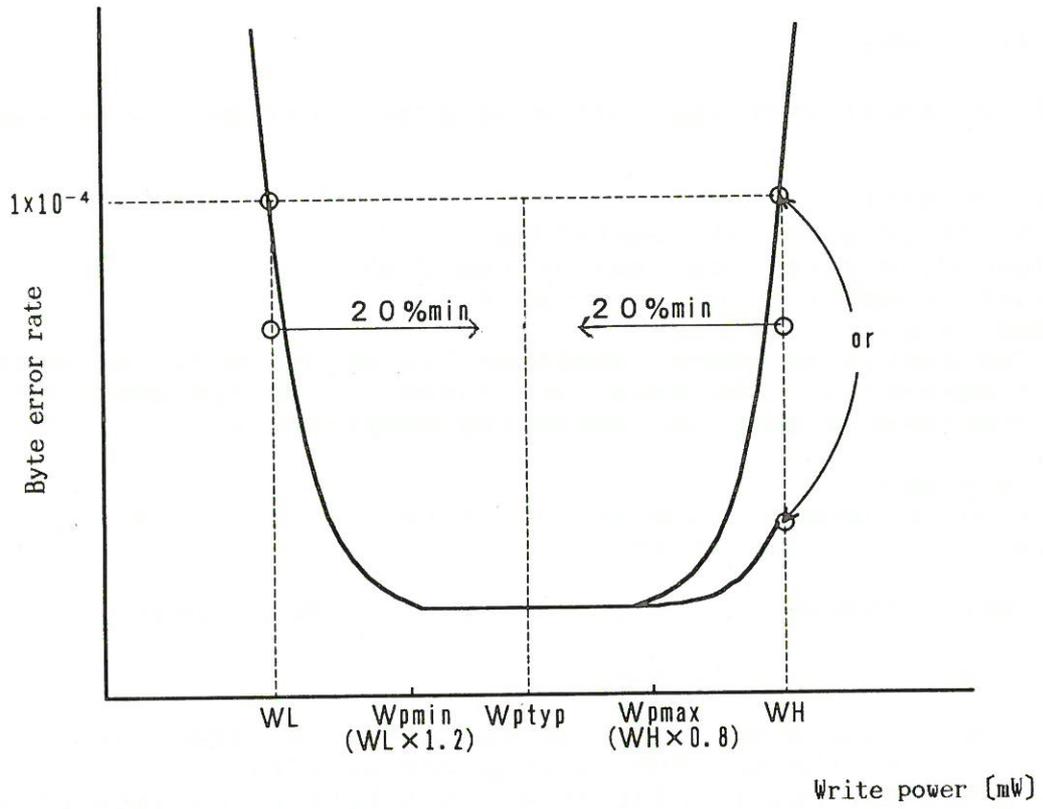


Fig. 4.7-1 Byte Error Rate Versus Write Power

#### 4.8 Erase power

IS&C drive shall meet the following specifications regarding the erase power.

(1) Test condition

- (a) Cartridge used: IS&C cartridge
- (b) Recording area: User area of the disk
- (c) Environmental conditions: See 4.1.
- (d) Recording conditions:

The recording signal shall be the signal with the maximum single frequency (3T). In this connection, the  $W_p$  typ and  $E_p$  typ shall be the value compensated with the operating temperature.

(2) Erase power

The relationship between the C/N ratio and the erase power (See Fig. 4.8-1) shall be

$$E_p \leq E_p \text{ typ} \leq 1, 2 \times E_p .$$

In Fig. 4.8-1 symbols are as follows.

CNRmax : C/N ratio due to  $W_p$  typ

CNRmin : C/N ratio 40 dB below CNRmax

$E_p$  : Erase power defined by the cross point A between the CNR curve and CNRmin.

#### 4.9 Erasure Ratio

IS&C drive shall meet the following specifications regarding the erasure ratio.

(1) Test conditions

- (a) Cartridge used: IS&C cartridge
- (b) Recording area: User area of the disk
- (c) Environmental conditions: See 4.1.
- (d) Recording and erase conditions:

The disk shall be recorded with a power +20% higher than the write power  $W_p$  typ. Then it shall be erased with a erase power  $E_p$  typ. In addition, the recording signal shall be the signal with the maximum single frequency (3T). The  $W_p$  typ and  $E_p$  typ shall be the value compensated with the operating temperature.

(2) Erasure ratio

$$\text{Erasure ratio} = 20 \log_{10} \left\{ \frac{\text{Carrier level after erasure}}{\text{Carrier level before erasure}} \right\} \leq - 40 \text{ dB}$$

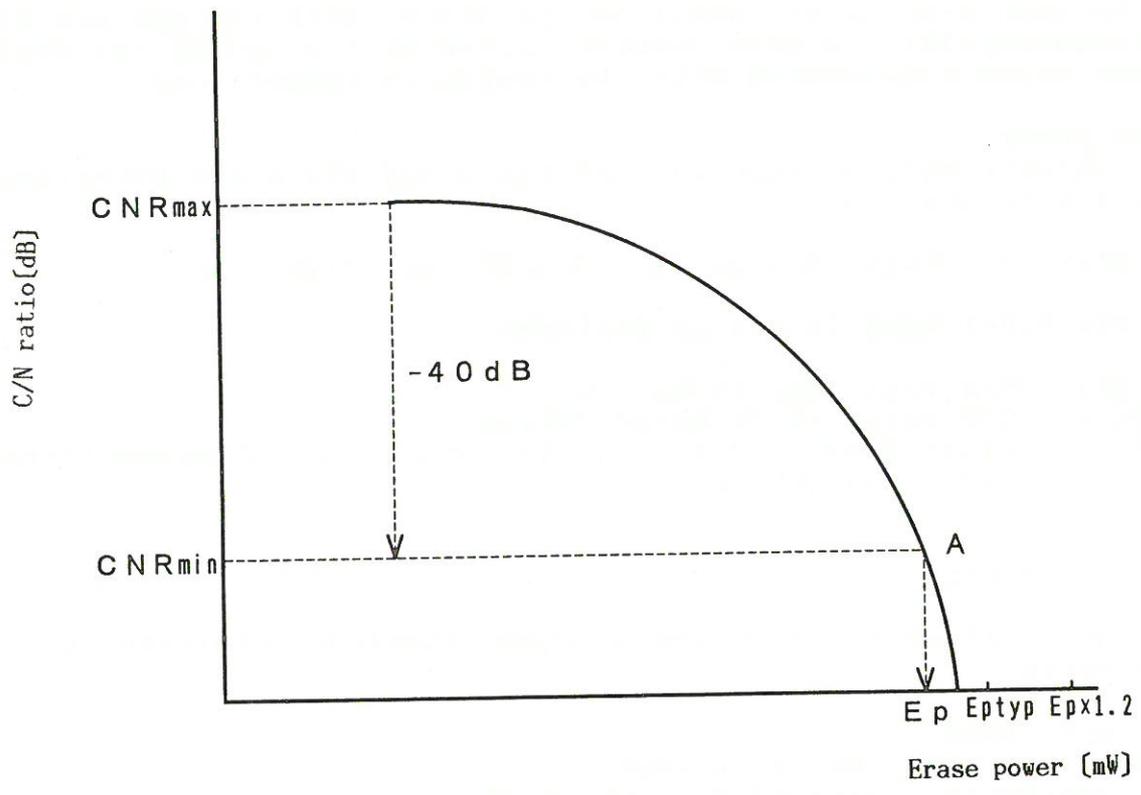


Fig. 4.8-1 C/N Ratio Versus Erase Power

#### 4.10 Write and erase cycle characteristics

##### (1) Test conditions

- (a) Cartridge used: IS&C Cartridge
- (b) Recording area: Innermost tracks
- (c) Environmental conditions: See 4.1.
- (d) Write/erase conditions:  
Using the write power  $W_p$  typ and erase power  $E_p$  typ,  $10^6$  write/erase cycle shall be done.

##### (2) Write and erase cycle characteristics

Under the test condition given above, the byte error rate after iteration (B.E.R. after) shall meet the following requirement with respect to the initial byte error rate (B.E.R. initial).

- (a)  $4,0 \times \text{B.E.R. initial} \geq \text{B.E.R. after}$
- (b)  $\text{B.E.R. after} < 1,0 \times 10^{-4}$

#### 4.11 Contiguous track characteristics (cross-talk)

##### (1) Test conditions

- (a) Cartridge used: IS&C Cartridge
- (b) Recording area: Innermost tracks and outermost tracks
- (c) Environment conditions: See 4.1.
- (d) Write/erase conditions:  
Signals with the maximum single frequency (3T) are recorded on the specified track and the contiguous + tracks. After measuring the C/N ratio of the specified track, the signals of the tracks next to the specified track are erased. In this connection, when measuring the C/N ratio of the contiguous tracks after erasure,  $0,1 \mu\text{m}$  track-offset shall be applied to the specified track.

##### (2) Contiguous track characteristics (cross-talk)

IS&C drive shall meet the following C/N ratio requirements under the test conditions above.

- (a) C/N ratio (after recording with the maximum single frequency on the specified track)  $\geq 45$  dB.

(b) Cross-talk =  $20 \log_{10} \left\{ \frac{\text{Carrier level of the contiguous tracks after erasure}}{\text{Carrier level of the specified track}} \right\} \leq -26$  dB .

#### 4.12 Load/unload cycle durability

##### (1) Test conditions

(a) Cartridge used: IS&C cartridge

(b) Test procedure: The cartridge is loaded into the drive and starts to rotation. After that, the ready status is confirmed. Finally, the disk stops rotation and the cartridge is ejected from the drive.

(c) Criteria : When one full cycle of these operation has been completed normally, it is counted as one cycle.

##### (2) Load/unload cycle

Under test conditions given above, the number of successful load/unload cycle iterations shall meet following requirement.

Successful load/unload cycle counts  $\geq 5 \times 10^4$

#### 4.13 Write interchangeability

##### (1) Test conditions

(a) Cartridge used: IS&C standard cartridge

(b) Recording area: User area of the disk

(c) Environmental conditions: See 4.1.

(d) Recording conditions:

The incremental data pattern (00<sub>H</sub> to FF<sub>H</sub>) is recorded.

##### \*Definition of IS&C standard cartridge:

Using IS&C cartridge, additional specifications are defined.

(a) Average byte error rate in the user area:  $5 \times 10^{-6} \sim 2 \times 10^{-5}$

(b) Maximum burst error length: 8 bytes

(c) Read checked CRC error rate in the ID address area:  $1 \times 10^{-4}$  or less

(d) C/N ratio when recording the maximum single frequency (3T):

45 dB or more (Both the innermost and outermost tracks are used.)

##### (2) Recording timing

IS&C drives shall end each data record within its sector.

In addition, the recording timing shall meet the following requirements.

(a) Deviation of the sync mark from the specified position :

$\pm 6$  channel bits or less

(b) Deviation of the end of data record from the specified position:

$\pm 7$  bytes or less

##### (3) Erase timing

IS&C drives should cover an end portion of sector data with respect to erase timing. In addition, they also shall meet the following condition.

Erase timing deviation from the end of the recorded sector data:  
-0 to 15 bytes.

#### 4.14 Read interchangeability

(1)ECC error

All the logical sectors can be read without uncorrectable ECC errors.

(2)Error rate

(a)Test conditions

Cartridge used:IS&C standard cartridge

Environmental conditions:See 4.1.

Recorded area:User area of the disk

Recording conditions:

The incremental data pattern(00<sub>H</sub> to FF<sub>H</sub>) is recorded.

(b)Error rate

Under the test conditions given above,the error rate shall meet the following requirement:

Average byte error rate in the user area  $\leq 5 \times 10^{-5}$

#### 4.15 Criteria of sector replacement during recording

IS&C drives shall replace defective sectors during recording under the following conditions.

(a)The number of byte errors per one interleave:More than 3(tentative)

(b)The number of ID and CRC errors:More than 1

The number of verification iterations (including retries) with respect to the above criteria is left unspecified. However,the sector replacement shall be executed if less than 50% of the verifications are OK. In this connection,the ECC correction ability shall be 8 bytes per one interleave.

#### 4.16 Recorded data retention

IS&C drives shall meet the following specifications regarding recorded data retention.

(1)Data loss due to track deviation:

If track deviation occurs during writing or erasure,it shall be detected quickly and terminated,preventing any damage to data on contiguous tracks.

(2)Thermal overload alarm:

If the internal ambient temperature exceeds the operating limit (55°C) of the disk,an alarm shall be sent to the host.

(3) Iterated read cycle

(a) Test conditions

Cartridge used: IS&C standard cartridge  
Read area: The same track of the user area  
Read power: Maximum allowable power  
Ambient temperature of the disk: Maximum allowable temperature  
(55 °C)

(b) Iterated read cycle requirement

Under the test conditions given in (a) above, the number of successful read cycle iterations shall meet the following requirement.

Limit of iterated read cycle counts  $\geq 1 \times 10^7$

4.17 DMA area error

IS&C drives shall not have any uncorrectable bad sectors in two Defect Management Areas of the IS&C standard cartridge at the initial stage.

Note: In this regard, defective sector (bad sector) specifications for IS&C cartridge are as follows.

At the initialization before shipment, criteria of sector replacement are

- (a) The number of byte errors per one interleave  
: More than 2
- (b) The number of ID and CRC errors: More than 1

Then with above criteria IS&C cartridge shall meet following requirement.

- (c) There is no defect in DMA.
- (d) The number of primary defects is 50 or less.

Finally after drive operation, the total number of defective sectors is always 2048 or less.

#### 4.18 Drive/Host communications and maintenance

IS&C drives shall meet the following specifications regarding their hosts.

##### (1) Drive response to "Write" command

IS&C drives shall perform "Write & Verify" function even when a "Write" command is received from the host.

##### (2) Thermal overload alarm

If an IS&C drive detects an internal ambient temperature exceeding upper-limit (55°C) of the disk, it must return a Check Condition status to the host and set the following Sense Key/Additional sense code.

(a) Sense key: 04<sub>H</sub>

(b) Additional sense code: 83<sub>H</sub> or DD<sub>H</sub>

When the host detects this status, it must quickly issue the command to eject the cartridge.

##### (3) Replacing the air filter

Dust, carried by the cooling air, will eventually clog the air filter. This obstructs the flow of cooling air, causing abnormally high operating temperatures in the drive. When an IS&C drive is sold, it is very important to give the user guidance for filter replacement, or arrange services of filter replacement by a selling company, a buying company, or a computer maintenance service company.

## 5. Other specifications

Additional IS&C drive specifications are listed here.

### 5.1 Operating environment for bare drives

- (1) Temperature range in operation: 5 °C to 45 °C
- (2) power supply: Both D.C. 12V and D.C. 5V

### 5.2 Installation orientation

The requirements apply to both subsystems and bare drives.

- (1) Orientation of installation: Horizontal or vertical
- (2) Installation inclination (error): Within 5° (in any direction)

### 5.3 Cooling required

- (1) Subsystem cooling:  
It requires a built-in fan to prevent elevation of the internal temperature within the cabinet.
- (2) Bare drive cooling:  
Select an air cooling system suitable for subsystems, library units or medical equipments.

Questions about IS&C Specification should be addressed to  
Headquarters of IS&C committee shown below.

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HEADQUARTERS of IS&C OFFICE

MEDIS-DC

(The Medical Information System Development Center)

TEL : 03-3586-6321

FAX : 03-3505-1996

ADDRESS : 10F Landic Akasaka Bldg.,  
2-3-4 Akasaka Minatoku  
Tokyo 107, Japan

