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Information technology — Guidelines for effective use of optical disk cartridges conforming to ISO/IEC 10090

Technologies de l'information — Lignes directrices pour utilisation efficace de cartouches de disque optique conformes à l'ISO/CEI 10090

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The main task of technical committees is to prepare International Standard, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example)

Technical Reports of type 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/IEC TR 13561, which is a Technical Report of type 3, was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 23, *Optical disk cartridges for information interchange*.

Introduction

This Technical Report covers several topics to prevent that different makers of drives A and B do not make a different judgement (Good (GO) or Not Good (NG)) on the same disk due to control scenario differences between drives A and B.
For example, in the case that a disk has some erroneous sector in the DMA, drive A may judge the disk as NG and drive B may accept this disk; this might confuse the users and this situation should be avoided from the usability point of view.
This Technical Report has been prepared by expert members of companies and organizations experienced in ODC manufacturing, research and distribution. This Technical Report is intended to aid the user in meeting the requirements of ISO/IEC 10090. The text of this Technical Report is to be construed as a guideline to a successful implementation of ISO/IEC 10090.

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Information technology — Guidelines for effective use of optical disk cartridges conforming to ISO/IEC 10090

1 Scope

This Technical Report provides guidelines for the control scenario including formatting, defect management, the usage of Control Zone Data, etc. of drives which claim conformance to ISO/IEC 10090, in order to achieve better usability of the 90mm optical disk cartridges conforming to ISO/IEC 10090.

2 References

ISO/IEC 10090 : 1992, *Information technology - 90mm optical disk cartridges, rewritable and read only, for data interchange*

3 Abbreviations

DDS Disk Definition Sector
DMA Defect Management Area
GO Good
LBA Logical Block Address
NG Not Good
PBA Physical Block Address
PDL Primary Defect List
SDL Secondary Defect List

4 Judgement for each item

The method and threshold for judgement whether a disk is GO or NG are described in this clause.
The items referring to the judgement of GO or NG of a disk are given in

(1) Functional Areas (see 4.1)
(2) Control zone informations (see 4.2)
(3) Number and alignment of erroneous sectors in DMA (see 4.3)
(4) Number of bad sectors in Rewritable zone (see 4.4)
(5) DDS information (see 4.5)
(6) Others (not described in this Technical Report).

Abovementioned objects (1) - (5) are divided into the cases A and B as follows to make the judgement of GO or NG (see figure1 and figure2):

Case A : Drives initialize or re-initialize the disk ("initialize" means that drive makes new DMAs)

Case B : Drives read/write the disk which is already recorded (including updating SDL)

The threshold for judgement whether a disk is GO or NG may be different depending on Case A or Case B. And the judgement may depend on the differences in the commands of host computers. The judgement whether a disk is GO or NG is described in the following clauses, item by item. The actions requested by the host computer when the error or NG occurs are shown in table 1.

4.1 Functional Areas

Functional Areas are on side A (see ISO/IEC 10090 : 9.3.6).
FA1 is open, FA2 is closed, which means the writing is inhibited.

The following situations occur:

1. Case A
   The drive should not certify the disk but return an appropriate error message.
2. Case B
   a. The drive writes data in the Test Zone (see ISO/IEC 10090 : 17.2.3)
   b. The drive reassigns sectors when the drive encounters difficulties in reading sector data. In this case the drive updates the SDL.

4.2 Control Zone information

(1) There are many kinds of information in the Control Zone (see annex F in ISO/IEC 10090). The two different types of information are : 1. mandatory 2. not mandatory. The disks conforming to ISO/IEC 10090 shall have the mandatory information in the Control Zone. But, the drive does not need to use the information in the Control Zone.

(2) This Technical Report recommends that the drive at least should check Byte 7 in the Control Zone.

(3) Using the information of the unspecified bytes (for example, Bytes 14 to 17 or Bytes 480 to 511) to justify rejection of the disk is not allowed in ISO/IEC 10090. But another method can be used. For example, the drive can derive the write power from the disk vendor name in the unspecified bytes in the case that the disk vendor name is recorded in those bytes.

4.3 Number and location of erroneous sectors in the DMA

The judgement whether a disk is GO or NG by the number and location of erroneous sectors in the DMA is made as follows :
The drive checks the number and location of erroneous sectors in the DMA as follows :
(1) Check DMA just after having made a new DMA, in Case A (see 4.3.1)

(2) Check DMA before reading/writing the data in user zone just after loading the disk into the drive, in Case B (see 4.3.2)

(3) Check DMA after updating the SDL, in Case B (see 4.3.3)

The criteria of disk acceptance for each situation are shown in figure 5.

A sector is considered as erroneous in the following three cases :
(This is different from the definition of bad sector in the user zone which should be replaced (see the Guideline in annex G in ISO/IEC 10090)).

(a) The data in the Data field cannot be corrected by own ECC.
(b) The Address can not be read.
(c) The contents are different from those allowed by ISO/IEC 10090.

4.3.1 Check DMA just after having made a new DMA, in Case A (11)

The drive checks whether the DMA meets the criteria in 5.3.2(The most stringent criterion is that all DMAs have no erroneous sectors). If the data of DDS, PDL, and SDL match the DMA information in the drive memory, the DMA is good. If not, the DMA is NG.
Additionally, other sectors than those for DDS,PDL, and SDL up to the 19th sector in each DMA (which may be used as SDL in future) may contain recorded (FF) data and may be checked. The maximum number of sectors actually used in a DMA is 19 : one DDS sector, one PDL sector and 17 SDL sectors.
The reason why this Technical Report recommends that the criteria for an NG DMA are not fixed is that the more stringent criteria easily could cause rejection during certification and rarely during the media life time. The criteria depend on each drive maker's concept of when the drive should report errors to the user, for example, during certification or during usage.

4.3.2 Check DMA before reading/writing the data in user zone just after loading the disk into the drive, in Case B (4 and 17)

Figure 3 shows how the DMA is checked. This Technical Report does not require drives to follow this flow, because this flow is just an example to explain DMA checking. This Technical Report recommends that each drive maker should design his drive so that the drive can get the same judgement as obtained by following the flow in figure 3.

The flow in figure 3 is :
(1) In the case that the DDS is an erroneous sector, the drive should not use the DMA following this DDS.
(2) The drive should use the first PDL which is followed by a good DDS by reading DMA1,2,3 and 4 sequentially.
(3) In the case that the lengths of the lists of SDLs (Byte 4,5) are different in each DMA, the drive should use the SDL which has the longest list of bad sectors.
(4) This Technical Report does not recommend how to handle if the contents of SDLs are different even though the lengths of lists of bad sectors are the same, because this case is very rare.
(5) The drive should make the complete SDL list by putting good sectors together from the SDLs which has the longest list of bad sectors.

Two examples for the procedure of figure 3 are shown in figure 6 and figure 7.

The flow in figure 3 shows the criteria of selecting a good DMA in the case that the drive intends to read data only in the user zone after this DMA checking. In the case that the drive updates an SDL or writes data in the user zone and updates the SDL after the DMA checking, the drive can use more stringent criteria than those of figure 3. The reason why this Technical Report recommends that the criteria for an NG DMA are not fixed is the same as given in 5.3.1.

4.3.3 Check a DMA after updating the SDL, in Case B (10, 14, and 23)

In this case, the drive should check whether there is one or more DMA which has no erroneous sector. If there is no such DMA, the disk is NG. Additionally, other sectors than those for DDS,PDL, and SDL up to the 19th sector in each DMA may be checked. The drive can use the same criteria as the abovementioned criteria in the case that the drive updates the SDL using a new sector and this new sector is an erroneous sector.

4.4 Number of bad sectors in the Rewritable Zone

The guidelines for bad sectors are given in annex G of ISO/IEC 10090.

(1) In the case that the number of bad sectors which is found by the certification process is more than the number of the spare sectors in Case A, the drive shall judge the disk as NG (9).

(2) In the case that the total number of bad sectors is more than the number of the spare sectors during the sector replacement or reassignment in Case B, the drive shall judge the disk as NG (8, 11, and 21).

(3) This Technical Report recommends drive users to allocate 1024 spare sectors, because the number of defective sectors could increase to 1024 by several reasons even if the initial number of defective sectors is very low. To allocate 1024 spare sectors, this Technical Report recommends that the number of spare sectors should be 1024 by default. And, if the drive permits a user to allocate less than 1024 spare sectors, the drive should make the user aware of the risk that the number of spare sectors can become exhausted which causes an error even if the disk conforms to ISO/IEC 10090.

4.5 DDS information

The drive should return a host computer error message if the identifier of a DDS is not (0A0A) (Case A : 6, Case B : 5 and 18).

5 The recommendation for the procedure of making a DMA

5.1 The contents of each DMA just after the certification

The contents of each DMA just after the certification consist of :

(1) In the case that there are some bad sectors detected by the certification

- PDL sectors which have the header (Bytes 0 to 3) and the information of the bad sectors.
- One SDL sector which has the header (Bytes 0 to 15) and no information of the bad sectors (Bytes 16 to 512 = (FF))
(But, in the special case that the number of bad sectors in a Group is higher than the number of spare sectors in a Group, the number of bad sectors in excess of the number of the Spare sectors in a Group shall be recorded in the SDL (see 19.2.1 in ISO/IEC 10090)
- Other sectors than those for DDS,PDL, and SDL up to the 19th sector in each DMA which may contain recorded (FF) data.

(2) In the case that there is no bad sector detected by certification

- One PDL sector which has the header (Bytes 0 to 3) and no information of the bad sectors (Bytes 4 to 512 are (FF))
- One SDL sector which has the header (Bytes 0 to 15) and no information of the bad sectors (Bytes 16 to 512 are (FF))
- Other sectors than those for DDS,PDL, and SDL up to the 19th sector in each DMA which may contain recorded (FF) data.

5.2 The usage of the old PDL and SDL which are already recorded in the case of re-initialization.

The drive can use the lists of bad sectors in the old PDL and SDL which are already recorded in the case of re-initialization. Some examples for re-initialization are :

(1) The drive does not use the old PDL and SDL which are already recorded.
1) The drive certifies in the same way as during the first initialization.
2) The drive does not certify but changes the length of the list of bad sectors in the PDL and the SDL to zero.

(2) The drive uses the old PDL and SDL which are already recorded. In this case, the drive does not certify . The drive makes a new PDL and SDL e.g. using the information of the bad sectors in the old PDL and SDL as follows :
1) The drive records the information of the bad sectors, if spare sectors in the Group are exhausted, in a new Group in a new SDL, and records the information of other bad sector in a new PDL.
2) The drive deletes the information of the bad sectors, if spare sectors in the Group are exhausted, and records the information of other bad sector in a new PDL.
3) The drive deletes the information in the old SDL, and does the same as in 1) and 2) using the information in the old PDL.

Additionally, the disk conforming to ISO/IEC 10090 does not have the P-list which is specified in SCSI-2, because the P-list on a Fixed Disk shall not be changed but the list in the PDL in ISO/IEC 10090 can be changed. In the SCSI-2 standard, the P-list is determined by the media manufacturer before shipping and shall never be changed.

5.3 Recommendation for the order of erasing/ writing a sector in the DMA

5.3.1 The order of erasing/ writing sectors in the DMA during initialization or re-initialization

The drive should write new DMAs after erasing all four DMAs (including DDS, PDL, SDL). By this procedure, it is possible to avoid that the contents of each DDS and PDL are not identical, even if, for example, power failure occurs during DMA updating. The drive should be designed so that the contents of DDS and SDL should not be changed except by initialization or re-initialization. (The drive can erase the DDS or the PDL temporarily in some cases, for example, when updating the SDL.)

5.3.2 The order of erasing/writing sectors in the DMA when updating the SDL

The drive should be designed so that the contents of DDS and PDL should not be changed during updating of the SDL. Updating of the SDL without erasing DDS and PDL may be done, however this is not recommended.
This Technical Report does not recommend which of four DMAs should be erased/written because the drive cannot always fix the order of erasing/writing DMAs. This order depends on the drive design concept.

Example for order of erasing/writing DMAs during updating of the SDL (see figure 8) :

If there is only one good DMA in which all sectors are good before updating the SDL, the drive does not update this good DMA, and the drive updates the other DMAs. If all DMAs which are updated have erroneous sectors, the drive returns the write error code to the computer without updating the good DMA. By this procedure, the drive can save the data in the old DMA. In this procedure, it is impossible to generally determine the order of the