X3T9.2/93-107

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

AIIM C21/93-022

May 27, 1993

Mr. John Lohmeyer
X3T9.2 Chairman
ATT/NCR
1635 Aeroplaza Drive
Colorado Springs, CO 80916

Dear John:

The Association for Information and Image Management (AIIM) Standards Board has appointed me to serve as a liaison to X3T9.2. AIIM Committee C21 (Optical Disk Applications), that I chair, is developing an ANSI/AIIM standard for the Use of Media Error Monitoring and Reporting for the Verification of the Information in Optical Disk-Based Information Systems. This draft standard (ANSI/AIIM MS59-199X) uses some of the SCSI-2 commands to obtain the media error information required by the system.

C21 considers it important to maintain liaison status with X3T9.2. I would appreciate it if you would include me in your mailing list for X3T9.2 document distribution. My address is Fernando L. Podio, AIIM C21 Chair, NIST, Bldg. 225, Room A61, Gaithersburg, MD 20899, Phone: (301) 975-2947, Fax: (301) 216-1369, Email: fernando@pegasus.nist.ncsl.gov.

I am enclosing a copy of the MS59 draft for your information. The document was balloted by C21. Comments received during the ballot may produce some modifications. I will send you an updated copy after accommodating these comments.

MS59 includes the definition of a MEDIA ERROR LOG page and a CURRENT THRESHOLD VALUES page (see Section 7.4). These pages are to be used with the INQUIRY SCSI command and are to be retrieved through the use of the vital product data specified by the page code field. At the present time, the proposed codes for the MEDIA ERROR LOG (Section 7.12.3.1.1) and the CURRENT THRESHOLD VALUES (Section 7.12.3.1.2) pages defined in MS59 are C0h and C1h respectively.

AIIM C21 proposes to introduce these codes, used in MS59, into the next version of the SCSI standard and to reserve them for exclusive use of the optical disk industry for media error reporting, (instead of as "vendor unique" codes). If these codes are or will be used for other applications, we will be happy to coordinate with your committee the page code numbers that we can use for our standard.

I regret that I will not be able to attend every X3T9.2 meeting. But I hope to be able to attend a meeting in the future to talk more about the AIIM C21 work.

Please do not hesitate to contact me if you, or your committee, require more information on the MS59 proposed standard and the work of AIIM C21.

Sincerely,

Fernando L. Podio

ANSI/AIIM MS59-199X
AIIM C21/93-016

April 9, 1993

Proposed

American National Standard

Use of Media Error Monitoring and Reporting Techniques for Verification of the Information Stored in Optical Disk-Based Information Systems

AIIM Project No. 117

Prepared by
Committee C21, Optical Disk Applications

Revision History

First Draft	AIIM C21/93-015	3/29/93
Second Draft	AIIM C21/93-016	4/9/93

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Foreword (This foreword is not part of the standard)

Data and records managers in many organizations are already using optical disk-based information systems for storing and retrieving large data sets and for storage of valuable information. The optical disk drives which are part of these systems are designed with powerful, but not unlimited, error correction capabilities. If the level of errors in a media sector exceeds the error detection and correction mechanisms implemented in the optical disk drive controller, the sector becomes uncorrectable (data loss may occur) . Data and records managers and other users would like to be able to use media error monitoring and reporting techniques to verify the information stored in optical disk-based information systems both initially when the data is transferred to that media and periodically to monitor the status of their data. The media error levels of correction taking place in the optical disk drive controller give an indication of the status of the information saved in these media.

This standard documents two approaches of media error monitoring and reporting techniques to verify the information stored in optical disk media: a high level approach with functional commands; and an implementation of a set of SCSI-2 (Small Computer Systems Interface - version 2) commands.

The high level interface approach is independent of the host operating system (e.g., DOS, Unix, OS/2, etc) and the interface that communicates between the optical disk device and the host (e.g. SCSI-2, IPI, LAN, etc). In addition, this high level interface is media type and size independent. That is, it can be used with systems that use WORM (write-once read many), rewritable or partially read-only media and with optical disk drives for different media sizes from 90 mm to 356 mm media. standard information on media errors allows the end users and system integrators to retrieve the same information even if their configurations consist of drives of different types, sizes and manufacturers. This information may be retrieved using the same software, which can be integrated into the media error information utilities or device drivers.

The SCSI interface may be used instead of the high level interface by using the selected set of SCSI-2 commands. This selected set of SCSI-2 commands allows systems integrators and end users to develop data verification tools at the SCSI level which are drive type and size independent, through the use of media error monitoring and reporting techniques. The use of a selected standard set of commands and approaches for media error monitoring and reporting allows any implementor to use a common set of software tools that do not change from drive to drive.

The media error information that can be obtained using the high level or SCSI-2 tools includes: (a) a list of reallocated sectors; (b) corrections above some threshold; (c) total number of bytes in error, number of bytes in error per sector and maximum number of bytes in error in any sector codeword; (d) the uncorrected or uncorrected sector content; (e) errors encountered reading header information such as the sector address, sector marks and synchronization signals; and (f) maximum length of contiguous defective bytes.

By acquiring optical disk-based information systems that comply with this standard, data and records managers will be able to access the required media error information at both a functional (higher) level and at the interface level for optical disk drives that implement the SCSI-2 standard. These tools allow data and records managers to have a better understanding of the status of their data stored on optical disks. They allow data and records managers to design more efficient media error monitoring and reporting techniques and data verification and recopying policies for transferring their data to similar or different media in a timely and economic manner.

These media error monitoring and reporting techniques also allow users to obtain media error information either in quasi-real time or during off-line operations. These techniques provide data recovery and media error monitoring tools with different levels of sophistication. Users can gather information on media errors that will allow them to highlight trends of the future on particular selected platters or in their entire data sets. Decisions on periodicity of use of these tools and the level of sophistication selected are not part of this standard.

This standard was prepared by the Committee C21 on Optical Disk Applications.

There is one annex in this standard. Annex A is informative and is not considered part of this standard.

Suggestions for improvement of this standard will be welcome. They should be sent to the Association for Information and Image Management, 1100 Wayne Avenue, Suite 1100, Silver Spring, Maryland 20910.

AIIM Committee C21, Optical Disk Applications, which developed this standard, has the following members:

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American National standard for Information Systems -

Use of Media Error Monitoring and Reporting Techniques for Verification of the Information Stored in Optical Disk-Based Information Systems

1 Scope and Purpose

1.1 Scope

This standard defines high level media error monitoring and reporting techniques (a set of functional commands) for verification of the information stored in optical disk-based information systems. This high level interface approach is independent of the host operating system (e.g. DOS, Unix, OS/2, etc) and the interface that communicate the optical disk device with the host (e.g. SCSI-2, IPI, LAN, etc). In addition, this high level interface approach is media type and size independent. That is, it can be used with systems that use WORM (write-once read many), rewritable or partially read-only media and optical disk drives for different media sizes from 90 mm to 356 mm media.

In addition, recognizing the importance and widespread use of the Small Computer Systems Interface (SCSI) in current generations of optical disk devices, this standard also defines an implementation of a selected set of SCSI-2 commands to provide for media error monitoring and reporting techniques for verification of the information stored in optical disk devices.

This standard also defines a set of user requirements for media error monitoring and reporting for verification of the information stored in optical disk-based information systems.

The media error information that can be obtained using these tools include (a) a list of reallocated sectors; (b) corrections above some threshold; (c) total number of bytes in error, number of bytes in error per sector and maximum number of bytes in error in any sector codeword; (d) the uncorrected or corrected sector content; (e) errors encountered reading header information such as the sector address, sector marks, and synchronization signals; and (f) maximum length of contiguous defective

bytes.

This standard covers the devices and media that use the following recording technologies: (a) Write-Once Read Many Times, including WORM and MO-WORM (Magneto-optic WORM), technologies with continuous composite and sampled servo formats; and (b) rewritable/read-only technology with continuous composite and sampled servo format (including discrete block format). This standard applies to removable and non-removable optical disk media and drives with both banded and non-banded formats.

Part of the information on this standard may be useful for CD-ROM subsystems, but the implementations for that technology is beyond the scope of this standard.

1.2 Purpose

The purpose of this standard is to provide users of optical disk-based information systems with standard media error monitoring and reporting techniques for verification of the information stored in these systems.

These techniques allow users of this standard: (a) to have a better understanding of the status of their data stored on optical disks; (b) to obtain media error information in quasi-real time or if they prefer to do so, during off-line operations; (c) to effect data recovery with tools of the desired level of sophistication; (d) to provide media error information allowing the user to make decisions about the media at the present time, and also provide error information which will highlight trends of the future, in particular selected platters or, in their entire data sets; (e) make decisions about how long the media can be used without an unacceptable risk of data loss; and (f) to develop more cost effective backup, recopying and data transfer policies.

The user or implementor will be able to format the media with or without certification and set the media error recovery threshold values in the optical disk drive to obtain early warning information of the status of the data at their desired level of correction or to reallocate sectors in the case these media error thresholds are exceeded. In addition, the user or implementor will be able to obtain information about the level of those set thresholds, information about all the reallocated sectors and/ or a defect list of initial media defects. The user or implementor will be able to have access to a media error log with information about the media error activity detected by the drive, and to the corrected or uncorrected content of a selected sector, including user data bytes and error correction bytes.

The high level interface approach is independent of the host operating system and can be used for any interface that communicate the optical disk subsystem with the host.

In addition, this high level interface is media type and size independent.

The use of a selected set of SCSI-2 commands with specific implementations and selected pages related to media error monitoring and reporting is defined. For the purpose of implementing this approach, any command, option or implementation not covered in this standard stays as specified in the SCSI-2 standard.

2 Conformance

This standard specifies two conformance levels: BASIC and EXTENDED. The BASIC level of conformance uses a minimum set of functions and commands. The EXTENDED level of conformance uses all of the functions and commands in the BASIC level plus a MEDIA ERROR LOG and the capability of optical disk device programmable thresholds. The EXTENDED level also allows the user to interrogate the optical disk system (using the functional commands) or the optical disk device (using a set of SCSI-2 commands) about the current setting of the optical disk device thresholds.

This standard specifies two media error monitoring and reporting levels: a system level and a device level. The system level interface uses a set of functional commands that may be used by the operating system, application software and/or by remote users. The device level uses a set of SCSI-2 commands that may be used by the device driver or a device application program.

Providers claiming conformance to this standard shall state the level of conformance (BASIC or EXTENDED) at the system level or/and device level.

An optical disk-based information subsystem conforms to this standard when it meets all the mandatory requirements of Section 6 (for the BASIC or EXTENDED compliance).

An optical disk device that conforms to the SCSI-2 standard, conforms to this standard when it meets all of the mandatory requirements of Section 7 (for the BASIC or EXTENDED compliance).

Table 1 summarizes the BASIC and EXTENDED levels of conformance at both the optical disk-based system and the optical disk device levels.

Table 1 - Conformance Levels for the Functions and Commands in this standard

	Level of Conformance	
Function/Command Description	**Basic**	**Extended**
Functional Level for Optical Disk-based Subsystems:		
Define Media Error Recovery Procedures (DMERP)	YES	YES
Read Defect Data List (RDDL)	YES	YES
Read Media Error Data (RDMED)	YES	YES
Read Log Data (RLD) - Media Error Log and Current Threshold Values	NO	YES
Set Media Error Thresholds (SMET)	NO	YES
Application of SCSI-2 Commands for Optical Disk Devices:		
FORMAT UNIT command	YES	YES
INQUIRY command (including the MEDIA ERROR LOG and the CURRENT THRESHOLD VALUES pages)	NO	YES
MODE SELECT command:		
* R/W and Verify Error Recovery Pages	YES	YES
* Set Thresholds Page	NO	YES
MODE SENSE command	YES	YES
READ DEFECT DATA command (PDL/SDL/WDL lists)	YES	YES
READ LONG command	YES	YES
REQUEST SENSE command, sense keys 01h or 03h and the related ASC and ASCQs.	YES	YES
VERIFY command with a stricter thresholds criteria	YES	YES
WRITE AND VERIFY command with stricter thresholds criteria	YES	YES

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ISO/IEC 9171 - 1 Information technology - 130 mm optical disk cartridge, write once, for information interchange - Part 1: Unrecorded optical disk cartridge.

ISO/IEC 9171 - 2 Information technology - 130 mm optical disk cartridge, write once, for information interchange - Part 2: Recording format.

ISO DIS 9316-1 Draft Standard, Small Computer System Interface - 2 (SCSI-2).

ISO/IEC 10089 Information technology - 130 mm rewritable optical disk cartridge for information interchange

ISO DIS 10090 Information technology - 90 mm Optical disk cartridge rewritable and read only for information interchnage

ISO/IEC 11560 Information technology - 130 mm rewritable optical disk cartridge write-once, using the magneto-optical effect for information interchange

ISO/IEC 10885 Information technology - 356 mm optical disk cartridge for information interchnage - Write once

ISO/IEC JTC1 SC23/WG3/TG1 Information Interchange on 300 mm Optical Disk Cartridges of the Write Once, Read Multiple (WORM) Using the CCS Method.

ISO/IEC DIS 13481 Data interchange on 130 mm optical disk cartridges - Capacity: 1 gigabyte per cartridge.

ANSI X3.131 -199X Proposed American National Standard for Information Systems - Small Computer System Interface - 2 (SCSI-2)

ANSI X3.191-1991 American national Standard for Information Systems - Recorded Optical Media Unit for Digital Information Interchange - 130 mm Write-Once Sampled Servo RZ Selectable-Pitch Optical Disk Cartridge

ANSI X3.200-1992 American National Standard for Information Systems - 356 mm

Write-Once Optical Disk Cartridge for Information Interchange

ANSI X3.211-1992 American National Standard for Information Systems - 130 mm Write-Once Optical Disk Cartridge Using Continuous Composite Servo, RLL 2,7 Encoding and LDC

ANSI X3.212-1992 American National Standard for Information Systems - 130 mm Optical Disk Cartridge Using the Magneto-Optical Effect and Continuous Composite Servo Format

ANSI X3.213-199X Proposed American National Standard for Digital Information Interchange 86 mm Rewritable Optical Disk Cartridge Using the Discrete Block Format (DBF) Method

ANSI X3.214.1992 Americna Natoinal Standard for Informaiton Systems - 130 mm Write-Once Optical Disk Cartridge Using Sampled Servo and 4/15 Modulation

ANSI X3.220-1992 American National Standard for Information Systems Digital Information Interchange 130 mm Optical Disk Cartridge Using the Magneto-Optical Effect for Write-Once Functionality

4 Definitions

For a complete set of definitions see Section 3 of the SCSI-2 standard and the definitions included in the related media interchange standards listed in Section 2 of this standard.

Initiator: An SCSI device that requests an I/O process to be performed by another SCSI device (a target).
Native Format: ECC data and control bytes, stripping sync bytes.
Target: An SCSI device that performs an operation requested by the initiator.
Verification of the Information: Verification of the integrity and status of the information

5. User Requirements

The high level interface approach defined in Section 6 of this standard documents commands that a host can use in order to retrieve from the optical disk-based subsystem the following information: (a) consumption of spare sectors - physical address of each sector reallocated and of spare sectors still available in the reallocation table (when a reallocation table exists) or a list of sector addresses of the replaced sector and its replacement; (b) corrections above some threshold; (c) total number of bytes in error, number of bytes in error per sector and maximum number of

bytes in error in any codeword; (d) the uncorrected (or corrected) sector content; (e) errors encountered reading header information (bad IDs, sector missing marks, data syncs and resync marks); and (f) maximum length of contiguous defective bytes. The high level interface provides also the capability of user modifiable thresholds.

The application of a selected set of SCSI-2 commands defined in Section 7 of this standard allows the user of optical disk-based subsystems that use SCSI-2 interfaces to develop data verification tools at the SCSI-2 level. The information listed above in this Section, can also be retrieved through the SCSI-2 implementation defined in Section 7.

6. High Level Media Error Monitoring and Reporting Techniques for Verification of the Information Stored in Optical Disk-Based Information Systems

6.1 Introduction

The purpose of this Section is to provide high level (a set of functional commands) media error monitoring and reporting techniques for the verification of the information stored in optical disk-based information systems. Through this implementation, the user of this standard will be able to: (a) set the ECC threshold values to obtain early warning information on the status of the data when the media error correction thresholds are exceeded by the ECC; (b) obtain information about the level of those set thresholds; (c) obtain information about all the reallocated sectors and or a defect list of initial media defects; (d) retrieve a media error log with information about the media error activity detected by the drive; and (e) the corrected or uncorrected sector content including user data bytes and ECC bytes.

This high level interface approach is independent of the host operating system (e.g. DOS, Unix, OS/2, etc) and the interface that communicate the optical disk device with the host (e.g. SCSI-2, IPI, LAN, etc). In addition, this high level interface is media type and size independent, that is, it can be used with systems that use WORM (write-once read many), rewritable or partially read-only media and optical disk devices for different media sizes from 90 mm to 356 mm media. Standard information on media errors will allow the end users and system integrators to retrieve the same information even in the event that their configurations consist of drives of different types, sizes and manufacturers (e.g. an implementor will be able to retrieve the same information on media errors with only one piece of routines integrated into their media error information utilities or device drivers.)

6.2 Functional Commands

The following functional or high level (host) commands shall be used for the

verification of the information.

6.2.1 Generic Command Description

This section describes the syntax that is used in this standard for the command format.

Command Name [parameter 1] [parameter 2] [parameter 3] [.....] [parameter n]

At least one parameter shall be included with the Command Name. Where there is a choice for a parameter to be set ON or OFF the choices for each parameter are represented in the command format box by stacking.

[Parameter	ON	]
[	OFF	]

6.2.2 Define Media Error Recovery Procedures (DMERP)

The DMERP command shall be used to define to the optical disk device the error recovery procedures, media error reporting, and media error data transfer that shall be executed. If a parameter is not specified the parameter shall default to OFF.

DMERP	[WR	ON	]	[RE	ON	]	[RRE	ON]
	[	OFF	]	[	OFF	]	[	OFF]

WR - Sector Reallocation on Write Error

ON - Enables the device error recovery procedures to automatically reallocate a sector (s) to a spare sector area on the disk if the optical disk device encounters that the error recovery set thresholds are exceeded when writing the sector (s).

OFF - Disables the optical disk device error recovery procedures from automatically reallocate a sector(s) when the optical disk drive encounters an error that exceeded the set thresholds when writing a sector(s).

RE - Sector Reallocation on Read Error

ON - Enables the optical disk device error recovery procedures to automatically reallocate a sector (s) to a spare sector area on the disk, if the optical disk device encounters an error that exceeded the set thresholds when reading a sector (s).

OFF - Disables the device error recovery procedures from automatically reallocate

a sector(s) when the optical disk device encounters an error that exceeded the set thresholds when reading a sector(s).

RRE - Report Recovered Errors.

ON - The optical disk device shall report recovered errors to the host.

OFF - The optical disk device shall not report recovered errors to the host.

6.2.3 Read Defect Data List Command (RDDL)

The RDDL command shall be used to the read defect data list from the optical disk device.

RDDL [List Size]

List Size: Specifies the number of bytes to be transferred. If the List Size is set to zero no data shall be transferred.

The defect list data shall be returned to the host in the format shown in Table 2.

Table 2 - Defect Data List

Byte No.	Description
1	Number of Entries in the List (MSB)
2	Number of Entries in the List (LSB)
3	Defective Sector Track number (MSB)
4	Defective Sector Track number
5	Defective Sector Track number (LSB)
6	Defective Sector Number
.	.
.	.
.	.
n - 3	Defective Sector Track number (MSB)
n - 2	Defective Sector Track number
n - 1	Defective Sector Track number (LSB)
n	Defective Sector Number

6.2.4 Read Media Error Data (RDMED)

The RDMED command shall be used to request the optical disk device to transfer the content of a sector to the host. The data transferred to the host shall include the user

data bytes, the ECC bytes, the DMP bytes and any other bytes that are part of the sector data field and can be corrected by the ECC. These bytes shall be sent to the host in the same order as they are on the media, according to the related media standard when any exist for the type of media used (e.g. for ISO 10089 Format A media, the type of bytes shall be Data, DMP, CRC, and ECC, see ISO 10089 Annex G). The most recent data written to the addressed sector shall be read from the media and returned.

RDMED [ADDR BXFER [CORR ON]]
[[OFF]]

ADDR - is the address of the sector that shall be transferred. This address is the logical or physical address of the sector expressed as track and sector number.

BXFER - is the number of bytes that shall be read by the optical disk device and transferred to the host.

CORR - data corrected by the ECC. If this parameter is not specified, the default shall be to turn ECC correction ON.

ON - causes the data to be corrected by the ECC before being transferred to the host.

OFF - causes the uncorrected data to be transferred to the host.

6.2.5 Read Log Data (RLD)

This command shall be used to request that the optical disk device report log data to the host. Each parameter included with the command identifies a different log.

RLD [MEL [CLRMEL ON]] [CTVL]
[[OFF]]

The logs shall be returned to the host in the order that the log parameters are passed to the optical disk device.

MEL - This log is the MEDIA ERROR LOG. This LOG provides detailed information of different media error levels. The data in this LOG shall be sent to the host in the format defined Table 12, Section 7 of this standard (from byte 3 to byte 190). The meaning of each register or value shall be as shown in Table 12.

CLRMEL - this parameter for MEL specifies if MEL shall be cleared when read. If

the parameter is not specified the default shall be not to clear MEL when it is read.

ON - the MEL shall be cleared when it is read.

OFF - the MEL shall not be cleared when it is read.

CTVL - This log is the CURRENT THRESHOLD VALUES LOG. This LOG provides information about the current set threshold values. These values shall be used by the optical disk device to provide an early warning informing to the host that the correction level for a parameter (s) went over the value for the related set threshold.

The sector (s) that provoke the early warning can be found through the MEDIA ERROR LOG. In addition, if either the WR or the RE parameters from the DERP command are ON, the optical disk device shall reallocate the sector (s) which have an error recovery level over one or more of these set thresholds. The data in the CTVL LOG shall be sent to the host in the format defined Table 13, Section 7 of this standard (from byte 4 to byte 45). The meaning of each register or value shall be as shown in Table 13.

6.2.6 Set Media Errors Threshold (SMET)

The SMET command shall be used to set the threshold levels that the optical disk device shall use for error recovery. See the correspondence between the thresholds that can be set with this commands and the ones reported by the CTVL parameters using the RLD command.

These thresholds shall be used for obtaining an early warning of media errors beyond the threshold level set by this command or for reallocating sectors. If the ECC level of correction exceeds one or more of the set levels and the parameters WR or RE in the DMERP command are ON, the sector shall be reallocated to a spare sector. If the parameters WR or RE in the DMERP command are OFF the optical disk device shall not reallocate the sector. In either of the above conditions, the optical disk device shall report that a set threshold was exceeded (indicating which one was exceeded), and if the data was recovered or unrecovered.

SMET [TBECW = n1] [TBES = n2] [TID = n3] [TSDL = n4]

[TMSM = n5] [TMDS = n6] [TMRS = n7]

where n1 to n7 are the threshold values

TBECW - Threshold for Number of Bytes in Error per Codeword

TBES - Threshold for Number of Bytes in Error per Sector

TID - Threshold for Number of Bad IDs

TSDL - Threshold for Maximum Single Defect Length

TMSM - Threshold for Missing Sector Marks

TMDS - Threshold for Missing Data Sync

TMRS - Threshold for Missing Resync

7. SCSI-2 Level Media Error Monitoring and Reporting Techniques for Verification of the Information Stored in Optical Disk Devices

7.1 Introduction

The purpose of this Section is to provide an implementation of a selected set of SCSI-2 commands. These commands from the SCSI-2 command set will allow the user to tailor the retrieval of media error information to the user's own needs.

This application of a selected set of SCSI-2 commands is only related to media error information and is to be used in conjunction with the SCSI-2 standard.

Descriptions of the use of some of the commands from the SCSI-2 standard as pertaining to media error monitoring and reporting for optical disk devices are included.

For other uses of these commands besides media error monitoring and reporting, the users are referred to the SCSI-2 standard.

Each subsection of Section 7, includes requirements for media error monitoring and reporting. These requirements define information for end users about methods for implementing better media error monitoring and reporting approaches and provide to the implementors with more information on how to satisfy the user requirements through the use of this standard .

The requirements for media error monitoring and reporting included in each command implementation supersede the implementation requirements given in the SCSI-2 standard.

Any command, option or implementation not covered in this standard will stay as

specified in the SCSI-2 standard. It is the responsibility of the initiator to request from the target any information provided by the commands as specified in this Section.

The FORMAT UNIT command shall be used to format the media. This command allows, as an option, to certify the media and create a Certification List which is retrievable as part of the information available through the READ DEFECT DATA Command (see Section 7.3).

The INQUIRY command shall be used to retrieve two pages related to media error information: the MEDIA ERROR LOG Page, which provides information about different media error indicators (see Section 7.12 of this standard), and the CURRENT THRESHOLD VALUES Page which allows to retrieve information on the current set threshold values. These set threshold values are used for providing to the initiator with a media errors early warning (that is, information on the level of correction taking place in the drive above certain set level).

When automatic reallocation is set, these set threshold values shall also be used by the optical disk device to reallocate sectors that reached these ECC correction levels (see Section 7.12 of this standard).

The MODE SELECT Command and the MEDIA ERRORS DEVICE PARAMETER page shall be used to set new threshold values different than the drive default values. This page shall also be used to clear the device MEDIA ERROR LOG (see Sections 7.5, 7.6 and 7.12 of this standard).

Two more pages shall be implemented: (a) the Read-Write Error Recovery Page (see Section 8.3.3.6 of the SCSI-2 standard; and (b) the Verify Error Recovery page (see Section 8.3.3.8 of the SCSI-2 standard)

The READ DEFECT DATA shall be used to retrieve information about bad sectors and sectors that have been reallocated (see Section 7.7).

The READ LONG command shall be used to retrieve the uncorrected or corrected content of a sector including user data, ECC and others sector bytes (see Section 7.8 of this standard).

The Request Sense Command is used to transfer sense data to the initiator (see Section 7.9 of this standard and Section 7.2.14 of the SCSI-2 standard).

The list of the selected set of SCSI-2 commands included in this application is shown below in Table 3.

7.2 List of SCSI-2 Commands Used in this Standard

Table 3 shows the list of SCSI-2 commands with specific implementations covered by this Section.

Table 3 - List of the Selected Set of SCSI-2 Commands Used in this Standard

SCSI-2 Command	Rewritable Media	WORM/Read-Only
FORMAT UNIT	√	--
INQUIRY	√	√
MODE SELECT	√	√
MODE SENSE	√	√
READ DEFECT DATA	√	√
READ LONG	√	√
REQUEST SENSE	√	√
VERIFY	√	√
WRITE AND VERIFY	√	√

7.3 The FORMAT UNIT Command

7.3.1 Introduction

Section 8.2.1 of the SCSI-2 standard documents the use of the FORMAT UNIT command. That information shall be considered part of this standard.

7.3.2 Requirements for Media Error Monitoring and Reporting

Before the use of this command, the user shall inspect the disk and take reasonable precautions to make sure that the disk is clean and free of dust. In case the disk is not clean or is not free of dust, the user shall clean the disk with media vendor recommended procedures. During the formatting of the disk, a disk surface that it is not clean can force the reallocation of sectors which otherwise could be used.

As noted above, the original manufacturer of the device or media may not certify the media. If the media is not certified by the manufacturer, the user that wants to implement media error monitoring and reporting techniques should format the media with certification on. Formatting with certification will create the Clist and a baseline for media error monitoring is created. When the manufacturer does media certification and then the user does a media certification also, both list will exists: the Plist is and the Clist.

Using the READ DEFECT DATA command with the Plist bit ON and the Glist bit OFF, the user shall get the PDL (Plist) if this list exists. In addition, using the READ DEFECT DATA command with the Glist bit ON and the Plist bit OFF, the user shall get the SDL (Glist which includes the Clist). If during the READ DEFECT DATA both the Plist and the Glist bits are ON the user shall get the two lists, first the PDL and then the SDL(1).

Its is recommended that the user do a READ DEFECT DATA with the Glist bit ON, immediately after certifying the media. In that case, the SDL (Glist) obtained will be the Clist. The Glist shall be maintained on the media in the Secondary Defect List (SDL) and updated for each event that produces a sector reallocation. When it exists on the media, the SDL is part of the Disk Definition Structure (DDS). DDS is defined in the media standards (see Section 3 of this standard). Other media use Defect Management Pointers or Sector Maps. In these cases, using the READ DEFECT DATA Command with the Glist bit ON the data transferred to the initiator shall be the list of reallocated sectors and replaced sectors in the format of a SDL list (see Section 7.7 and Table 6 of this standard).

It is recommended that MODE SELECT parameters be set prior to issuing the FORMAT UNIT command. Otherwise, the values recorded on the media will be used (if available). If these values are not in the media, the default values of the optical disk device will be used (see the SCSI programming manual for the appropriate optical disk device for setting the MODE SELECT parameters).

Notes:

(1) For WORM media and devices, a third defect list may exist (the WDL), see Section 7.7.2 of this standard: "Requirements for Media Error Monitoring and Reporting" under the READ DEFECT DATA Command.

(2) The Bytes for Index Format on Table 8-5 and 8-7 of the SCSI-2 standard do not apply to this standard. Defect descriptors shall be returned either in the block format or the physical format.

(3) Bytes 0 to 2 on Table 8-8 of the SCSI-2 standard are the track Number of Defect.

7.4 The INQUIRY Command

7.4.1 Introduction

Section 7.2.5 of the SCSI-2 standard document the use of the INQUIRY command.

That information shall be considered part of this standard.

7.4.2 Requirements for Media Error Monitoring and Reporting

The INQUIRY command shall be used for retrieving the MEDIA ERROR LOG Page and the CURRENT THRESHOLD VALUES Page. These Pages ares retrieved through the use of the vital product data specified by the page code field.

The page code for the MEDIA ERROR LOG Page shall be C0h (Proposed Code) and the page code for the CURRENT THRESHOLD VALUES Page shall be C1h (Proposed Code). See Sections 7.4.4 (Vital Product Data), 7.12 (Parameters for Optical Disk Devices), 7.12.3.1.1 for the MEDIA ERROR LOG Page definition and 7.12.3.1.2 of this standard for the CURRENT THRESHOLD VALUES page definition.

The content of the MEDIA ERROR LOG page shall be cleared through the CLRMEL bit (bit 0, byte 2 of the MEDIA ERRORS DEVICE PARAMETERS page defined in Section 7.12.2.1 of this standard). After the REZERO UNIT Command, the CURRENT THRESHOLD VALUES Page shall have a set of default threshold values set by the manufacturer of the device. When a new set of threshold values are set through the MEDIA ERRORS DEVICE PARAMETERS Page, the optical disk device shall change the content of the CURRENT THRESHOLD VALUES Page to the new set values.

7.4.3 Standard Inquiry Data

For information on the Standard INQUIRY Data see Section 7.2.5.1 of the SCSI-2 standard.

7.4.4 Vital Product Data

In addition to implement the Standard INQUIRY Data, Vital product Data shall be implemented to retrieve a MEDIA ERROR LOG Page which contains media error information and a CURRENT THRESHOLD VALUES Page which contain the current set of threshold values.. Vital product data for other purposes than media error monitoring is optional in the SCSI-2 standard and is not covered in this standard. For other uses of the Vital Product Data see Section 7.2.5.2 of the SCSI-2 Standard.

To request the vital product data information the initiator shall set the EVPD bit to ONE and specify the page code of the desired vital product data (see Section 7.12.3, and Table 10 of this standard). If the target does not implement the requested page it shall return CHECK CONDITION status. The a sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to INVALID FIELD IN CDB.

It is recommended that the target have the ability to execute the INQUIRY command even when a device error occurs which prohibits normal command execution. In such a case, CHECK CONDITION status would be returned for commands other than INQUIRY or REQUEST SENSE. The sense data returned may contain the field replaceable unit code. The vital product data would be obtained for the failing device using the INQUIRY command.

This standard does not define the location or method of storing the vital product data. The retrieval of the data may require completion of initialization operations within the device which may induce delays before the data is available to the initiator. Time-critical requirements are an implementation consideration and are not addressed in this standard.

7.5 The MODE SELECT Command

7.5.1 Introduction

Sections 7.2.8 and 7.2.9 of the SCSI-2 standard document the use of the MODE SELECT command. That information shall be considered part of this standard.

7.5.2 Requirements for Media Error Monitoring and Reporting

Some applications are more critical than others and the users (or their system integrators) of these more critical applications would want to adjust the sector retirement or early warning thresholds according to their applications. For instance, an application would want highly reliable media error reporting and other applications need recoverable data, but can not afford to perform frequent recopy operations because of the large size of the data sets and consequent high cost. For these latter applications, the user may want to get the maximum useful life time for their media.

The target shall provide user modifiable thresholds for the following media error conditions: number of bytes in error in a sector, number of bytes in error in any codeword of the sector, number of bad IDs, maximum single defect length, number of missing sector marks, number of missing data syncs, and number of missing resyncs. The thresholds levels shall be set in the optical disk device through the MEDIA ERRORS DEVICE PARAMETERS Page (see Section 7.12.2.1 of this standard).

If the threshold criteria is exceeded during a READ, WRITE, VERIFY or a WRITE AND VERIFY operation, the optical disk device shall return a CHECK CONDITION status with a sense key of 01h (RECOVERED ERROR) or 03h (MEDIUM ERROR) and with the additional sense code (ASC) set to the appropriate code as shown in Table 7-41 of the SCSI-2 standard. The optical disk device shall also provide the

appropriate additional sense code qualifier (ASCQ) according to Table 7-41 of the SCSI-2 standard and the set ASC. Additional ASC and ASCQ information of the type of error may be sent using the additional sense bytes field of the REQUEST SENSE command (see Section 7.9 of this standard and Section 7.2.14 of the SCSI-2 standard). The MEDIA ERRORS DEVICE PARAMETERS Page shall be also used to clear the MEDIA ERROR LOG (see Sections 7.4.2 and 7.12.3.1.1 of this standard).

7.6 The MODE SENSE Command

7.6.1 Introduction

Sections 7.2.10 and 7.2.11 of the SCSI-2 standard document the use of the MODE SENSE command. That information shall be considered part of this standard.

7.6.2 Requirements for Media Error Monitoring and Reporting

Table 4 - Mode Page Code Usage for Optical Memory Devices

Page Code	Description	Section of this Standard or the SCSI-2 Standard
08h	Caching Page	8.3..3.1 (SCSI-2 standard)
0Ah	Control Mode Page	7.5.3.1 (SCSI-2 standard)
02h	Disconnect-Reconnect page	7.3.3.2 (SCSI-2 standard)
0Bh	Medium Types Supported page	8.3.3.4 (SCSI-2 standard)
06h	Optical Memory Page	15.3.3.1 (SCSI-2
09h	Peripheral Device page	7.3.3.3 (SCSI-2 standard)
01h	Read-Write Error Recovery page	8.3.3.6 (SCSI-2 standard)
07h	Verify Error Recovery Page	8.3.3.8 (SCSI-2 standard)
03h-05h	Reserved	
0Ch-1Fh	Reserved	
00h	Vendor Specific (does not require page	
20h-3Dh	Vendor Specific (page format required)	
3Eh (*)	Media Error Device Parameters Page	7.12.2.1 (this standard)
3Fh	Return all mode pages (valid only for the MODE SENSE command)	

The requirements for media error monitoring are documented in Section 7.5.2. In addition, Table 4 replaces Table 7-26 and 15-26 of the SCSI-2 standard. Table 4 includes code 3Eh which is the proposed code for the Media Error Device Parameters Page.

7.7 The READ DEFECT DATA Command

7.7.1 Introduction

Section 8.2.8 of the SCSI-2 standard document the use of the READ DEFECT DATA command. That information shall be considered part of this standard.

7.7.2 Requirements for Media Error Monitoring and Reporting

Using the READ DEFECT DATA command with the Plist bit ON and the Glist bit OFF, the user shall get the PDL (Plist) if this list exists. In addition, using the READ DEFECT DATA command with the Glist bit ON and the Plist bit OFF, the user shall get the SDL (Glist which includes the Clist). If during the READ DEFECT DATA both the Plist and the Glist bits are ON the user shall get the two lists, first the PDL and then the SDL(1).

A PDL may or may not exist on the media. If it exist it may be empty (this is the case of media not certified by the manufacturer but for a media type that defines in that case an empty PDL. If the PDL exist it shall be sent through the READ DEFECT DATA command using Defect Descriptor 0 (*) (see Table 5) reading the Plist.

Table 5 - Defect Descriptor 0 Format (PDL)

Byte	Description
0	(00)
1	(01) (Defect List Identifier)
2	Number of entries MSB (each entry is 4 bytes long)
3	Number of entries LSB
4	Address of the first defective sector (track number MSB) (*)
5	Address of the first defective sector (track number) (*)
6	Address of the first defective sector (track number LSB) (*)
7	Address of the first defective sector (sector number) (*)
.	.
.	.
.	.
n - 3	Address of the first defective sector (track number MSB) (*)
n - 2	Address of the first defective sector (track number) (*)
n - 1	Address of the first defective sector (track number LSB) (*)
n	Address of the first defective sector (sector number) (*)

If a SDL exist on the media, (empty or not), it shall be sent through the READ DEFECT DATA command using Defect Descriptor 1 (*) reading the Glist.

For WORM media a third list may exist, the WDL which shall be sent trough the READ DEFECT DATA Command using Defect Descriptor 2 (*) with the Glist bit ON. Note that these list may not exist on the media or if they do they may be empty.

The format of Defect Descriptors 0 (PDL), 1 (SDL) and 2 (WDL) shall be as shown in Tables 5, 6, and 7 of this standard.

For optical disk media that do not specify defect lists (such as PDL, SDL and WDL) but use spare areas and Defect Management Pointers (DMP) only or other type of defect management such as sector maps, the information on defective sectors shall be provided as defined in Table 2 (Defect Data List).

Table 6 - Defect Descriptor 1 Format (SDL)

Byte	Description
0	(00)
1	(02) (Defect List Identifier)
2	(00)
3	(01)
4	MSB of the list length specified in number of bytes from byte 6 to byte x-1
5	LSB of the list length
6	(02) (SDL)
7	(01)
8	MSB of the list length specified in number of bytes from byte 10 to byte x-1
9	LSB of the list length
10	Address of the first defective sector (track number, MSB)
11	Address of the first defective sector (track number)
12	Address of the first defective sector (track number LSB)
13	Address of the first defective sector (sector number)
14	Address of the first replacement sector (track number, MSB)
15	Address of the first replacement sector (track number)
16	Address of the first replacement sector (track number LSB)
17	Address of the first replacement sector (sector number)
.	.
.	.
.	.
x -8	Address of the last defective sector (track number, MSB)
x - 7	Address of the last defective sector (track number)
x - 6	Address of the last defective sector (track number LSB)
x - 5	Address of the last defective sector (sector number)
x - 4	Address of the last replacement sector (track number, MSB)
x - 3	Address of the last replacement sector (track number)
x - 2	Address of the last replacement sector (track number LSB)
x - 1	Address of the last replacement sector (sector number)

Table 7 - Defect Descriptor 2 Format (WDL)

Byte	Description
0	(00)
1	(03) (Defect List Identifier)
2	(00)
3	(00), indicating that the WDL has no sublist
4	The list length specified in number of bytes from byte 6 to byte x(*) (MSB)
5	The list length specified in number of bytes from byte 6 to byte x(*) (LSB)
6	(00)
7	The page number of the WDL
8	(FF)
9	(FF)
10	Address of the first defective sector (track number, MSB)
11	Address of the first defective sector (track number)
12	Address of the first defective sector (track number LSB)
13	Address of the first defective sector (sector number)
14	Address of the first replacement sector (track number, MSB)
15	Address of the first replacement sector (track number)
16	Address of the first replacement sector (track number LSB)
17	Address of the first replacement sector (sector number)
.	.
.	. (each unit shall correspond to byte 10 to 17)
.	.
y	.
y + 1	This byte shall be set to (FFh)
.	. . .
.	. . .
.	. . .
z (*)	This byte shall be set to (FFh)

(*)Notes: x is the last byte which has the newest link information of the replacement, z is usually equal to 1023 for a 1024 byte sector and is 511 for a 512 byte sector.

7.8 The READ LONG Command

7.8.1 Introduction

Section 8.2.9 of the SCSI-2 standard document the use of the READ LONG command. That information shall be considered part of this standard.

7.8.2 Requirements for Media Error Monitoring and Reporting

The Data passed during the READ LONG command shall include the user data bytes, the ECC bytes, and any other bytes that can be corrected by the ECC (e.g. data synchronization mark within the area covered by ECC). It is not important for the ECC bytes to be at the end of the data bytes; however, they shall be in the same order as they are on the media, according to the related media standard when any exist for the type of media used (e.g. for ISO 10089 Format A media the type of bytes shall be Data, DMP, CRC, and ECC, see ISO 10089 Annex G). The most recent data written to the addressed logical block shall be read from the media and returned.

7.9 The REQUEST SENSE Command

7.9.1 Introduction

Section 7.2.14 of the SCSI-2 standard documents the use of the REQUEST SENSE Command. That information shall be considered part of this standard with the additional requirement that a CHECK CONDITION status returned because a threshold criteria was exceeded shall set the ASCQs (see Sections 7.5.2 and 7.9.2 of this standard).

7.9.2 Requirements for Media Error Monitoring and Reporting

If the threshold criteria is exceeded during a READ, WRITE, VERIFY or a WRITE AND VERIFY operation, the optical disk device shall return a CHECK CONDITION status with a sense key of 01h (RECOVERED ERROR) or 03h (MEDIUM ERROR) and with the additional sense code (ASC) set to the appropriate code as shown in Table 7-41 of the SCSI-2 standard. The optical disk device shall also provide the appropriate additional sense code qualifier (ASCQ) for the set ASC, according to Table 7-41 of the SCSI-2 standard.

Additional ASC and ASCQ information of the type of error may be sent using the additional sense bytes field of the REQUEST SENSE command (see Section 7.2.14 of the SCSI-2 standard).

7.10 The VERIFY Command

7.10.1 Introduction

Section 8.2.19 of the SCSI-2 standard documents the use of the VERIFY Command. That information shall be considered part of this standard.

7.10.2 Requirements for Media Error Monitoring and Reporting

The MODE SELECT command and the Verify Error Recovery Page shall be implemented. In this standard MODE SELECT and the Verify Error Recovery Page are not optional as described in Section 8.2.19 of the SCSI-2 standard.

Table 8 - Thresholds Set by the Stricter Criteria

Threshold for Number of Bytes in Error per Codeword
Threshold for Number of Bytes in Error per Sector
Threshold for Number of bad IDs
Threshold for Maximum Single Defect Length
Threshold for Number of Missing Sector Marks (Mark or Space)
Threshold Number for Missing Data Sync
Threshold for Number Missing ReSync (*)

Note (*): In case the media does not use ReSyncs this threshold shall not be implemented.

The VERIFY command shall use a stricter media error monitoring criteria. This stricter criteria shall make sure that the data can be verified under this condition. The stricter criteria shall set the thresholds shown in Table 8.

When a threshold criteria is exceeded during a VERIFY command, the optical disk device shall return a CHECK CONDITION status with the appropriate sense key, ASC and ASCQ. See Sections 7.5.2 and 7.9.2 of this standard.

7.11 The WRITE AND VERIFY Command

7.11.1 Introduction

Section 8.2.22 of the SCSI-2 standard defines the use of the WRITE AND VERIFY Command. That information shall be considered part of this standard.

7.11.2 Requirements for Media Error Monitoring and Reporting

The MODE SELECT command and the Verify Error Recovery Page shall be implemented. In this standard, the use of MODE SELECT and the Verify Error

Recovery page are not optional as described in Section 8.2.22 of the SCSI-2 standard.

The WRITE AND VERIFY command shall use a stricter criteria for the verification of the data. This stricter criteria shall make sure that the data can be verified under this condition. The stricter criteria shall set the thresholds shown in Table . The stricter criteria shall apply only to the VERIFY part of the command.

When a threshold criteria is exceeded during a WRITE AND VERIFY command, the optical disk device shall return a CHECK CONDITION status with the appropriate sense key, ASC and ASCQ. See Sections 7.5.2 and 7.9.2 of this standard.

7.12 Parameters for Optical Disk Devices

7.12.1 Media Errors Monitoring and Reporting Associated Parameters

Sections 7.3, 8.3, and 15.3 of the SCSI-2 Standard, specified parameters, descriptors, and page structures used by different SCSI commands. The following subsections specified only the parameters, descritors and page structures associated with media error monitoring and reporting in optical disk devices. When appropriate, information extracted from Sections 7.3, 8.3, and 15.3 of the SCSI-2 standard has been combined to make it only relevant for optical disk devices.

7.12.2 Mode Parameters

Sections 7.3.3 and 15.3.3 of the SCSI-2 standard describe the mode parameters. That information shall be considered part of this standard. The content of these sections of the SCSI-2 standard shall be used with the MODE SELECT AND MODE SENSE Commands.

7.12.2.1 Media Errors Monitoring and Reporting Using Mode Pages

Table 4 (in Section 7.6.2 of this standard) specifies the Mode Page Codes for optical disk devices.

Three mode pages shall be implemented: the Read-Write Error Recovery Page, the Verify Error Recovery Page and the MEDIA ERRORS DEVICE PARAMETERS Page.

1) The Read-Write Error Recovery Page shall be implemented according to the information provided in Section 8.3.3.6 of the SCSI-2 standard. That information shall be considered part of this standard.

2) The Verify Error Recovery page shall be implemented according to Section

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8.3.3.8 of the SCSI-2 standard. The information contained in that Section of the SCSI-2 standard shall be considered part of this standard.

3) Table 9 shows the MEDIA ERRORS DEVICE PARAMETERS Page. This page shall be used to set the thresholds the optical disk device shall used to provide an early warning on a level of ECC corrections that is taking place in the device on:

(a) Number of Bytes in Error per Codeword
(b) Number of Bytes in Error per Sector
(c) Number of Bad IDs
(d) Maximum Single Defect Length
(e) Number of Missing Sector Marks
(f) Number of Missing Data Sync
(g) Number of Missing ReSync

If the threshold criteria is exceeded during a READ, READ LONG, WRITE, VERIFY or a WRITE AND VERIFY operation, the optical disk device shall return a CHECK CONDITION status with a sense key of 01h (RECOVERED ERROR) or 03h (MEDIUM ERROR) and with the additional sense code (ASC) set to the appropriate code as shown in Table 7-41 of the SCSI-2 standard. The optical disk device shall also provide the appropriate additional sense code qualifier (ASCQ) according to Table 7-41 of the SCSI-2 standard and the set ASC.

Additional ASC and ASCQ information of the type of error may be sent using the additional sense bytes field of the REQUEST SENSE command (see Section 7.9 of this standard and Section 7.2.14 of he SCSI-2 standard).

If automatic reallocation is set when these levels of correction are exceeded, the sector(s) that exceeded one or more of the conditions in bytes 3 to 9 shall be reallocated.

This page shall also be used to clear the MEDIA ERROR LOG through the MODE SELECT Command as shown below. This page can also be used to pass additional optional vendor specific information.

A clear media error log (CLRMEL) of zero indicates that the MODE SELECT Command shall not clear the MEDIA ERROR LOG. The contents of this error log remains unaffected.

A CLRMER of one indicates that the MODE SELECT Command clears the MEDIA ERROR LOG.

The parameters savable (PS) bit shall only be used with the MODE SELECT command. This bit is reserved with the MODE SELECT command. A PS bit of one indicates that the target is capable of saving the page in a non-volatile vendor-specific location.

The clear media error log (CLRMEL) bit shall be only used with the MODE SELECT command. When set to one, indicates to the device that it shall clear the MEDIA ERROR LOG. No transfer of data shall take place. (The MEDIA ERROR LOG shall be read through the INQUIRY command and the MEDIA ERROR LOG Page which is a vital product data page.

A CLRMEL bit of zero indicates that the MEDIA ERROR LOG shall not be cleared.

Bytes 3 to 9 are self explanatory.

Table 9 - The MEDIA ERRORS DEVICE PARAMETERS Page

Bit / Byte	7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code (3Eh Proposed Code)					
1	Page Length (n - 1)							
2	Vendor Specific							CLRMEL
3	Threshold for Number of Bytes in Error per Codeword							
4	Threshold for Number of Bytes in Error per Sector							
5	Threshold for Number of bad IDs							
6	Threshold for Maximum Single Defect Length							
7	Threshold for Number of Missing Sector Marks (Mark or Space)							
8	Threshold Number for Missing Data Sync							
9	Threshold for Number Missing ReSync (*)							
10	Vendor Specific							
n								

Note (*): In case the media does not use ReSyncs this field shall contain FFh.

7.12.3 Vital Product Data Parameters

This section describes the vital product data page structure and two pages related with media error monitoring and reporting: the MEDIA ERROR LOG Page and the CURRENT THRESHOLD VALUES Page (see Table 10).

The MEDIA ERROR LOG Page and the CURRENT THRESHOLD VALUES Page shall be applicable to all optical disk SCSI devices and shall be implemented as shown below.

In addition to these two pages, the SCSI-2 Standard specifies other optional vital product data pages that are beyond the scope of this standard.

These pages shall be returned by the INQUIRY command (see Section 7.4 of this standard). The available Vital Product Data Page Codes are as shown in Table 10.

Table 10 - Vital Product Data Page Codes

Page Code	Description	Sections of this
82h	ASCII Implemented Operating Definition Page	7.3.4.1 (SCSI-2)
01h - 7Fh	ASCII Information Page	7.3.4.2 (SCSI-2)
81h	Implemented Operating Definitions Page	7.3.4.3 (SCSI-2)
00h	Supported Vital Product Data Pages	7.3.4.4 (SCSI-2)
80h	Unit Serial Number Page	7.3.4.5 (SCSI-2)
83h - BFh	Reserved	
C0h	Media error log page (proposed code)	Section 7.4 of this standard
C1h	Current threshold values page (proposed code)	Section 7.4 of this standard
C2h - FFh	Vendor Specific	

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7.12.3.1 Media Error Monitoring and Reporting Using Vital Product Data Pages

The supported vital product data pages format is shown in Table 11. The peripheral qualifier field is defined in Table 7-16 of the SCSI-2 Standard and the peripheral device type field is defined in Table 7-17 of the SCSI-2 Standard.

The page code field shall be set to the value of the page code field in the INQUIRY command descriptor block (see Section 7.4 of this standard). The page length field specifies the length of the supported page list. If the allocation length is too small to transfer all of the page, the page length shall not be adjusted to reflect the truncation.

The supported page list field shall contain a list of all vital product data page codes implemented for the target or logical unit in ascending order beginning with page code 00h.

Table 11 - Supported Vital Product Data Pages

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (00h)							
2	Reserved							
3	Page Length (n - 3)							
4	Supported Page List							
5								

7.12.3.1.1 The MEDIA ERROR LOG Page

Table 12 defines a data structure which provides accumulated media error data. The content of the MEDIA ERROR LOG shall be maintained by the optical disk device until is cleared through the MODE SELECT command using the CLRMEL bit of the MEDIA ERRORS DEVICE PARAMETERS Page (see Table 9, byte 2, bit 0).

This standard does not specify the status of the MEDIA ERROR LOG after the initiator sends a REZERO UNIT Command (see manufacturer specifications).

The manufacturer may also decide not to maintain these data in non-volatile RAM; therefore, the information may be lost after a device POWER OFF (see also manufacturer specifications).

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Table 12 - The MEDIA ERROR LOG Page

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (C0h - Proposed Code)							
2	Reserved							
3	Page Length (BBh)							
4 - 9	Number of Read Retries							
5 - 10	Number of Write Retries							
11 - 16	Number of Total Bytes Corrected							
17 - 22	Number of Sectors Read							
23 - 28	Number of Sectors Uncorrectable by the ECC							
29 - 34	Number of Sectors that Have Codewords with More than 8 Bytes in Error							
35 - 40	Number of Sectors that Have Codewords with 6, 7 or 8 Bytes in Error							
41 - 46	Number of Sectors that Have Codewords with 4 or 5 Bytes in Error							
47 - 52	Number of Sectors that Have Codewords with 1, 2 or 3 Bytes in Error							
53 - 58	Total Number of Bytes in Error							
59 - 64	Number of Sectors with Over Maximum Number of Bytes in Error							
65 - 70	Number of Sectors with [(7 * Maximum)/8 to Maximum Bytes in Error							
71 - 76	Number of Sectors with [(6 * Maximum)/8 to ((7 * Maximum)/8) - 1]] Bytes in Error							
77 - 82	Number of Sectors with [(5 * Maximum)/8 to ((6 * Maximum)/8) - 1]] Bytes in Error							
83 - 88	Number of Sectors with [(4 * Maximum)/8 to ((5 * Maximum)/8) - 1]] Bytes in Error							
89 - 94	Number of Sectors with [(3 * Maximum)/8 to ((4 * Maximum)/8) - 1]] Bytes in Error							
95-100	Number of Sectors with [(2 * Maximum)/8 to ((3 * Maximum)/8) - 1] Bytes in Error							
101-106	Number of Sectors with [(Maximum)/8 to ((2 * Maximum)/8) - 1] Bytes in Error							

Table 12 - The MEDIA ERROR LOG Page (Continued)

Bit / Byte	7	6	5	4	3	2	1	0
107-112	Number of Sectors with [0 to (Maximum/8) - 1] Bytes in Error							
113 -118	Number of Sectors Requiring no Correction with ECC							
119-124 124	Number of Sectors with Max. Single Defect Length of (0% - 25%) ECC Correction Capability							
125-130	Number of Sectors with Max. Single Defect Length of (26% - 50%) ECC Correction Capability							
131-136	Number of Sectors with Max. Single Defect Length of (51 - 75%) ECC Correction Capability							
137-142	Number of Sectors with Max. Single Defect Length of (76% -100%) ECC Correction Capability							
143-148	Number of Sectors with Max. Single Defect Length of (over 100%) ECC Correction Capability							
149-154	Number of Sectors with 3 Sector IDs in Error							
155-160	Number of Sectors with 2 Sector IDs in Error							
161-166	Number of Sectors with 1 Sector IDs in Error							
167-172	Number of Sectors with 0 Sector IDs in Error							
173-178	Number of Sectors with Errors in the Sector Mark - Sectors Readable							
179-184	Number of Sectors with Errors in the Data Sync - Sectors Readable							
185-190	Number of Sectors with Missing ReSync Marks - Sectors Readable (*)							

Note: (N * Maximum)/8 , where maximum reflects the maximum ECC correction capability per sector. These numbers shall be rounded to the nearest integer. Annex A gives examples of these register for three cases: (a) 80 bytes of maximum correction capability, (b) 40 bytes and (c) 46 bytes.

Note (*): In case the media does not use ReSyncs this field shall be FFh.

7.12.3.1.2 The Current Threshold Values Page

Table 13 defines a data structure which provides the current threshold values set in the optical disk device. These values may be the default device values or may be the values set before by the MODE SELECT Command and the MEDIA ERRORS DEVICE PARAMETERS Page (see Sections 7.5 and 7.12..2.1 of this standard).

Table 13 - The CURRENT THRESHOLD VALUES Page

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral			Peripheral Device Type				
1	Page Code (C1h - Proposed Code)							
2	Reserved							
3	Page Length (h)							
4 - 9	Threshold for Number of Bytes in Error per Codeword							
10 - 15	Threshold for Number of Bytes in Error per Sector							
16 - 21	Threshold for Number of Bad Ids							
22 - 27	Threshold for Maximum Single Defect Length							
28 - 33	Threshold for Missing Sector Marks							
34 - 39	Threshold for Missing Data Sync							
40 - 45	Threshold for Missing Resync (*)							

Note (*): If the media does not use ReSyncs this threshold shall not be implemented and bytes 40 - 45 shall be FFh.

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Annex A (Informative)

Recommendations on Thresholds for Early Warning and Sector Retirement

This Annex lists two examples of sector retirement guidelines, recommendations on thresholds for early warning and high criteria definitions for different media types. The information has been extracted from two media interchange standards.

It is nor uncommon that some errors may occur in the media. Therefore, it is not recommended to set very conservative threshold values. Refer to the documentation associated with a particular drive.

1. ISO/IEC 10089 - Information technology - 130 mm rewritable optical disk cartridge for information interchange (approved standard):

This standard recommends in Annex H (informative) the following set of sector retirement guidelines:

The standard assumes that up to 2048 sectors may be replaced in any of the following cases:

a) A sector does not have at least two reliable Headers.

b) The Sector Mark is not readable.

c) A single defect of more than 30 bytes on a 1 024-byte per sectors is detected (15 bytes in a 512-byte sector).

d) The total number of defective bytes exceeds 40 bytes in 1 024-byte sectors (15 bytes in a 512-byte sector), or 5 bytes in one ECC interleave of a 1 024-byte sector, (3 bytes in a 512-byte sector).

2. ISO/IEC JTC 1/SC23/WG3 N186 - Information Interchange on 300 mm optical disk cartridges of he write once, read multiple (WORM) type using the CCS method (working draft - October 1992):

This working draft recommends in Annex H (informative) the following set of guidelines for sector replacement:

A sector is assumed to be defective and will be replaced by the defect management when any of the following conditions exist:

a) A sector has two or three Address fields with an error detected by the CRC check.

b) A column in the Data field (see Figure E1 of the working draft) contains more than three defective bytes A_n.

For other examples of sector retirement guidelines refer to the standards and draft standards listed under Section 3.