DEVELOPMENT STANDARD

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CD-ROM COMPATIBLE TAPE FORMAT
FOR INSTALLABLE FILE SYSTEM

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CD-ROM Compatible Tape Format for Installable File System
QIC-174 Rev A

Rev. A

INITIAL RELEASE FROM QIC 95-102 REV B.

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1. Introduction

This Standard relies on ISO 9660:1988 (E) with Microsoft Joliet Version 1 Extensions for Unicode with long file naming and the applicable QIC tape Common Recording Format, CRF1, CRF2, CRF3, or equivalent recording standard, to read and write volume and file structures on tape compatible with ISO-9660 CD-ROM images. In addition, any level 1 ISO 9660 compliant CD-ROM image with or without Joliet extensions can be written or read with only possible reductions in performance. This Standard extends ISO-9660 to provide for multiple CD-ROM images written in the tape Data Partition, a separate tape Directory Partition containing pointers to all CD-ROM images and the CD-ROM directory of the last image. This extension of ISO-9660 specifies the CD-ROM System Area and tape Directory Partition to improve system performance by making it possible for tape device drivers to buffer directory data and to quickly locate sessions.

Tapes fully compliant with this Standard use the QIC fixed dual partitioning and an entry within each CD-ROM System Area. This System Area entry is also compliant with ISO 9660 as described in Section 6.2.1 of the ISO 9660 specification. The tape Data Partition contains one or more complete CD-ROM images written sequentially. The tape Directory Partition contains the last CD-ROM image excluding the file extents. Should the CD-ROM System Area entry indicate tape extensions, there is an implied sequence of structures as indicated in Tables 1-4. In addition, the CD-ROM directory extents must be contiguous and immediately follow their respective Path Table.

Zero padding at the end of each tape session is added to improve performance for read ahead utilities. This padding adds the number of sectors to keep the partition an even modulo of 4 CD-ROM sectors. There is also zero padding added before the Supplementary Path Table.

In the case of CRF3, there may be tape Volume Table entries that precede entries for the CD-ROM images and directory and only the QCDF encapsulation is used. Within the tape Data Partition containing the CD-ROM images or Directory Partition, Filemarks are not used.

2. System Area Definition for CD-ROM Tape Extensions

In addition to the tape Directory Partition, the CD-ROM Tape Extensions will occupy the CD-ROM System Area, Relative Sector Numbers 0 to 15 (relative to the beginning of the session). For clarity, CD-ROM logical blocks will be referred to as Sectors. A translation must be made to convert CD-ROM logical Sectors into tape logical blocks. The preferred tape block size is 512 bytes whereas the CD-ROM Sector is always 2048 bytes. In this case, the CD-ROM Sector will contain 4 tape logical blocks that will be read or written in groups of 4. The System Area entries refer to Absolute Sectors (relative to the beginning of the tape Data Partition).

Although the Logical CD-ROM Sector and tape block Address start at 0, the CD-ROM image Byte Position, BP, starts at one. The BP offset is relative to the beginning of the session creating the CD-ROM image. The maximum BP of the CD-ROM System Area is 32768. The optional CD-ROM Directory Offset and the Description Offset fields are offsets to zero terminated ASCII strings. Use an offset of zero to omit any Directory or Description string. The Directory string is the starting directory of the image source. The Description string is text that provides information about the session.

2.1 CD-ROM System Area Tape Extension Entry

BP	Field Name	Content
1 to 16	Signature	"ISO 9660 TapeExt"
17 to 20	Version	numerical value[2] = 100 (16-bit)
21 to 52	Volume Identifier (as in PVD)	d-characters[4]
53 to 56	Serial Number	4 byte value[5] (32-bit)
57 to 64	Directory Partition Total Sectors[1]	numerical value[3] (32-bit)
65 to 72	Directory Partition Used Sectors	numerical value[3] (32-bit)
73 to 80	Directory Partition Start Sector	numerical value[3] (32-bit)
81 to 88	Data Partition Total Sectors[1]	numerical value[3] (32-bit)
89 to 96	Data Partition Used Sectors	numerical value[3] (32-bit)
99 to 100	Tracks per Cartridge[1] (**q**)	numerical value[2] (16-bit)
101 to 104	Track Sector List BP Offset[1] (**p**)	numerical value[2] (16-bit)
105 to 108	Session Total (**n**)	numerical value[2] (16-bit)
109 to 112	Session List BP Offset (**m**)	numerical value[2] (16-bit)
113 to 115	Addon Signature	"PG+" (as example)
116 to 116	Addon Size	numerical value (1-byte)
117 to 118	Addon Flags	numerical value (16-bit)
119 to 122	Addon Tape Free KB	numerical value (32-bit)
123 to 128	Addon Version Text	string (6-char)
m+0 to **m**+7	Session 1 Start Sector	numerical value[3] (32-bit)
m+8 to **m**+11	Session 1 Directory BP Offset	numerical value[2] (16-bit)
m+12 to **m**+15	Session 1 Description BP Offset	numerical value[2] (16-bit)
m+16 to **m**+23	Session 2 Start Sector	numerical value[3] (32-bit)
m+24 to **m**+27	Session 2 Directory BP Offset	numerical value[2] (16-bit)
m+28 to **m**+31	Session 2 Description BP Offset	numerical value[2] (16-bit)
….. to …..	Session **n** Start Sector	numerical value[3] (32-bit)
….. to …..	Session **n** Directory BP Offset	numerical value[2] (16-bit)
….. to …..	Session **n** Description BP Offset	numerical value[2] (16-bit)
p+0 to **p**+7	Track 0 Sector Address	numerical value[3] (32-bit)
p+8 to **p**+15	Track 1 Sector Address	numerical value[3] (32-bit)
	…	
….. to …..	Track (**q**-1) Sector Address	numerical value[3] (32-bit)

3. Tape Directory for CD-ROM Tape Extensions

For the CD-ROM image to be compliant with this Standard for tape extensions as indicated by the signature within the CD-ROM System Area, specific ordering of the CD-ROM structures is required. This ordering enables device drivers to improve system performance by buffering CD-ROM directories. This ordering ensures File and Directory Descriptors follow File Extents. Tables 1 and 3 show the required ordering for the Data Partition and Tables 2 and 4 show the required ordering for the Directory Partition.

Table 1 Data Partition Tape Extension sequence ISO-9660 Level 1

Relative Sectors	Description	ISO 9660 Reference
0 to 15	System Area	Section 6.2.1
16	Primary Volume Descriptor	Section 8.4
17	Volume Descriptor Set Terminator	Section 8.3
18 to 31	System Area Extension	
32 to n	File Extents	Section 6.4.3.6
n + 1	Path Table	Section 6.9
	File and Directory Descriptors	Section 9
	Pad to even Modulo 4 sectors	

Table 2 Directory Partition Tape Extension sequence ISO-9660 Level 1

Relative Sectors	Description	ISO 9660 Reference
0 to 15	System Area	Section 6.2.1
16	Primary Volume Descriptor	Section 8.4
17	Volume Descriptor Set Terminator	Section 8.3
18 to 31	System Area Extension	
32	Path Table	Section 6.9
	File and Directory Descriptors	Section 9
	Pad to even Modulo 4 sectors	

Table 3 Data Partition Tape Extension sequence with Unicode (Joliet)

Relative Sectors	Description	ISO 9660 Reference
0 to 15	System Area	Section 6.2.1
16	Primary Volume Descriptor	Section 8.4
17	Supplementary Volume Descriptor	Section 8.5
18	Volume Descriptor Set Terminator	Section 8.3
19 to 31	System Area Extension	
32 to n	File Extents	Section 6.4.3.6
n + 1	Supplementary Path Table	
	Supplementary File and Directory Descriptors	
	Pad to even Modulo 4 sectors	
	Primary Path Table	Section 6.9
	Primary File and Directory Descriptors	Section 9
	Pad to even Modulo 4 sectors	

Table 4 Directory Partition Tape Extension sequence with Unicode (Joliet)

Relative Sectors	Description	ISO 9660 Reference
0 to 15	System Area	Section 6.2.1
16	Primary Volume Descriptor	Section 8.4
17	Supplementary Volume Descriptor	Section 8.5
18	Volume Descriptor Set Terminator	Section 8.3
19 to 31	System Area Extension	
32	Supplementary Path Table	
	Supplementary File and Directory Descriptors	
	Pad to even Modulo 4 sectors	
	Primary Path Table	Section 6.9
	Primary File and Directory Descriptors	Section 9
	Pad to even Modulo 4 sectors	

Footnotes:

[1] Optional field, use a value of zero if unknown, these fields are used to optimize access of tape

[2] 16-bit numerical values are stored in 32-bits, in Intel low to high, then in Motorola high to low, as described in ISO 9660 Specification section 7.2.3

[3] 32-bit numerical values are stored in 64-bits, in Intel low to high, then in Motorola high to low, as described in ISO 9660 Specification section 7.3.3

[4] d-characters are 37 characters A-Z, 0-9, and underbar, as described in ISO 9660 Specification section 7.4.1

[5] Serial number is a 4 byte value used to uniquely identify a tape, typically this is the 32-bit encoded date and time of the tape initialization

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