

This is a preview - [click here to buy the full publication](#)

# INTERNATIONAL STANDARD

# ISO/IEC 14776-341

First edition  
2000-06

---

---

## Information technology – Small Computer System Interface-3 (SCSI-3) – Part 341: Controller Commands (SCC)

© ISO/IEC 2000

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

ISO/IEC Copyright Office • Case postale 56 • CH-1211 Genève 20 • Switzerland



PRICE CODE **XB**

*For price, see current catalogue*

## PATENT STATEMENT

The International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this International Standard may involve the use of patents concerning SCC.

The ISO and IEC take no position concerning the evidence, validity and scope of this patent right. The holder of this putative patent right has assured the ISO and IEC that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of the putative patent rights is registered with the ISO and IEC. Information may be obtained from:

IBM Corporation  
Intellectual Property Licensing  
5600 Cottle Road  
San Jose, CA 95153

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights other than those identified above. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

## Contents

	Page
Foreword .....	x
Introduction .....	xi
1 Scope .....	1
2 Normative references .....	1
2.1 Normative references .....	1
2.2 Approved references .....	1
2.3 References under development .....	1
3 Definitions, symbols, abbreviations, and conventions .....	1
3.1 Definitions .....	1
3.2 Abbreviations .....	4
3.3 Conventions .....	4
4 General .....	6
5 Models for systems containing arrays of devices .....	7
5.1 General .....	7
5.2 System layering model .....	7
5.2.1 SACL functions .....	7
5.2.2 Protocol conversion layer .....	8
5.2.3 Storage array conversion layer (SACL) .....	9
5.2.4 Examples of system layering variations .....	10
5.2.5 Branch of generic layers .....	11
5.2.6 Software SACL with a branch of SCSI disks .....	12
5.2.7 Branch with HBA SACL .....	13
5.2.8 Branch with bridge controller SACL .....	14
5.2.9 Branch with SACLs in multiple layers .....	15
5.3 Model for SCSI-3 storage arrays .....	16
5.3.1 SCSI storage array addressing .....	16
5.3.1.1 SCSI-3 storage array base address .....	16
5.3.1.2 Eight byte LUN structure .....	16
5.3.1.3 Component device address method .....	18
5.3.1.4 Logical unit address method .....	18
5.3.1.5 Peripheral device address method .....	19
5.3.1.6 Redundancy group address method .....	20
5.3.1.7 Spare address method .....	20
5.3.1.8 Volume set address method .....	20
5.3.2 SCSI-3 storage array objects .....	21
5.3.2.1 Adding objects .....	21
5.3.2.2 Association of objects .....	21
5.3.2.3 Attachment of objects .....	21
5.3.2.4 Covering of objects .....	22
5.3.2.5 Exchanging objects .....	22
5.3.2.6 Protected objects .....	22
5.3.2.7 Removing objects .....	22
5.3.2.8 Component device .....	23
5.3.2.9 Peripheral device .....	23
5.3.2.10 P_extent .....	23
5.3.2.11 Ps_extent .....	23
5.3.2.12 Redundancy group .....	24
5.3.2.12.1 No redundancy method of check data mapping .....	27
5.3.2.12.2 Copy redundancy method of check data mapping .....	27

5.3.2.12.3 XOR or P+Q redundancy method of check data mapping .....	27
5.3.2.12.4 Vendor specific redundancy method of check data mapping .....	27
5.3.2.13 Spares .....	27
5.3.2.14 Volume sets .....	28
5.3.3 SCSI-3 storage array operations .....	34
5.3.3.1 Rebuild operation .....	34
5.3.3.2 Recalculate operation .....	34
5.3.3.3 Regenerate operation .....	34
5.3.3.4 Verify operation .....	34
5.3.4 SCSI-3 storage array states .....	34
5.3.5 SCSI-3 storage array exception conditions .....	34
<b>6 Commands for SCSI-3 storage array devices .....</b>	<b>36</b>
6.1 Commands .....	36
6.2 MAINTENANCE(IN) command .....	37
6.2.1 MAINTENANCE(IN) command service actions .....	37
6.2.1.1 REPORT ASSIGNED/UNASSIGNED P_EXTENT service action .....	37
6.2.1.2 REPORT COMPONENT DEVICE service action .....	40
6.2.1.3 REPORT COMPONENT DEVICE ATTACHMENTS service .....	43
6.2.1.4 REPORT PERIPHERAL DEVICE service action .....	47
6.2.1.5 REPORT PERIPHERAL DEVICE ASSOCIATIONS service action .....	49
6.2.1.6 REPORT PERIPHERAL DEVICE/COMPONENT DEVICE IDENTIFIER service action .....	52
6.2.1.7 REPORT STATES service action .....	54
6.3 MAINTENANCE (OUT) commands .....	62
6.3.1 MAINTENANCE (OUT) command service actions .....	62
6.3.1.1 ADD PERIPHERAL DEVICE/COMPONENT DEVICE service action .....	63
6.3.1.2 ATTACH TO COMPONENT DEVICE service action .....	64
6.3.1.3 BREAK PERIPHERAL DEVICE/COMPONENT DEVICE service action .....	65
6.3.1.4 EXCHANGE P_EXTENT service action .....	66
6.3.1.5 EXCHANGE PERIPHERAL DEVICE/COMPONENT DEVICE service action .....	68
6.3.1.6 INSTRUCT COMPONENT DEVICE service action .....	69
6.3.1.7 REMOVE PERIPHERAL DEVICE/COMPONENT DEVICE service action .....	70
6.3.1.8 SET PERIPHERAL DEVICE/COMPONENT DEVICE IDENTIFIER service action .....	71
6.4 REDUNDANCY GROUP (IN) command .....	73
6.4.1 REDUNDANCY GROUP (IN) command service actions .....	73
6.4.1.1 REPORT REDUNDANCY GROUPS service action .....	73
6.4.1.2 REPORT UNASSIGNED REDUNDANCY GROUP SPACE service action .....	77
6.5 REDUNDANCY GROUP (OUT) command .....	80
6.5.1 REDUNDANCY GROUP (OUT) command service actions .....	80
6.5.1.1 CONTROL GENERATION OF CHECK DATA service action .....	81
6.5.1.2 CREATE/MODIFY REDUNDANCY GROUP service action .....	82
6.5.1.3 DELETE REDUNDANCY GROUP service action .....	85
6.5.1.4 REBUILD P_EXTENT service action .....	86
6.5.1.5 REBUILD PERIPHERAL DEVICE service action .....	88
6.5.1.6 RECALCULATE CHECK DATA service action .....	91
6.5.1.7 VERIFY CHECK DATA service action .....	92
6.6 VOLUME SET (IN) command .....	95
6.6.1 VOLUME SET (IN) command service actions .....	95
6.6.1.1 REPORT VOLUME SETS service action .....	95
6.7 VOLUME SET (OUT) command .....	98
6.7.1 VOLUME SET (OUT) command service actions .....	98
6.7.1.1 CONTROL GENERATION OF CHECK DATA service action .....	99
6.7.1.2 CONTROL WRITE OPERATIONS service action .....	100
6.7.1.3 CREATE/MODIFY VOLUME SET service action .....	101
6.7.1.4 DELETE VOLUME SET service action .....	104
6.7.1.5 RECALCULATE VOLUME SET CHECK DATA service action .....	105
6.7.1.6 VERIFY VOLUME SET CHECK DATA service action .....	107

6.8 SPARE (IN) command .....	111
6.8.1 SPARE (IN) command service actions .....	111
6.8.1.1 REPORT P_EXTENT SPARE service action .....	111
6.8.1.2 REPORT PERIPHERAL DEVICE/COMPONENT DEVICE SPARE service action .....	114
6.9 SPARE (OUT) command .....	117
6.9.1 SPARE (OUT) command service actions .....	117
6.9.1.1 CREATE/MODIFY P_EXTENT SPARE service action .....	118
6.9.1.2 CREATE/MODIFY PERIPHERAL DEVICE/COMPONENT DEVICE SPARE service action .....	121
6.9.1.3 DELETE SPARE service action .....	122
6.10 Parameters for direct-access devices .....	124
6.10.1 Mode parameters .....	124
6.10.1.1 LUN mapping page .....	124
Annex A SCSI-3 storage array IDENTIFY message format .....	126
A.1 SCSI-3 storage array IDENTIFY message overview .....	126
A.2 IDENTIFY message .....	126
Annex B SCSI-3 storage array addressing examples .....	127
B.1 SCSI storage array addressing examples overview .....	127
B.2 Addressing Examples for the 8-byte LUN structure .....	127
B.3 Addressing Examples for the 6-bit LUN structure .....	130
Annex C Examples of check data and user data mappings .....	132
C.1 Example XOR redundancy mapping .....	132
C.2 User data mapping examples .....	133

## Tables

	Page
1 Addressing methods within a SCSI-3 storage array .....	16
2 Eight byte LUN structure adjustments .....	17
3 Eight byte LUN structure .....	17
4 FIRST LEVEL ADDRESSING field, SECOND LEVEL ADDRESSING field, THIRD LEVEL ADDRESSING field, and FOURTH LEVEL ADDRESSING field .....	18
5 ADDRESS METHOD .....	18
6 Logical unit addressing .....	19
7 Peripheral device addressing .....	19
8 Volume set addressing .....	20
9 Commands for SCSI storage array devices .....	36
10 Service actions for MAINTENANCE(IN) command .....	37
11 REPORT ASSIGNED/UNASSIGNED P_EXTENT service action .....	38
12 REPORT ASSIGNED/UNASSIGNED P_EXTENT parameter list .....	39
13 Data format of ASSIGNED/UNASSIGNED P_EXTENT DESCRIPTOR .....	39
14 Data format of P_EXTENT DESCRIPTOR .....	40
15 REPORT COMPONENT DEVICE service action .....	41
16 REPORT COMPONENT DEVICE parameter list .....	42
17 Data format of COMPONENT DEVICE DESCRIPTOR .....	42
18 COMPONENT DEVICE TYPES .....	43
19 REPORT COMPONENT DEVICE ATTACHMENTS service action .....	44
20 REPORT COMPONENT DEVICE ATTACHMENTS parameter list .....	45
21 Format of COMPONENT DEVICE ATTACHMENT DESCRIPTOR .....	46
22 Data format of LOGICAL UNIT DESCRIPTOR .....	46
23 LOGICAL UNIT types .....	47
24 REPORT PERIPHERAL DEVICE service action .....	47
25 SELECT REPORT .....	48
26 REPORT PERIPHERAL DEVICE parameter list .....	48
27 Format of PERIPHERAL DEVICE DESCRIPTOR .....	49
28 REPORT PERIPHERAL DEVICE ASSOCIATIONS service action .....	50
29 REPORT PERIPHERAL DEVICE ASSOCIATIONS parameter list .....	51
30 Format of PERIPHERAL DEVICE ASSOCIATIONS DESCRIPTOR .....	52
31 REPORT PERIPHERAL DEVICE/COMPONENT DEVICE IDENTIFIER service action .....	53
32 REPORT PERIPHERAL DEVICE/COMPONENT DEVICE IDENTIFIER parameter list .....	54
33 REPORT STATES service action .....	55
34 REPORT STATES .....	55
35 REPORT STATES parameter list .....	56
36 Format of LOGICAL UNIT STATES DESCRIPTORS .....	57
37 Target base device (LUN 0) states .....	58
38 Volume set states .....	59
39 Redundancy group states .....	60
40 Peripheral device and p_extent states .....	61
41 Spare states .....	61
42 Component device states .....	62
43 Service actions for MAINTENANCE (OUT) command .....	62
44 ADD PERIPHERAL DEVICE/COMPONENT DEVICE service action .....	63
45 ATTACH COMPONENT DEVICE service actions .....	64
46 ATTACH COMPONENT DEVICE parameter list .....	65
47 BREAK PERIPHERAL DEVICE/COMPONENT DEVICE service action .....	66
48 EXCHANGE P_EXTENT service action .....	67
49 EXCHANGE P_EXTENT parameters list .....	67
50 EXCHANGE PERIPHERAL DEVICE/COMPONENT DEVICE Service Action .....	68
51 INSTRUCT COMPONENT DEVICE service action .....	69
52 COMPONENT DEVICE INSTRUCTION field .....	69
53 INSTRUCT COMPONENT DEVICE parameter list .....	70
54 REMOVE PERIPHERAL DEVICE/COMPONENT DEVICE service action .....	70

55 SET PERIPHERAL DEVICE/COMPONENT DEVICE IDENTIFIER service action .....	71
56 SET PERIPHERAL DEVICE/COMPONENT DEVICE IDENTIFIER parameter list .....	72
57 Service actions for REDUNDANCY GROUP (IN) command .....	73
58 REPORT REDUNDANCY GROUPS service action .....	73
59 REPORT REDUNDANCY GROUPS parameter list .....	74
60 Format of REPORT REDUNDANCY GROUP DESCRIPTOR .....	75
61 REDUNDANCY GROUP IDENTIFIERS .....	75
62 GRANULARITY OF UNITS .....	76
63 REDUNDANCY GROUP P_EXTENT DESCRIPTOR .....	76
64 REPORT UNASSIGNED REDUNDANCY GROUP SPACE service action .....	77
65 REPORT UNASSIGNED REDUNDANCY GROUP SPACE parameter list .....	78
66 Format of REPORT UNASSIGNED REDUNDANCY GROUP SPACE DESCRIPTOR .....	79
67 Data format of PS_EXTENT DESCRIPTOR .....	80
68 Service actions for REDUNDANCY GROUP (OUT) command .....	81
69 CONTROL GENERATION OF CHECK DATA service action .....	81
70 CREATE/MODIFY REDUNDANCY GROUP service action .....	82
71 CREATE/MODIFY REDUNDANCY GROUP parameter list .....	83
72 Data format of CREATE/MODIFY P_EXTENT DESCRIPTOR .....	84
73 DELETE REDUNDANCY GROUP service action .....	85
74 REBUILD P_EXTENT service action .....	86
75 Rebuild types .....	87
76 REBUILD P_EXTENT parameter list .....	88
77 REBUILD PERIPHERAL DEVICE service action .....	89
78 Rebuild types .....	90
79 REBUILD PERIPHERAL DEVICE parameter list .....	91
80 RECALCULATE CHECK DATA service action .....	92
81 VERIFY CHECK DATA service action .....	93
82 Service actions for volume set (in) command .....	95
83 REPORT VOLUME SETS service action .....	95
84 REPORT VOLUME SETS parameter list .....	96
85 Format of REPORT VOLUME SET DESCRIPTOR .....	97
86 VOLUME SET PS_EXTENT DESCRIPTOR .....	98
87 Service actions for VOLUME SET (OUT) command .....	99
88 CONTROL GENERATION OF CHECK DATA service action .....	99
89 CONTROL WRITE OPERATIONS service action .....	101
90 CREATE/MODIFY VOLUME SET service action .....	102
91 CREATE/MODIFY VOLUME SET parameter list .....	103
92 Data format of CREATE/MODIFY PS_EXTENT DESCRIPTOR .....	104
93 DELETE VOLUME SET service action .....	105
94 RECALCULATE VOLUME SET CHECK DATA service action .....	106
95 RECALCULATE VOLUME SET CHECK DATA parameter list .....	107
96 VERIFY VOLUME SET CHECK DATA service action .....	108
97 VERIFY RANGE .....	109
98 VERIFY VOLUME SET CHECK DATA parameter list .....	110
99 Service actions for SPARE (IN) command .....	111
100 REPORT P_EXTENT SPARE service action .....	111
101 REPORT P_EXTENT SPARE parameter list .....	112
102 Format of REPORT P_EXTENT SPARE DESCRIPTOR .....	113
103 REPORT PERIPHERAL DEVICE/COMPONENT DEVICE SPARE service action .....	114
104 REPORT PERIPHERAL DEVICE/COMPONENT DEVICE SPARE parameter list .....	115
105 Format of REPORT PERIPHERAL DEVICE/COMPONENT DEVICE SPARE DESCRIPTOR .....	116
106 Data format of covered LOGICAL UNIT DESCRIPTOR .....	117
107 LOGICAL UNIT TYPES .....	117
108 Service actions for spare (out) command .....	118
109 CREATE/MODIFY P_EXTENT SPARE service action .....	118
110 CREATE/MODIFY P_EXTENT SPARE parameter list .....	120
111 CREATE/MODIFY PERIPHERAL DEVICE/COMPONENT DEVICE SPARE service action .....	121

This is a preview - [click here to buy the full publication](#)

112 CREATE/MODIFY PERIPHERAL DEVICE/COMPONENT DEVICE SPARE parameter list ..... 122  
113 DELETE SPARE service action ..... 123  
114 Mode page codes ..... 124  
115 LUN mapping page ..... 125  
A.1 IDENTIFY message format ..... 126



## Figures

	Page
0 SCSI-3 document road map .....	xii
1 Protocol conversion layer .....	8
2 SACL conversion layer .....	9
3 Typical system diagram .....	10
4 Branch of generic layers .....	11
5 Software SACL with a branch of SCSI disks .....	12
6 Branch with HBA SACL .....	13
7 Branch with bridge controller SACL .....	14
8 Branch with SACLs in multiple layers .....	15
9 Single redundancy group .....	24
10 Multiple volume sets associated with a single redundancy group .....	25
11 Redundancy group check data mapping flow chart .....	26
12 Multiple redundancy groups .....	29
13 Single volume set associated with multiple redundancy groups .....	29
14 Volume set user data mapping flow chart (part 1) .....	31
15 Volume set user data mapping flow chart (part 2) .....	32
16 Volume set user data mapping flow .....	33
C.1 XOR redundancy mapping example .....	132
C.2 User data mapping for a RAID 5 configuration .....	133
C.3 User data mapping for a RAID 3 configuration .....	134

## Foreword

ISO (the International Organization of 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 standard 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. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75% of the national bodies casting a vote.

International Standard ISO/IEC 14776-341 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

## Introduction

The SCSI command set is designed to provide efficient peer-to-peer operation of input/output devices (disks, tapes, printers, etc.) by an operating system. The SCSI command set assumes a command-response protocol. Action on SCSI commands shall not be deemed completed until a response is received. The response shall include a status that indicates the final disposition of the command.

The SCSI command set provides multiple operating systems concurrent control over one or more input/output devices. However, the multiple operating systems must properly coordinate their actions or data corruption will result. This standard defines commands that assist with coordination between multiple operations systems. However, details of the coordination are beyond the scope of the SCSI command set.

This standard defines a device model for SCSI-3 storage arrays. This standard defines the SCSI commands that may apply to SCSI-3 storage arrays and the SCSI commands that are uniquely for SCSI-3 storage arrays.

The SCSI-3 Controller Commands (SCC) standard is divided into six clauses:

- Clause 1 is the scope;
- Clause 2 enumerates the normative references that apply to this standard;
- Clause 3 describes the definitions, symbols and abbreviations used in this standard;
- Clause 4 describes the conceptual relationship between this document and the SCSI-3 Architecture Model;
- Clause 5 describes the command model for SCSI-3 storage array devices;
- Clause 6 defines the commands that may be implemented by an SCSI-3 storage array device.

The annexes provide information to assist with implementation of the SCSI-3 Controller Commands standard. Annex A is normative and is considered part of this standard. Annexes B and C are for information only.

Figure 0 is intended to show the relationship of this document to other SCSI-3 standards. The figure is not intended to imply a relationship such as a hierarchy, protocol stack, or system architecture. It indicates the applicability of a standard to the implementation of a given transport.

This is a preview - click here to buy the full publication

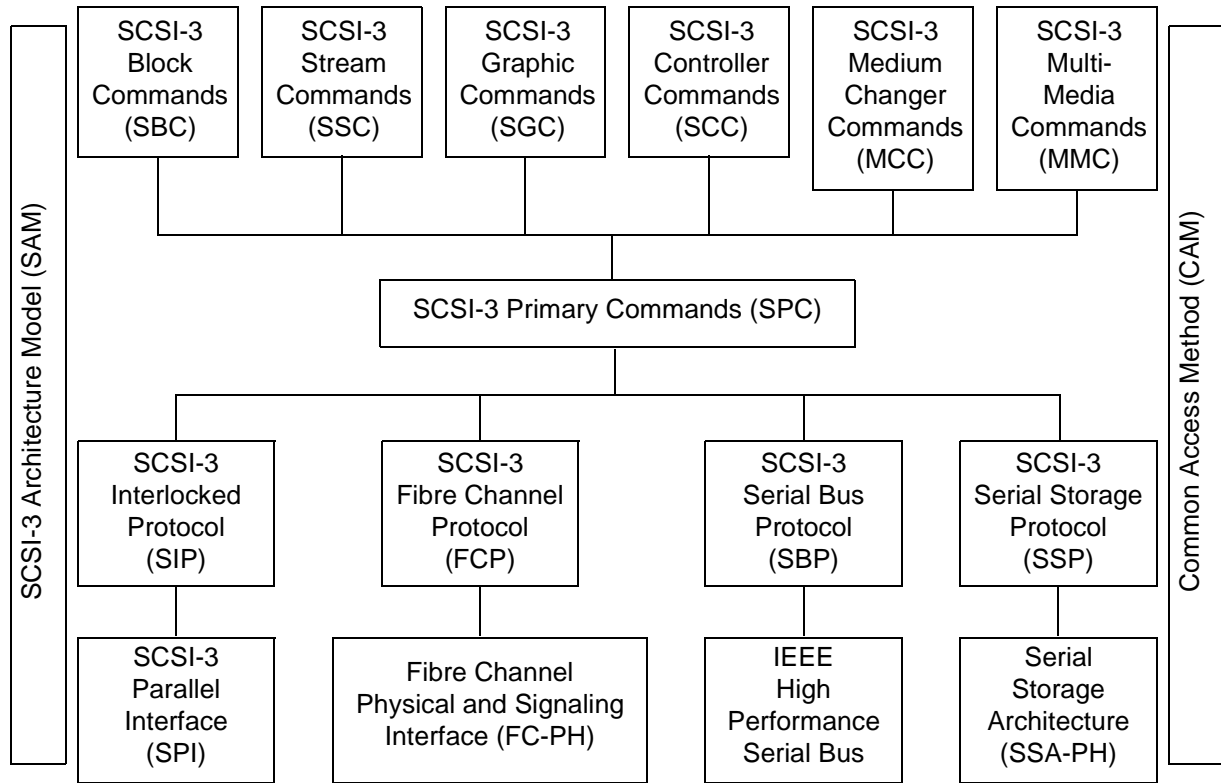


Figure 0 - SCSI-3 document road map

## 1 Scope

This International Standard defines the command set extensions for SCSI-3 storage array devices; commonly known as RAID devices. This standard is principally intended to be used in conjunction with, not as an alternate to, any of the SCSI-3 command standards and the SCSI-3 Architecture Model Standard (ISO/IEC IS 14776-411). The resulting commands facilitate the control and configuration of SCSI-3 storage arrays and thus provide a common command specification for both system integrators and suppliers of SCSI-3 storage array devices.

The clause(s) of this standard pertaining to the SCSI-3 storage array device class, implemented in conjunction with the applicable clauses within any of the SCSI-3 command standards, shall specify the standard command set available for SCSI-3 storage arrays.

The objectives of the SCSI-3 Controller Commands is to provide the following:

- a) Transfer commands unique to SCSI-3 Controller Command devices;
- b) Control commands to manage the operation of an SCSI-3 Controller Command device;
- c) Optional device mapping and pass-through support.

## 2 Normative references

### 2.1 Normative references

The following standards contain provisions which, through reference in the 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 listed below.

Members of IEC and ISO maintain registers of currently valid standards.

### 2.2 Approved references

SCSI-3 Architecture Model Standard (ISO/IEC 14776-411)

### 2.3 References under development

At the time of publication, the following referenced standards were still under development. For information on the current status of the document, or regarding availability, contact the relevant standards body or other organization as indicated.

SCSI-3 Interlocked Protocol Standard (ISO/IEC 14776-211)

SCSI-3 Primary Commands Standard (ISO/IEC 14776-311)