



**Table A.4 – Summary of new ASC/ASCQs required**

ASC/ASCQ	SEND DIAGNOSTIC
34h/0	Enclosure failure
0B/02	Enclosure warning
35h/0	Enclosure Services Failure
35h/1	Unsupported Enclosure Function
35h/2	Enclosure Services Unavailable
35h/3	Enclosure Transfer Failure
35h/4	Enclosure Transfer Refused

## Annex B (informative)

### Additional ASC/ASCQ for enclosure services devices

#### B.1 Additional ASC/ASCQ for enclosure services function integrated into devices.

Seven new ASC/ASCQ values should be defined for conditions associated with enclosure services or with the delivery of enclosure services information.

**Enclosure Failure:** This ASC/ASCQ is provided to indicate when a critical or an unrecoverable enclosure failure has been detected by the enclosure. This is provided using the Sense Key of HARDWARE ERROR. Further information may be available using the REQUEST DIAGNOSTIC RESULTS command and requesting the enclosure services in page. This condition can only be presented by an enclosure services type device for a command other than SEND DIAGNOSTIC or RECEIVE DIAGNOSTIC RESULTS.

**Enclosure Degraded Warning:** This ASC/ASCQ is provided to indicate that an informational condition or a noncritical failure has been detected by the enclosure. This is provided using the Sense Key of RECOVERED ERROR and may be managed by the Informational Exceptions Control mode page. Further information may be available using the RECEIVE DIAGNOSTIC RESULTS command and requesting the enclosure services in page. This condition can only be presented by an enclosure services type device for a command other than SEND DIAGNOSTIC or RECEIVE DIAGNOSTIC RESULTS.

**Unspecified Enclosure Services Failure:** This ASC/ASCQ is provided to indicate that the enclosure services device has failed in an unknown manner. This condition can be presented by any device that provides enclosure services access.

**Unsupported Enclosure Function:** This ASC/ASCQ indicates that the device has been

asked to invoke an enclosure services function that does not exist. This condition can be presented by any device that provides enclosure services access.

**Enclosure Services Unavailable:** This ASC/ASCQ indicates that the device has been asked to invoke an enclosure services function that is temporarily busy or unavailable. This condition can be presented by any device that provides enclosure services access.

**Enclosure Transfer Failure:** This ASC/ASCQ indicates that the device communication with the enclosure services function has failed. This condition can be presented by any device that provides enclosure services access.

**Table A.3 – Enclosure Transfer Refused**  
This ASC/ASCQ indicates that the device or the enclosure services function indicated either an error or an invalid format in their communication. This condition can be presented by any device that provides enclosure services access.

**Table A.2 – RECEIVE DIAGNOSTIC RESULTS command (Table 41 of SPC)**

Bits Bytes	7	6	5	4	3	2	1	0
0	Operation Code (1Ch)							
1	reserved			PF				
2	page code							
3	(MSB) Allocation Length (LSB)							
4								
5	Control							

“If the PF bit is set to zero, the RECEIVE DIAGNOSTIC RESULTS command shall transfer the information specified by a previous SEND DIAGNOSTIC command. If no previous SEND DIAGNOSTIC command information is valid in the device server, the response is vendor-specific.”

“If the PF bit is set to one, the RECEIVE DIAGNOSTIC RESULTS command shall transfer the diagnostic page specified by the page code field. If the specified diagnostic page is not implemented by the device server, the command shall be terminated with a CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB. If the specified diagnostic page is implemented by the device server, but is temporarily or permanently not accessible, the command shall be terminated with a CHECK CONDITION status with a sense key specific to the device model.”

“If the allocation length is greater than the length of the fields to be returned, only the data specified by the page formats is returned. Device servers shall not adjust the content of the returned data to reflect truncation if the allocation length is less than the length specified by the page formats.”

Paragraphs including: “A reservation conflict shall occur....page format definitions.” remain unchanged. Appropriate wording that requires that a reservation conflict occur when there is a conflicting persistent reservation must be added.

## Annex A (informative)

### Additions to SPC document in support of SES

Table numbers and section numbers, where applicable, are referenced using SPC X3T10/995D revision 8.

#### A.1 Additions to INQUIRY command

Those devices using the enclosure services device type model use a peripheral device type code of 0Dh. The following entries must be added or modified in Table 21, Peripheral device type. Only those rows that are added or modified are included in Table A.1.

**Table A.1 – 21 - Peripheral device type**

Code	Doc.	Description
0Dh	SES	Enclosure services device
0Eh - 1Eh		Reserved

Those devices providing enclosure services, but not using the enclosure services device model will use the following bit and bit definition in the INQUIRY command to indicate their support for those commands.

Byte 6, bit 6 of Table 19 - Standard INQUIRY data format (section 7.5.1) is changed from reserved to ESS. The following text is added in section 7.5.1 in the proper order to describe the ESS bit.

“The ESS (Enclosure Services Supported) bit of one indicates that the device supports the enclosure services pages of the SEND DIAGNOSTIC and RECEIVE DIAGNOSTIC RESULTS page. An ESS bit of zero indicates that the device does not support the enclosure services pages.”

#### A.2 Definition of SEND DIAGNOSTIC and RECEIVE DIAGNOSTIC RESULTS

Section 7.23 of SPC defines the SEND DIAGNOSTIC command. No change is required.

Section 7.16 of SPC defines the RECEIVE DIAGNOSTIC RESULTS command. The first paragraph and the parameter descriptions are modified to allow a particular page to be requested and to allow the command to be executed without a preceding SEND DIAGNOSTIC command as follows. Note that this text also corrects a discrepancy in the present definition of the command, where the definition of the returned page is not specified clearly for the case where no SEND DIAGNOSTIC precedes the RECEIVE DIAGNOSTIC RESULTS command.

#### A.2.1 New Text for RECEIVE DIAGNOSTIC RESULTS command, 7.16 of SPC

“The RECEIVE DIAGNOSTIC RESULTS command (see table A.2) requests that analysis data be sent to the application client after completion of a SEND DIAGNOSTIC command (see 7.23). The command optionally specifies which diagnostic page is to be returned by setting the page code to a value other than zero.”

## **5 Bibliography**

### **5.1 Bibliography and references**

This bibliography contains those references to published documents that are products of consortia, ad hoc organizations, and specialized standards bodies that do not have national or international recognition.

Small Form Factor (SFF) document SFF-8045, *SCA-2 connector for FC-AL*.



**6.2.21 SCSI Initiator Port element**

**Table 65 – SCSI Initiator Port element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								Enable

**Enable:**

1 = SCSI target port shall be enabled

**Table 66 – SCSI Initiator Port element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3								Enabled

**Enabled:**

1 = SCSI target port is enabled



**Table 62 – Current sensor element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1							Over	
2 thru 3	sign	(MSB) Current Value (milliamps, 2's complement notation) (LSB)						

**Over current sensed:**

1 = Over current warning or critical threshold violated

units of 1 milliamp. The high order bit is a sign indication using the convention of 2's complement arithmetic

**Current value:**

Indicate the 16-bit 2's complement value of current being detected at the sensor, measured in

**6.2.20 SCSI Target Port element**

**Table 63 – SCSI Target Port element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								Enable

**Enable:**

1 = SCSI target port shall be enabled

**Table 64 – SCSI Target Port element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3								Enabled

**Enabled:**

1 = SCSI target port is enabled

**Table 59 – Voltage sensor element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								

**Table 60 – Element status bytes for voltage sensor**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1							Over	Under
2 thru 3	sign	(MSB)	Voltage Value (millivolts, 2's complement notation) (LSB)					

**Over voltage sensed:**

1 = Over voltage warning or critical threshold violated

**Under voltage sensed:**

1 = Under voltage warning or critical threshold violated

**Voltage value:**

Indicate the 16-bit 2's complement value of voltage being detected at the sensor, measured in

units of 1 millivolt. The high order bit is a sign indication using the convention of 2's complement arithmetic

**6.2.19 Current Sensor element**

The current sensor element uses a threshold value applied to the magnitude of the most significant 8 bits.

**Table 61 – Current sensor element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								

technical English using ASCII character encoding is being used.

### 6.2.17 Communication port element

**Table 57 – Communication Port for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								Disable

**Disable:**

1 = Instructs communication port to disable or remain disabled.

0 = Instructs communication port to enable or remain enabled.

**Table 58 – Communication port for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3								Disabld

**Disabld:**

1 = Indicates communication port is disabled

### 6.2.18 Voltage Sensor element

The voltage sensor element uses a threshold value applied to the magnitude of the most significant 8 bits.

**Table 54 – SCSI port/transceiver for enclosure and array control status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3				Disabl			LOL	Lsr Fail

**Disabl:**

1 = Indicates transceiver is disabled

**Loss of Light :**

1 = Indicates receiver is not detecting input, either due to a receiver failure or a line failure.

**Laser Failure:**

1 = Indicates transmit laser has failed and has been turned off

**6.2.16 Language element**

**Table 55 – Language element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2	Language code							
3								

**Language Code:**

Request the language and character encoding of all text scripts. Code structure to be selected.

**Table 56 – Language element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2	Language code							
3								

**Language Code:**

Indicate the language and character encoding of all text scripts. Code structure to be selected. A code of all zero indicates that the default of

**6.2.14 Key pad entry device element**

**Table 51 – Key pad entry device element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								

**Table 52 – Key pad entry device element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3								

Bits to be defined

**6.2.15 SCSI port/transceiver element**

**Table 53 – SCSI port/transceiver for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3				Disable				

***Disable:***

1 = Instructs transceiver to disable or remain disabled.

0 = Instructs transceiver to enable or remain enabled.

**AC hi:**

1 = AC line voltage is higher than specified value.

**AC qual:**

1 = AC line voltage quality is outside specified values.

**AC fail :**

1 = AC line voltage has failed.

**DC Fail:**

1 = DC line voltage has failed.

**UPS Fail:**

1 = The UPS is detected to have an operational failure.

**Warn :**

1 = The UPS has provided a warning signal that indicates that output power will soon fail.

**Intf Fail:**

1 = The enclosure services interface to the UPS has failed.

**Batt fail :**

1 = UPS battery has failed.

**BPF (Battery Predicted Failure) :**

1 = UPS battery is detected to be close to a failure condition.

**6.2.13 Display element**

**Table 49 – Display element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								

**Table 50 – Display element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3								

Bits to be defined

**Table 46 – Nonvolatile cache element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3								

Note that failures of the nonvolatile cache may require immediate changes in the operating mode for the system. Information may not be accessible from the cache after such a failure.

Bits to be defined

**6.2.12 Uninterruptible power supply element**

the UPS may use a threshold value based on the 8 bits of the battery status field.

**Table 47 – Uninterruptible power supply element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								

**Table 48 – Uninterruptible power supply element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1	Battery Status (minutes of charge at present power usage rate)							
2	AC lo	AC hi	AC qual	AC fail	DC fail	UPS fail	Warn	Intf Fail
3							Batt fail	BPF

Preliminary definitions.

**Battery Status:**

Battery status is indicated in minutes of capability from 1 to 254 minutes. An indication of 255 minutes indicates that the battery will last longer than 254 minutes. An indication of 0 minutes

indicates that the battery is not operating or not available.

**AC lo:**

1 = AC line voltage is lower than specified value.

**6.2.10 SCC controller electronics element**

**Table 43 – SCC controller element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								

**Table 44 – SCC controller element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3								

Bits to be defined

**6.2.11 Nonvolatile cache element**

**Table 45 – Nonvolatile cache element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								



**Rqst Mute:**

1 = Indicates panel control has been manipulated to request that the audible alarm be muted.

0 = Indicates panel control has not been activated.

**Muted:**

1 = Indicates audible alarm is in muted state.

0 = Indicates audible alarm is in un-muted state.

**Remind:**

1 = Indicates audible alarm is set to tone suitable for reminding user that other tones have been previously active.

0 = Indicates audible alarm is set to transmit tone requested by tone urgency indicators/controls.

**Tone urgency indicator/control:**

Each bit indicates a tone of increasing urgency (bit 4, least urgent). If more than one bit is set to

1, the most urgent of the selected tones is active.

All bits = 0 indicates audible alarm is quiet.

**Info:**

1 = Indicates audible alarm with tone suitable for informational warning.

**Non-Crit:**

1 = Indicates audible alarm with tone suitable for noncritical failure.

**Crit:**

1 = Indicates audible alarm with tone suitable for critical failure.

**Unrecov:**

1 = Indicates audible alarm with tone suitable for unrecoverable failure.

**6.2.9 ES controller electronics element**

**Table 41 – ES controller element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								

**Table 42 – ES controller element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3								

Bits to be defined

### 6.2.8 Audible Alarm element

**Table 39 – Element control bytes for audible alarm**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3		Set Mute		Set Remind	Urgency control			
					Info	Non-Crit	Crit	Unrecov

**Set Mute:**

1 = Sets audible alarm to muted state. The remind state may optionally be used instead of the muted state under software control.

0 = Sets audible alarm to un-muted state.

**Set Remind:**

1 = Sets audible alarm to tone suitable for reminding user that other tones have been previously active.

0 = Sets audible alarm to transmit tone requested by tone urgency indicators/controls.

**Tone urgency control:**

Each bit establishes a tone of increasing urgency (bit 4, least urgent). If more than one bit is set to 1, the most urgent of the selected tones is activated.

The quality of each tone and the use of separate tones is enclosure dependent. The bits and

tones may be set either through the control byte or by the enclosure.

If a new error condition occurs while the audible alarm is set in the Remind or Muted state, the state will be reset and the normal alarm conditions will occur for that error, but not the previous error.

**Info:** 1 = Sets audible alarm with tone suitable for informational warning.

All bits = 0 indicates audible alarm is quiet.

**Non-Crit:** 1 = Sets audible alarm with tone suitable for noncritical failure.

**Crit:** 1 = Sets audible alarm with tone suitable for critical failure.

**Unrecov:**

1 = Sets audible alarm with tone suitable for unrecoverable failure.

**Table 40 – Element status bytes for audible alarm**

Bits Bytes	7	6	5	4	3	2	1	0
1								
2								
3	Rqst Mute	Muted		Remind	Urgency indicator			
					Info	Non-Crit	Crit	Unrecov

**Over Temperature (OT) Warning:**

1 = temperature at sensor is higher than normal operating temperature but will not damage the enclosure.

**Under Temperature (UT) Warning:**

1 = temperature at sensor is lower than normal operating temperature range but will not damage the enclosure.

**Under Temperature (UT) Failure:**

1 = temperature at sensor is lower than a safe operating temperature and enclosure damage may occur.

**6.2.7 Door lock element**

**Table 37 – Door lock element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3								Unlock

**Unlock:**

1 = Instructs door latch to unlock or remain unlocked.

0 = Instructs door latch to lock or remain locked.

**Table 38 – Door lock element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3								Unlocked

**Unlocked:**

1 = Indicates door lock is unlocked

**Table 34 – Speed Code**

Speed Code	Description
000b	Fan stopped (Actual Speed Code only)
001b	Fan at lowest speed
010b	Fan at second lowest speed
011b	Fan at speed 3
100b	Fan at speed 4
101b	Fan at speed 5
110b	Fan at intermediate speed
111b	Fan at highest speed

**6.2.6 Temperature sensor element**

The temperature sensor may use a threshold value based on the Temperature field.

**Table 35 – Temperature sensor element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1-3	Reserved							

**Table 36 – Temperature sensor element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2	Temperature (degrees Celsius + 20)							
3					OT, Failure	OT, warning	UT, Failure	UT, warning

**Temperature :**

value = temperature at sensor in degrees Celsius + 20. Range is from -20 to +245 degrees Celsius

**Over Temperature (OT) Failure:**

1 = temperature at sensor is higher than a safe operating temperature and enclosure damage may occur.

**Set Fail Indicator:**

1 = Instructs the enclosure to turn the cooling element failure indicator on.

0 = Instructs the enclosure to turn the cooling element failure indicator off unless turned on by internal circuitry.

**Request on:**

1 = Instructs the cooling element to turn on or remain on.

0 = Instructs the cooling element to turn off or remain off.

**Requested Speed Code:**

Code indicates requested speed of fan or cooling device

**Table 32 – Speed Code**

Speed Code	Description
000b	Fan stopped (Actual Speed Code only)
001b	Fan at lowest speed
010b	Fan at second lowest speed
011b	Fan at speed 3
100b	Fan at speed 4
101b	Fan at speed 5
110b	Fan at intermediate speed
111b	Fan at highest speed

**Table 33 – Cooling element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2								
3		Fail	Rqsted On			Actual Speed Code		

**Fail:**

1 = Indicates that cooling element failure indicator is on or has been set on.

**Requested on:**

1 = Indicates that the cooling element has been requested to be in the operating state.

**Actual Speed Code:**

Code indicates actual speed of fan or cooling device

**Table 30 – Power Supply element for enclosure and array status pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1								
2					DC over-voltage	DC under-voltage	DC over-current	
3		Fail	Rqsted On		Ovrtmp Fail	Temp warning	AC Fail	DC Fail

**DC Overvoltage:**

1 = DC voltage is above limits

**DC Undervoltage:**

1 = DC voltage was below limits

**DC Overcurrent:**

1 = DC current limitation was exceeded

**Fail :**

1 = Indicates that failure indicator is on or has been set on.

**Requested on:**

1 = Indicates that the power supply has been requested to be in the operating state.

**Overtmp fail:**

1 = Indicates temperature is higher than a safe operating temperature and the power supply is or soon will be shutdown.

**Temp warning:**

1 = Indicates temperature is higher than normal operating temperature, but has not yet reached a temperature that requires the power supply to shut down.

**AC Fail:**

1 = Indicates power supply is not receiving specified AC power.

**DC Fail:**

1 = Indicates power supply cannot provide specified DC power.

**6.2.5 Cooling element**

**Table 31 – Cooling element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3		Set Fail Ind	Rqst On			Requested Speed Code		

1 = indicates that the device has been removed and inserted since the last time the Swap indicator has been reset.

**Remove (Rmv):**

1 = device is prepared for removal and removal indicators, if any, are set

**Identify:**

1 = enclosure identify indicator has been set. This indicator is intended to make it easy to locate the selected enclosure and device.

**Enable Bypass A:**

1 = indicates that port A of the device is bypassed either by request of the device or by request of the enclosure

**Enable Bypass B:**

1 = indicates that port B of the device is bypassed either by request of the device or by request of the enclosure

**Byp A Enabled:**

1 = indicates that port A of the device is bypassed by request of the device. This is usually associated with the device being removed, turned off, or not operational.

**Byp B Enabled:**

1 = indicates that port B of the device is bypassed by request of the device. This is usually associated with the device being removed, turned off, or not operational.

**6.2.4 Power Supply element**

**Table 29 – power supply element for enclosure and array control pages**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2								
3		Set Fail Indicator	Rqst On					

**Set Fail Indicator:**

1 = Instructs the enclosure to turn the power supply failure indicator on.  
 0 = Instructs the enclosure to turn the power supply failure indicator off unless turned on by internal circuitry.

**Request on:**

1 = Instructs the power supply to turn on or remain on.  
 0 = Instructs the power supply to turn off or remain off.

**Do not remove:**

1 = set to request that device not be removed

**Rst Swap:**

1 = reset the swap status bit

**Rqst Insert:**

1 = request that device bay be prepared for insertion.

**Rqst remove:**

1 = request that device be prepared for removal.

**Rqst Identify:**

1 = request that the identify indicator be set.

**Enable Byp A:**

1 = request that device bypass A be enabled by enclosure

**Enable Byp B:**

1 = request that device bypass B be enabled by enclosure

The element is defined for the device array status page (page code 06). This element contains information defining the state of the device relative to any array activities. Those codes common to the device enclosure status page, used with page code 02, shall be set to 1 for both status elements if they are present in either status element.

**Table 28 – Device element for array status page**

Bits Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1	OK	Rsrvd Drive	Hot Spare	Cons Chk	In Crit Array	In Failed Array	Rebuild/Remap	R/R Aborted
2		Do not remove		Swap		Remove	Identify	
3					Enable Byp A	Enable Byp B	Byp A Enabled	Byp B Enabled

**OK:**

1 = indicates that the enclosure has set the OK indicators

**Reserved Drive:**

1 = indicates that the enclosure has set the reserved drive indicators

**Hot Spare:**

1 = indicates that the enclosure has set the hot spare indicators

**Consistency Check in Progress:**

1 = indicates that the enclosure has set the consistency check in progress indicators

**In Critical Array:**

1 = indicates that the enclosure has set the in critical array indicators

**In Failed Array:**

1 = indicates that the enclosure has set the failed array indicators

**Rebuild/Remap:**

1 = indicates that the enclosure has set the rebuild/remap indicators

**Rebuild/Remap Aborted:**

1 = indicates that enclosure has set the rebuild/remap aborted indicators

**Do not remove:**

1 = indicates that device should not be removed, and protective indicators, if any, are set.

**Swap:**



**Fault Requested:**

1 = indicates that fault indicators are set by enclosure as requested by the control page.

**Drive off:**

1 = indicates that device is powered off

**Enable Bypass A:**

1 = indicates that port A of the device is bypassed either by request of the device or by request of the enclosure

**Enable Bypass B:**

1 = indicates that port B of the device is bypassed either by request of the device or by request of the enclosure

**Byp A Enabled:**

1 = indicates that port A of the device is bypassed by request of the device. This is usually associated with the device being removed, turned off, or not operational.

**Byp B Enabled:**

1 = indicates that port B of the device is bypassed by request of the device. This is usually associated with the device being removed, turned off, or not operational.

**6.2.3 Device element for array pages**

This device element is defined for the device array control page (page code 06) in table 27. This element contains control information related to the device's use in an array. Those codes common to the device enclosure control page, used with page code 02, shall have effect if they are set by either the enclosure control page or the array control page.

**Table 27 – Device element for array control page**

Bits Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1	Set OK	Set Rsrvd Drive	Set Hot Spare	Set Cons Check	Set In Crit Array	Set In Failed Array	Set Rebuild/Remap	Set R/R Aborted
2		Do not remove		Rst Swap		Rqst remove	Rqst Identify	
3					Enable Byp A	Enable Byp B		

**Set OK:**

1 = requests that the OK indicators be set

**Set Reserved Drive:**

1 = requests that the reserved drive indicators be set

**Set Hot Spare:**

1 = requests that the hot spare indicators be set

**Set Cons Check:**

(Set Consistency Check in Progress)

1 = requests that the consistency check in progress indicators be set

**Set In Critical Array:**

1 = requests that the in critical array indicators be set

**Set in failed array:**

1 = requests that the in failed array indicators be set

**Set Rebuild/Remap:**

1 = requests that the rebuild/remap indicators be set

**Set Rebuild/Remap Aborted:**

1 = requests that the rebuild/remap aborted indicators be set

**Rqst remove:**

1 = request that device be prepared for removal.

**Rqst Identify:**

1 = request that the identify indicator be set.

**Rqst Fault:**

1 = requests that fault indicators be set

**Drive Off:**

1 = requests that device be powered off

**Enable Byp A:**

1 = request that device bypass A be enabled by enclosure

**Enable Byp B:**

1 = request that device bypass B be enabled by enclosure

The device element for the ES enclosure status page (page code 02) is defined in table 26. This element contains information pertaining to the enclosure of the device. Those codes common to the device array status page, used with page code 06, shall be set to 1 for both status elements if they are present in either status element.

**Table 26 – Device element for enclosure status page**

Bytes	Bits	7	6	5	4	3	2	1	0
0		Resrvd	PredFai I			Status Code			
1		Hard address setting for device							
2			Do not remove		Swap	Ready to Insert	Rmv	Identify	
3			Fault Sensed	Fault Reqstd	Drive Off	Enable Byp A	Enable Byp B	Byp A Enbled	Byp B Enbled

**Hard address setting for device:**

Set to value of SCSI target address defined for designated element.

For type device enclosure elements, this is an arbitrary identifier for the group of devices and may be related to a path identifier for the group of devices.

**Do not remove:**

1 = indicates that device should not be removed, and protective indicators, if any, are set.

**Swap:**

1 = indicates that the device has been removed and inserted since the last time the Swap indicator has been reset.

**Ready to insert:**

1 = device bay is prepared for device to be inserted, and insertion indicators, if any, are set.

**Remove (Rmv):**

1 = device is prepared for removal and removal indicators, if any, are set

**Identify:**

1 = enclosure identify indicator has been set. This indicator is intended to make it easy to locate the enclosure.

**Fault Sensed:**

1 = indicates that fault indicators are set by device in this location.

**Table 24 – Element status codes**

Type Code	Name	Condition	Mandatory Optional
00h	Unsupported	status detection is not implemented for this element	Optional
01h	OK	element is installed and no error conditions are known by the enclosure.	Mandatory
02h	Critical	critical element failure is detected	Optional
03h	Noncritical	noncritical element failure is detected	Optional
04h	Unrecoverable	unrecoverable element failure is detected	Optional
05h	Not installed	element is detected to be not installed in enclosure	Mandatory
06h	Unknown	sensor has failed or element status is not available	Optional
07h	Not Available	element installed, no known errors, but the element has not been turned on or set into operation.	Optional

**6.2 Element entry definitions**

**6.2.1 Unspecified element type**

The element status bits are reserved for the status entry for the unspecified element type.

The element control bits are reserved for the control entry for the unspecified element type.

**6.2.2 Device element for enclosure pages**

The device element for the ES enclosure control page (page code 02) is defined in table 25. This element contains control information related to the enclosure of the device. Those codes common to the device array control page, used with page code 06, shall have effect if they are set by either the enclosure control page or the array control page.

**Table 25 – Device element for enclosure control page**

Bytes	Bits 7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1								
2		Do not remove		Rst Swap	Rqst Insert	Rqst remove	Rqst Identify	
3			Rqst Fault	Drive Off	Enable Byp A	Enable Byp B		

**Do not remove:**

1 = set to request that device not be removed

**Rst Swap:**

1 = reset the swap status bit

**Rqst Insert:**

1 = request that device bay be prepared for insertion.

## 6.1 Formats for element entries

These subclauses specify the general format for element entries.

Unless otherwise specified, all status and control bits are optional. The enclosure is not required to present any optional status bit. The enclosure is not required to act on any optional

control bit and may ignore any control bit if required to maintain a proper operating environment in the enclosure.

### 6.1.1 Control entry format

The element control format for all elements is provided in table 22.

**Table 22 – Standard format of control entry**

Bytes	7	6	5	4	3	2	1	0
0	Select	PredFail	Disable	Reserved				
1-3	Element control							

**Select:** The select bit is set to one if the control function defined by this element control entry is to be performed. The select bit is set to zero if this element control entry is to be ignored by the enclosure. The select bit allows individual element control entries from the entire list of control entries to be selected for execution.

**PredFail:** The optional PredFail (Predicted Failure) bit shall be set to 1 to indicate that the application client wants to set the predicted failure state for the element. The PredFail bit shall be set to 0 to indicate that the application client wants to turn off the predicted failure state for

the element. The element is not required to implement the bit or the predicted failure state.

**Disable:** The optional Disable bit shall be set to 1 to indicate that the application client wants to disable this sensor. The Disable bit will only be recognized on sensor type elements, including the temperature sensors, the voltage sensors, and the current sensors. This enables sensors that are giving erroneous results to be shut off.

### 6.1.2 Status entry format

The element status format for all elements is provided in table 23.

**Table 23 – Standard format of status entry**

Bytes	7	6	5	4	3	2	1	0
0	Resrvd	PredFail			Status Code			
1-3	Element status							

**Pred Fail:** The optional PredFail (Predicted Failure) bit of 1 indicates that the element of the enclosure has the capability of predicting failure and that a failure has been predicted. The bit has the optional capability of being set to 1 by the PredFail bit of the element control entries. The PredFail bit set to 0 shall indicate that the predicted failure state is not set or that the predicted failure function is not implemented.

**Status Code:** The status codes and the definition of the status codes are shown in table 24.

## 6 Element definitions

This clause contains the definitions of the standard element entries for the environmental ser-

vices enclosure control, enclosure status, array control, and array status pages. Table 21 lists the element type codes and elements for the configuration page.

**Table 21 – Element type codes**

Type Code	Type of element
00h	unspecified
01h	device
02h	Power supply
03h	Cooling Element
04h	Temperature Sensors
05h	Door Lock
06h	Audible Alarm
07h	ES controller electronics
08h	SCC controller electronics
09h	Nonvolatile cache
0Ah	Reserved
0Bh	Uninterruptible Power Supply
0Ch	Display
0Dh	Key pad entry device
0Eh	Reserved
0Fh	SCSI port/transceiver
10h	Language
11h	Communication port
12h	Voltage Sensor
13h	Current Sensor
14h	SCSI Target Port
15h	SCSI Initiator Port
16-7Fh	Reserved
80h-FFh	Vendor-specific codes

**Table 20 – Enclosure services management page**

Bits Bytes	7	6	5	4	3	2	1	0
0	PS	Rsrvd	Page Code (TBDh)					
1	Page length							
2	Reserved							
3	Reserved							
4	Reserved							
5							TD	EnbITD
6	(MSB) Maximum task completion time (LSB)							
7								

**TD:** The optional TD (Timed Disconnect) bit shall be set to 1 by the device server in the MODE SENSE command if the timed disconnect function is implemented by the device server. The bit shall be set to 0 if the timed disconnect function is not supported by the device server. The bit shall be ignored by the device server in the MODE SELECT command.

**EnbITD:** The EnbITD (Enable Timed Disconnect) bit shall be supported by the device server if it supports the timed disconnect function. The application client uses the EnbITD to enable or disable the use of the timed disconnect function by the device server. If the EnbITD is set to 1, the device server shall enable the timed disconnect function. If the EnbITD is set to 0, the device server shall disable the timed disconnect function. In a MODE SENSE command, the EnbITD shall be set to 1 if the timed disconnect function is enabled and to 0 if the function is not enabled.

**Maximum task completion time:** The maximum task completion time indicates the maximum time that a device server may choose to remain disconnected after the transmission of a REQUEST DIAGNOSTIC RESULTS CDB to the device server. The value is specified in units of 100 milliseconds.

When a REQUEST DIAGNOSTIC RESULTS command is transmitted to a device that supports enclosure services and the EnbITD bit has been set to 1 to enable timed disconnect,

the device may disconnect and wait up to the time specified by the maximum disconnected time field before returning the appropriate parameter page. The device will normally perform this delay operation only for status pages. If a noncritical, critical, or unrecoverable event is present or occurs during the disconnected period, the device shall report the event by returning the proper status page as soon as possible. The intent of the timed disconnect function is to allow an application client to execute status polling commands relatively infrequently, while still learning quickly of any important occurrences in the enclosure.

**5.1.12 Short ES enclosure status page**

Some very simple devices are not capable of reporting any enclosure service page except the short status page, defined in table 18. Such devices shall always provide the short status page, regardless of which enclosure services

page was requested. It shall not be an error to respond with a short status page when another enclosure services page has been requested by a RECEIVE DIAGNOSTIC RESULTS command.

**Table 18 – ES short enclosure status page**

Bytes	7	6	5	4	3	2	1	0
0	Page Code (08h)							
1	VS	VS	VS	VS	VS	VS	VS	VS
2	(MSB) Page Length (= 0) (LSB)							
3								

NOTE – Note: The short status page is provided when a device that is capable of supporting full enclosure services determines that the enclosure attached to it is only capable of providing a single 8-bit data field. Such a device is defined by the Small Form Factor specification SFF-8045, describing a single connector SCSI FCP FC-AL disk drive with a simple enclosure sensing mechanism.

The mode parameter header medium type is reserved.

The mode parameter device specific parameter is reserved.

The block descriptor length shall be zero and no block descriptor shall be included in the mode parameter list.

**5.2 MODE SENSE/MODE SELECT pages for ES devices.**

This subclause describes the pages used with MODE SELECT and MODE SENSE commands that are applicable to enclosure services devices.

Table 19 defines the mode pages that are applicable to enclosure services devices that include the optional MODE SELECT and MODE SENSE commands. All mode pages are optional.

**5.2.1 Mode parameters**

The mode parameter header for enclosure services devices specifies a length appropriate to the specified pages.

**Table 19 – Mode Page Codes for ES devices**

Page Code	Description	Defining Subclause
0Ah	Disconnect-reconnect mode page	SPC
01h	Enclosure services management page	5.2.2
1Ch	Informational exceptions control page	SPC

**5.2.2 Enclosure services management page.**

features involving communication with the enclosure for a SCSI device.

The enclosure services management page (see table 20) provides controls over those SCSI

**Table 16 – ES element descriptor page**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Page Code (07h)									
1										
2	(MSB)	Page Length (= n-3)							(LSB)	
3										
4-7	(MSB)	Generation Code						(LSB)		
8 -?										Type descriptor header and descriptive text for first element type
(4+?)	Element descriptor header and descriptive text for first element of first element type									
...										
(4+?)	Element descriptor header and descriptive text for last element of first element type									
(4+?)	Type descriptor header and descriptive text for second element type									
(4+?)	Element descriptor header and descriptive text for first element of second element type									
...										
(4+ ?)	Element descriptor header and descriptive text for last element of last element type									

The generation code is implemented as in the ES enclosure status page, described in clause 5.1.3

Each descriptor and descriptive text element has the format shown in table 17.

**Table 17 – Format of type and element descriptor header and descriptive text**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Reserved									
1	Reserved									
2	(LSB)	Descriptor field length (n)							(MSB)	
3										
4 - (3+n)	Descriptive text string									

The descriptor length may be zero, in which case, the descriptor field is not placed between consecutive headers.

The format is always in ASCII and is not modified by the language element.



RAID array. Some relevant information is duplicated in both the device enclosure elements and the device array elements. In those cases, the actual state of the device or device bay shall be expressed by the logical 'OR' of the two conditions.

Only the elements associated with devices are included in the array status page. The device elements are in the same order as the device

elements in the enclosure status and enclosure control pages.

The array status page is read by the RECEIVE DIAGNOSTIC RESULTS command. The transmission of a page with page code 6 is defined as the transmission of an enclosure services array control page. Table 15 describes the ES array status page.

**Table 15 – ES array status page**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Page Code (06h)									
1						Info	Non-Crit	Crit	Unrecov	
2	(MSB)	Page Length (= n-3)								
3									(LSB)	
4-7	(MSB)	Generation Code								(LSB)
8 -11	Type status for device array element type									
12 - 15	Element status for first device array element type									
...										
n-3 to n	Element status for last device array element type									

The enclosure services array status page returns a type array status entry for each type of device element included in the enclosure. Below each type array status entry, there is an element array status entry for each of the device elements that have been allowed for by the number of possible elements value of the configuration page.

The generation code is implemented as in the ES enclosure status page, described in clause 5.1.3

The summary bits, Info, Non-Crit, Crit, and Unrecov are implemented as in the ES enclosure status page, described in clause 5.1.3

**5.1.11 ES element descriptor page**

The ES element descriptor page returns a list of variable length fields, one for each element in the ES enclosure status page. The fields can be used to return vendor-specific descriptive text for each elements, including such useful information as the element part number, serial number, revision level, and location description.

The ES element descriptor page is optional.

The format of the ES element descriptor page is shown in table 16.

ments measure temperature in degrees Celsius + 20. The threshold value is also established and presented in degrees Celsius + 20. All values are considered positive, and must be either inverted or biased to a positive value if negative values are possible.

### 5.1.9 ES array control page

The optional enclosure services array control page transmits the ES array elements for the SCSI devices resident in the enclosure. This information is specialized for managing the state of indicators and flags associated with each device's membership and status within a RAID array. Some relevant information is duplicated in both the device enclosure elements and the device array elements. In those cases, the actual

state of the device or device bay shall be expressed by the logical 'OR' of the two conditions.

Only the elements associated with devices are included in the array status and array control pages. The device elements are in the same order as the device elements in the enclosure status and enclosure control pages. More than one type descriptor headers may be defined for devices.

The array control page is transmitted by the SEND DIAGNOSTIC command. The request of a page using RECEIVE DIAGNOSTIC RESULTS, page code 5 is defined as the request for an enclosure services array status page. Table 14 describes the enclosure services array control page.

**Table 14 – ES array control page**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Page Code (06h)									
1					Info	Non-Crit	Crit	Unrecov		
2	(MSB)	Page Length (= n-3)							(LSB)	
3										
4-7	Reserved									
8-11	Type control for device array type									
12-15	Element control for first device array element									
...										
4 bytes	Element control for last device array element									

The enclosure services array control page transmits a type array control entry for each type of device element included in the enclosure. Below each type array control entry, there is an element array control entry for each of the device elements that have been allowed for by the number of possible elements value of the configuration page.

The summary bits, Info, Non-Crit, Crit, and Unrecov are implemented as in the ES enclosure control page, described in clause 5.1.12

### 5.1.10 ES array status page

The optional enclosure services array status page returns the ES array elements for the SCSI devices resident in the enclosure.

This status is specialized for determining the state of indicators and flags associated with each device's membership and status within a

**Table 12 – Format of ES Threshold In page**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Page Code (05h)									
1										
2	(MSB)	Page Length (= n-3)							(LSB)	
3										
4-7	Reserved									
4-7	Type threshold entry for first element type									
8-15	Element threshold entry for first element of first element type									

4 bytes	Element threshold entry for last element of first element type
4 bytes	Type threshold entry for second element type
4 bytes	Element threshold entry for first element of second element type

n-3 to n	Element threshold entry for last element of last element type
----------	---------------------------------------------------------------

The enclosure services threshold in page reports a type threshold entry for each type of element included in the enclosure. Below each type threshold entry, there is an element threshold entry for each of the

elements of that type that have been allowed for by the number of possible elements value of the configuration page. Each threshold entry has the standard format specified in table 11.

**Table 13 – Format for threshold entry**

Bytes	Bits	7	6	5	4	3	2	1	0
0	High Critical Threshold								
1	High Warning Threshold								
2	Low Warning Threshold								
3	Low Critical Threshold								

Those elements for which no threshold is defined shall return an entry with all values equal to zero. The threshold may be undefined either because the element has no value which can be compared against a threshold or because the element is implemented in such a manner

that the threshold is not adjustable or accessible.

Each 8-bit threshold value shall have the same meaning as the corresponding 8-bit status value. As an example, temperature sensor ele-

an element threshold entry for each of the elements of that type that have been allowed for by the number of possible elements value of the configuration page. The individual entry overrides the type

entry if the elements are implemented with individually settable thresholds. Each threshold entry has the standard format specified in table 11.

**Table 11 – Format for threshold entry**

Bytes	Bits	7	6	5	4	3	2	1	0
0		High Critical Threshold							
1		High Warning Threshold							
2		Low Warning Threshold							
3		Low Critical Threshold							

Those elements which have no value to be compared with a threshold shall ignore the contents of the threshold entry. Those elements which have a value which can be compared with a threshold may accept the specified thresholds, round the specified thresholds to a more appropriate value, or may ignore the contents of any or all of the threshold entries. A threshold entry with all four thresholds having a value of zero shall be ignored for that element. This allows individual entries to be modified without the requirement of setting all other entries at the same time.

Each 8-bit threshold value shall have the same meaning as the corresponding 8-bit status value. As an example, temperature sensor elements measure temperature in degrees Celsius + 20. The threshold value is also established and presented in degrees Celsius + 20. All values are considered positive, and must be either inverted or biased to a positive value if negative values are possible. The values shall be selected such that:

High Critical > High Warning > normal value range > Low Warning > Low Critical

If the values do not meet this requirement, and if the values are not ignored by the enclosure services device, the enclosure services device shall generate a CHECK CONDITION with an ASC/ASCQ indicating INVALID FIELD IN PARAMETER LIST.

When the value of a sensed parameter rises equal to the high critical threshold or falls below the low critical threshold, indications of a critical failure are presented in the ES enclosure status page. For those commands that use CHECK CONDITION to indicate enclosure failures, sense information of Enclosure Failure shall be presented.

When the value of a sensed parameter rises equal to the high warning threshold or falls below the low warning threshold, indications of a noncritical failure are presented in the enclosure services enclosure status page. For those commands that use CHECK CONDITION to indicate enclosure failures, sense information of Enclosure Degraded Warning shall be presented.

**5.1.8 ES Threshold In page**

The threshold in page is transmitted from the enclosure services processor to report threshold values for those elements that have limit sensing capability, especially voltage sensors, current sensors, and temperature sensors. The threshold out page is transmitted by the RECEIVE DIAGNOSTIC RESULTS command.

The format of the threshold in page is shown in Table 12. Implementation of this page is optional.

**Table 9 – ES string in page**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Page Code (04h)									
1	Reserved									
2	(MSB)	Page Length (= n-3)							(LSB)	
3										
4-n	Binary data provided by enclosure to application client									

**5.1.7 ES Threshold Out page**

The threshold out page is transmitted to the enclosure services processor to establish threshold values for those elements that have limit sensing capability, especially voltage sensors, current sensors, and temperature sensors. The

threshold out page is transmitted by the SEND DIAGNOSTIC command.

The format of the threshold in page is shown in Table 10. Implementation of this page is optional.

**Table 10 – Format of ES Threshold Out page**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Page Code (05h)									
1										
2	(MSB)	Page Length (= n-3)							(LSB)	
3										
4-7	Reserved									
4-7	Type threshold entry for first element type									
8-15	Element threshold entry for first element of first element type									
...										
4 bytes	Element threshold entry for last element of first element type									
4 bytes	Type threshold entry for second element type									
4 bytes	Element threshold entry for first element of second element type									
...										
n-3 to n	Element threshold entry for last element of last element type									

The enclosure services threshold out page transmits a type threshold entry for each

type of element included in the enclosure. Below each type threshold entry, there is

**Table 7 – ES help text page**

Bytes	Bits	7	6	5	4	3	2	1	0
0		Page Code (03h)							
1		Reserved							
2	(MSB)	Page Length (= n-3)							(LSB)
3									
4 - n		Enclosure services help text character string							

**5.1.5 ES string out page**

The enclosure services string out page transmits an enclosure dependent binary string from the application client to the enclosure. The string may contain bits describing indicator states, text or graphic display information, or control information outside the context of the enclosure elements defined in the enclosure

services configuration page. The format is not specified by this standard. The format of the string may be determined by an application client using manufacturer name and model from the INQUIRY command and any applicable descriptive text in the RECEIVE DIAGNOSTIC RESULTS enclosure services configuration page. Table 8 describes the enclosure services string out page transmitted using the SEND DIAGNOSTIC command.

**Table 8 – ES string out page**

Bytes	Bits	7	6	5	4	3	2	1	0
0		Page Code (04h)							
1		Reserved							
2	(MSB)	Page Length (= n-3)							(LSB)
3									
4-n		Binary data provided by application client to enclosure							

**5.1.6 ES string in page**

The enclosure services string in page transmits an enclosure dependent binary string from the enclosure to the application client. The string may contain bits describing keyboard states, switch states, or the content of other information provided through or by the enclosure to the application client. The format is not specified by this standard. The format of the string may be determined by an application client using manufacturer name and model from the INQUIRY command and any applicable descriptive text in the RECEIVE DIAGNOSTIC RESULTS encl-

sure services configuration page. Table 9 describes the enclosure services string in page received using the RECEIVE DIAGNOSTIC RESULTS command.

Some very simple devices are not capable of reporting any enclosure service page except the short status page, defined in clause 5.1.12. Such devices shall always provide the short status page, regardless of which enclosure services page was requested.

may be reduced by a noncritical condition. The noncritical condition bit shall continue to be presented until all noncritical conditions have been corrected.

**Crit:** The critical condition (Crit) bit shall be set to 1 to indicate that an element is not operating correctly or is operating outside its specification and that the failure of the element has affected or will soon affect the continued normal operation of the enclosure. Other elements of the enclosure may continue to operate normally. The critical condition bit shall continue to be presented until all critical conditions have been corrected.

**Un-recov:** The unrecoverable condition (Un-recov) bit shall be set to 1 to indicate that an element is not operating correctly and that the failure of the element has disabled some functions of the enclosure. The enclosure may be incapable of recovering or redundantly bypassing the failure and will normally require repairs to correct the condition. The unrecoverable condition bit shall continue to be presented until all repairs necessary to correct unrecoverable conditions are completed.

**Generation code:** The generation code is a four byte value that is incremented by 1 by the enclosure services device every time the configuration page is changed. The value is not changed by status changes for elements already described by the configuration page.

**Type status entry:** The type status entry for each element type has the same format as the corresponding element status entry. There is exactly one type status entry for each type descriptor in the configuration page. The type status optionally indicates a summary of the status for all of the elements of that type collectively. The type status also may be used to indicate the status of those elements whose individual status is not available, but that do have a measurable overall status. An example might be an enclosure with 3 temperature sensors FRUs that cannot record the individual temperatures from those sensors. The type status entry might report the average of the 3 sensors.

**Element status entry:** One or more element status entries are provided immediately after the type status entry for that element type. There are n element status entries for each type descriptor in the configuration page, where

n shall be identical to the number of possible elements field in the type descriptor entry. Each element status entry optionally indicates the status for the particular element. Each standard element type has a fixed format for its status.

The global status and element status formats and the corresponding element control formats for each element type are described in clause 6.1.

#### 5.1.4 ES help text page

The enclosure services help text page transmits a string of characters from the enclosure that describes the present state of the enclosure and provides text indicating what corrective actions, if any, are desirable to bring the enclosure to its fully operational state. The help text page has the standard enclosure services diagnostic page header. The help text page is intended to allow the writing of enclosure independent SCSI drivers that can return enclosure specific text describing the state of the enclosure and explaining enclosure dependent corrective actions that may be required. The page is optional. The language and character set of the help text are defined by the language element.

The enclosure services help text page shall be read by the RECEIVE DIAGNOSTIC RESULTS command. The transmission of a page with page code 03 using a SEND DIAGNOSTIC command is an error, causing the presentation of CHECK CONDITION and ASC/ASCQ of INVALID FIELD IN PARAMETER LIST (26/00).

Some very simple devices are not capable of reporting any enclosure service page except the short status page, defined in clause 5.1.12. Such devices shall always provide the short status page, regardless of which enclosure services page was requested.

Table 22 describes the enclosure services help text page.

**Table 6 – ES enclosure status page**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Page Code (02h)									
1					Info	Non-Crit	Crit	Un-recov		
2	(MSB)	Page Length (= n-3)								
3									(LSB)	
4-7	(MSB)	Generation Code								(LSB)
8 -11	Type status for first element type									
12 - 15	Element status for first element of first element type									
...										
4 bytes	Element status for last element of first element type									
4 bytes	Type status for second element type									
4 bytes	Element status for first element of second element type									
...										
n-3 to n	Element status for last element of last element type									

The elements for each element type are arranged in a fixed order. The relationship between the element number and the location of the element is vendor-specific. The relationship may be described by the descriptor fields of the configuration page, by the descriptors in the element descriptor page, or by external references. The relationship is fixed for each enclosure configuration.

The summary bits, Info, Non-Crit, Crit, and Un-recov are returned in normal status pages and are mandatory. The bits can be recovered with a very short allocation length and can be examined by an enclosure polling procedure to determine if any special or unusual conditions requiring more exhaustive sensing procedures are required. The bits are set independently and can be presented in any combination. The bits may be set by either the enclosure services device server or with the ES enclosure control page.

**Info:** The information bit (Info bit) shall be set to 1 if one or more conditions have been detected in the enclosure since the last time an ES enclosure status page has been presented to the initiator that should be provided for the information of the application client, but that do not reflect any error or abnormal condition. Such conditions include temperature and battery status that do not reflect a failure or reduction of availability. The information bit shall be provided once as an indication to the application client that interesting information is available and not provided again until some new condition requires it to be set.

**Non-Crit:** The noncritical condition (Non-Crit) shall be set to 1 to indicate that an element is not operating correctly or is operating outside its specification, but that the failure of the element will not affect continued normal operation of the enclosure and all SCSI devices in the enclosure. The degree of operational redundancy



ure of the element has disabled some functions of the enclosure.

**type control entry:** The type control entry for each element type has the same format as the corresponding element control entry. There is exactly one type control entry for each type descriptor in the configuration page. The type control entry provides collective control for all elements described in the element control entries. Control values may be applied to either the type control entry or the element control entry.

**element control entry:** Following the global control entry, there shall be one element control entry for each of the possible elements identified by the number of possible elements field in the corresponding type descriptor header. Each element control entry optionally contains control information for the specified element. Each standard element type has a standard fixed format for its control entry. In most cases, the status entries and control entries are very similar and contain complementary functions.

The standard control element entry is used by other control type pages. The format is defined by table 24 of clause 6.1.

### 5.1.3 ES enclosure status page

The ES enclosure status page returns sense information for each of the elements identified by the configuration page. In addition, a separate sense field is provided to collect information about the collection of elements of the same type defined by each type descriptor header. The information provides the status about many standard functions within the addressed enclosure.

The status page has the standard diagnostic page header as defined by SPC.

The ES enclosure status page returns a type status entry for each type of element described by a type descriptor header in the enclosure services configuration page. Below each type status entry, there is an element status entry for each of the elements of that type that have been allowed for by the element count value of the configuration page. The list of entries is in the order defined by the ES configuration page.

This page shall be implemented if the device supports enclosure services. The status page is read by the RECEIVE DIAGNOSTIC RESULTS

command. The transmission of a page with page code 2 is defined as the transmission of an enclosure services enclosure control page.

Some very simple devices are not capable of reporting any enclosure service page except the short status page, defined in clause 5.1.12. Such devices shall always provide the short status page, regardless of which enclosure services page was requested.

Table 21 describes the ES enclosure status page.

**Table 5 – ES enclosure control page**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Page Code (02h)									
1						Info	Non-Crit	Crit	Un-recov	
2	(MSB)	Page Length (= n-3)							(LSB)	
3										
4-7	Reserved									
8-11	Type control for first element type									
12-15	Element control for first element of first element type									
...										
4 bytes	Element control for last element of first element type									
4 bytes	Overall control for second element type									
4 bytes	Element control for first element of second element type									
...										
n-3 to n	Element control for last element of last element type									

The summary bits, Info, Non-Crit, Crit, and Un-recov, are presented by the enclosure in all the ES status pages to indicate that unusual conditions have been detected in the enclosure. If unusual conditions have been detected by the application client, these bits can be set for reference by other initiators and other application clients using the ES enclosure control page. The bits can be overridden or ignored by the ES device server. If the ES device server accepts the bits, it shall present them in the same manner as it would if it had detected the conditions itself.

**Info:** The Information bit (Info) may be set by the application client to indicate that it has determined that there is an enclosure condition corresponding to the normal status definition of Info. Info is set to 1 to indicate that new conditions have been detected in the enclosure that do not reflect any error or abnormal condition.

**Non-Crit:** The noncritical condition bit (Non-Crit) may be set by the application client to indicate that it has determined that there is an enclosure condition present corresponding to the normal status definition of Non-Crit. Non-Crit is set to indicate that an element is operating not operating correctly or is operating outside its specification, but that the failure of the element will not affect continued operation of the enclosure and all SCSI devices contained in the enclosure.

**Crit:** The critical condition (Crit) bit may be set by the application client to indicate that it has determined that there is an element not operating correctly and that the element has affected or will soon affect the continued normal operation of the enclosure or the devices within the enclosure.

**Un-recov:** The unrecoverable condition (Un-recov) may be set by the application client to indicate that it has determined that there is an element not operating correctly and that the fail-

**Table 4 – Configuration page type descriptor header format**

Bytes	Bits	7	6	5	4	3	2	1	0
0	Type of element								
1	Number of possible elements								
2	Marker	Reserved							
3	Type descriptor text length								

**Type of element:** The type of element field in each type descriptor indicates the type of element being described in that particular header. The list of element types is shown in clause 21, table 21.

More than one type descriptor header may exist for a particular type of element. As an example, there may be two power supplies that provide +12 volts, and five power supplies that provide +5 volts. In this case, separate headers may be used for each of the power supply types, since they may have separate text descriptions.

**Number of possible elements:** The number of possible elements field indicates the number of elements of that type that can be installed in the enclosure. The actual number of elements installed may be smaller than the number which the configuration is capable of accepting.

**Marker:** The Marker bit indicates that the group of elements defined by this element descriptor are distinguished in a vendor-specific manner. As one example, the elements described by this header may be physically distinct from the particular enclosure being addressed, but under the control of the enclosure. The elements may be shared among multiple enclosures. The elements are otherwise identical to any other set of elements of a corresponding type, although different capabilities may be available in the control and sense pages.

**Type descriptor text length:** The type descriptor text length field specifies the length in bytes of the type descriptor text string for the particular element. Any standard type may have a type descriptor text length of zero. Vendor unique element types shall have a descriptor length field that is nonzero and shall have a type descriptor text adequate to identify the element to a driver program.

Some very simple devices are not capable of reporting any enclosure service page except the short status page, defined in clause 5.1.12. Such devices shall always provide the short status page, regardless of which enclosure services page was requested.

### 5.1.2 ES enclosure control page

The ES enclosure control page provides control information to each of the elements identified by the configuration page. In addition, a separate control field is provided for the collection of elements of the same type defined by each type descriptor header. The information allows the application client to control many standard functions within the addressed enclosure.

The control page has the standard diagnostic page header as defined by SPC.

The ES enclosure control page contains a type control entry for each type of element described by a type descriptor header in the enclosure services configuration page. Below each type control entry, there is an element control entry for each of the elements of that type that have been allowed for by the number of possible elements value of the configuration page. The list of entries is in the order defined by the ES configuration page.

The ES enclosure control page shall be implemented if the device supports enclosure services. The control page is transmitted by the SEND DIAGNOSTIC command. The request of a page using RECEIVE DIAGNOSTIC RESULTS, page code 2 is defined as the request for an enclosure services enclosure status page. Table 5 describes the ES enclosure control page.

lished when a configuration change occurs for any command except READ DIAGNOSTIC RESULTS with a page code of configuration page or a REQUEST SENSE command.

**global descriptor length:** The global descriptor length specifies the number of bytes that follow the 4-byte global descriptor header. The value shall be a multiple of 4, having allowed values between 0 and 252. The global descriptor length includes the length of the enclosure logical identifier, the enclosure vendor identification, the product identification, the product revision level, and any vendor unique global descriptor information.

**number of element types supported:** The number of element types supported field defines the number of 4-byte type descriptor fields that will follow the global descriptor.

**Enclosure logical identifier:** The first 8 bytes of the global descriptor shall contain the logical identifier of the enclosure. The enclosure logical identifier shall use the world wide name format defined by X3.230-1994. The enclosure logical identifier is unique to the enclosure and may be different from the world wide name of the device providing the enclosure services.

**Enclosure vendor identification:** The enclosure vendor identification field shall contain the identification string for the vendor of the enclosure in the same format as specified for the vendor identification field of the INQUIRY command. The enclosure vendor identification may not be the same as the LU vendor identification.

**Product identification:** The product identification field shall always contain the product identification string for the enclosure in the same format as specified for the product identification field of the INQUIRY command. The enclosure product identification may not be the same as the LU product identification.

**Product revision level:** The product revision level field shall contain the product revision level string for the enclosure in the same format as specified for the product revision level field of the INQUIRY command. The enclosure product revision level may not be the same as the LU product revision level.

**Vendor-specific enclosure information:** The vendor-specific enclosure information is optional. It may contain vendor unique identification of

the enclosure profile, vendor unique identification of the enclosure's software and hardware level, and vendor unique text strings describing the enclosure's characteristics.

**Type descriptor header:** The type descriptor header is a 4-byte header that indicates the type of element being described, the number of such elements, and the length of an optional text describing the element type. The elements of an enclosure will be listed in the same order in the configuration page, the type descriptor text of the configuration page, the status page, and the control page. All those elements defining SCSI devices shall be specified before elements of other types. The type descriptor text strings are placed after all type descriptor headers. The format of the type descriptor header is shown in table 4.

**type descriptor text string:** The type descriptor text string is an optional text string from 0 to 255 bytes for each type descriptor header. The text string, if it has a length greater than zero, may contain any descriptive information about the element type that might be useful to a driver that is displaying the configuration of the enclosure. Examples include the manufacturer's part number for a replacement element, a brief description of the element and its properties, or instructions about configuration limitations and redundancy requirements of the elements of that type. All type descriptor text strings follow the complete list of type descriptor headers. The type descriptor text strings are placed in the same order as the type descriptor headers, except that strings of 0 length are omitted.

The type descriptor text string uses the character encoding and language specified by the language element.

**Table 3 – ES configuration page**

Bytes	Bits	7	6	5	4	3	2	1	0	
0	Page Code (01h)									
1	Reserved									
2	(MSB)	Page Length (n)							(LSB)	
3										
4-7	(MSB)	Generation Code						(LSB)		
8	Global descriptor length (m)									
9	Reserved									
10	Number of element types supported (T)									
11	Reserved									
12 - 19	Enclosure logical identifier (World Wide Name or other identifier)									
20 - 27	Enclosure vendor identification (As defined for INQUIRY command)									
28-43	Product identification (as defined for INQUIRY command)									
44-47	Product revision level (as defined for INQUIRY command)									
48 - (11+m)	Vendor-specific enclosure information									
(4 bytes)	Type descriptor header for first element type									
...										
(4 bytes) - 11+m+4T	Type descriptor header of T <sup>th</sup> element type									
	First type descriptor text string									
...										
last byte = n	Last type descriptor text string									

The page code field and page length field for diagnostic pages are defined by SPC.

**generation code:** The generation code is a four byte value that is incremented by 1 by the enclosure services device every time the con-

figuration page is changed. The value is not changed by status changes for elements already described by the configuration page. Enclosures that cannot change in configuration use a fixed value equal to 0 for the generation code. A Unit Attention condition shall be estab-

to specify a value shorter than the total length of the diagnostic page. The page length field shall always specify the correct length of a complete diagnostic page.

The supported page list specified by SPC shall contain a list of all diagnostic page codes implemented by the device server in ascending order beginning with page code 00h. If the device is capable of accessing a diagnostic function or enclosure function that may temporarily or permanently be unavailable to the device, the page code associated with that information shall be included in the list. Check conditions are only posted in the list. Check conditions are only posted by the target when a diagnostic command is executed and fails, not when the list of supported pages is generated.

### **5.1.1 Enclosure services configuration page**

The enclosure services configuration page returns a list of components in an enclosure. This page shall be implemented if the device supports enclosure services. The component list shall include all components for which component status or controls are defined and may list any other components in the enclosure. The configuration page provides global enclosure information and parameters. The configuration page optionally provides descriptive text which can be used by drivers to identify components in more detail. The configuration page may be read by the RECEIVE DIAGNOSTIC RESULTS command. The transmission of a page with page code 01 using a SEND DIAGNOSTIC command is an error, causing the presentation of CHECK CONDITION and an ASC/ASCQ of INVALID FIELD IN PARAMETER LIST (26/00). Table 3 describes the enclosure services configuration page.

## 5 Parameters for ES devices

### 5.1 Diagnostic Parameters

This subclause describes the diagnostic page structure and the diagnostic pages that are applicable to ES devices. Each diagnostic page provides either management or status presentation functions required by the enclosure and the elements within the enclosure.

The diagnostic page format is specified by SPC.

All enclosure services control pages shall be transferred by the SEND DIAGNOSTIC command. Device servers are only required to accept a single diagnostic page in each command.

All enclosure services status presentation pages shall be transferred by the RECEIVE DIAGNOSTIC RESULTS command using the PF bit equal to one

The page code field identifies which enclosure services page is being sent or requested. The page codes are defined in table 2.

**Table 2 – Diagnostic page codes for enclosure service devices**

Page Code	Description	Control or Status	Mandatory or Optional	Defining Subclause
00h	Supported diagnostics	Status	M	SPC
01h	ES Configuration	Status	M	5.1.1
02h	ES Enclosure Control	Control	M	5.1.2
02h	ES Enclosure Status	Status	M	5.1.3
03h	ES Help Text	Status	O	5.1.4
04h	ES String Out	Control	O	5.1.5
04h	ES String In	Status	O	5.1.6
05h	ES Threshold Out	Control	O	5.1.7
05h	ES Threshold In	Status	O	5.1.8
06h	ES Array Control	Control	O	5.1.9
06h	ES Array Status	Status	O	5.1.10
07h	Element Descriptor	Status	O	5.1.11
08h	Short Enclosure Status	Status	O	5.1.12
08h-3Fh	Reserved (applies to all device type pages)	N/A	N/A	N/A
40h-7Fh	See specific device type for definition	N/A	N/A	N/A
80h-FFh	Vendor-specific pages	N/A	N/A	N/A

The page length field specifies the length in bytes of the diagnostic parameters that follow this field. For a SEND DIAGNOSTIC command, if the application client sends an allocation length that is not equal to the page length value plus 4 bytes, the device server shall terminate the command with CHECK CONDITION status. The actual number of bytes transferred across the SCSI connection shall be the allocation length or 4, whichever is shorter. The sense

key shall be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST. The information in the page shall not be used by the target device if such a truncation occurs.

For a RECEIVE DIAGNOSTIC RESULTS command, it is not an error for the allocation length

**Table 1 – Commands for Enclosure Services type devices**

Command name	Operation Code	Type	Subclause
INQUIRY	12h	M	SPC
MODE SELECT (6)	15h	O	SPC
MODE SELECT (10)	55h	O	SPC
MODE SENSE (6)	1Ah	O	SPC
MODE SENSE (10)	5Ah	O	SPC
PERSISTENT RESERVE IN	5Eh	O	SPC
PERSISTENT RESERVE OUT	5Fh	O	SPC
RECEIVE DIAGNOSTIC RESULTS	1Ch	M	SPC
RELEASE(6)	17h	O	SPC
RELEASE(10)	57h	O	SPC
REQUEST SENSE	03h	M	SPC
RESERVE(6)	16h	O	SPC
RESERVE(10)	56h	O	SPC
SEND DIAGNOSTIC	1Dh	M	SPC
TEST UNIT READY	00h	M	SPC
WRITE BUFFER	3Bh	O	SPC
Key: M = Command implementation is mandatory O = Command implementation is optional.			

All the above commands are completely described in SPC. The special enclosure services diagnostic pages are defined in clause 5.1. The format for each of the defined types of enclosure element is defined in clause 6.

NOTE – Annex A presently includes the changes that are to be installed in SPC for reference. When the revisions in SPC are approved, Annex A will be deleted.



## 4 SCSI enclosure services model

### 4.1 Models for access to enclosure services devices

SCSI devices reside in enclosures that provide power, cooling, and protection for the devices. In addition, the enclosures provide external indicators about the state of the enclosure and devices. The indicators may identify the enclosure, may identify proper operation of the disks and enclosure components, may provide indications of the state of RAID devices in the enclosure, and may provide failure and maintenance information. Many of the individual components of an enclosure are removable and replaceable while the unit is continuing to operate. An enclosure services process typically manages all these enclosure elements and communicates with the SCSI application client on their behalf. All those elements managed by the enclosure services process are in the enclosure domain of that process. The enclosure domain may extend outside the actual box containing the enclosure services process. A common example is an uninterruptible power supply element, which may be located remotely and attached to the box containing the enclosure services process by

The application client has two mechanisms for accessing the enclosure services process. It may access them through an enclosure services device type logical unit or through a logical unit of another type. The commands have been selected so that the enclosure services process can be accessed through any type of SCSI device.

#### 4.1.1 Access through ES device

An application client may address the enclosure services as a logical unit having the peripheral device type of enclosure services device. The commands for this model are described in clause 4.2. The model uses the SEND DIAGNOSTIC command and the enclosure services outbound pages to set various indicators and states within the enclosure domain, allowing the enclosure to provide the most appropriate environment for the other SCSI logical units contained within it. Similarly, the application client may request information from the enclosure services logical unit using the RECEIVE DIAGNOSTIC RESULTS command and the enclosure services inbound pages to examine various status and warning information available

from the enclosure. The pages and page formats are defined in clause 5.1.

#### 4.1.2 Access through non-ES device

An application client may also be able to address the enclosure services using some other peripheral device type as a transport for enclosure services information to and from the application client. Such peripheral devices have a port that communicates with the enclosure services process. The actual enclosure services device is not visible as a SCSI device, but merely transmits the standard enclosure services bit patterns to and from the addressed SCSI device for transport. Those devices shall use the same SEND DIAGNOSTIC and RECEIVE DIAGNOSTIC RESULTS commands that would be used by an enclosure services device, but otherwise support the device model specified by their peripheral device type value. SCSI devices use the ESS (Enclosure Services Supported) bit in the INQUIRY command to indicate that they may serve as a transport mechanism to the enclosure services process. The existence of an enclosure services process available to the device is determined by requesting the ES configuration page. If the SCSI device is not able to identify a port to the enclosure services process, an appropriate CHECK CONDITION is posted.

### 4.2 Commands for enclosure services devices

The commands for enclosure services devices shall be as shown in table 1. All remaining operation codes are reserved for future standardization.



If a field or a control bit in a frame is specified as *ignored*, the entity which receives the frame shall not check that field or control bit.

### 3.2.1 Binary notation

Binary notation is used to represent relatively short fields. For example, a three-bit flag-field-code containing a binary value of 010 is shown in binary format as 010b.

### 3.2.2 Hexadecimal notation

Hexadecimal notation is used to represent relatively long fields. For example, a two-byte Source\_Address field containing a binary value of 11000100 00000011 is shown in hexadecimal format as C403h.

## 3.3 Abbreviations, acronyms and symbols

Abbreviations, acronyms and symbols applicable to this International Standard are listed. Definitions of several of these items are included in 3.1. The index at the back of the document provides help in locating these terms in the body of the document.

### 3.3.1 Acronyms and other abbreviations

<b>ES</b>	enclosure services
<b>FRU</b>	field-replaceable unit
<b>hex</b>	hexadecimal notation
<b>LED</b>	light emitting diode
<b>LOL</b>	loss of light
<b>LSB</b>	least significant bit
<b>LU</b>	logical unit
<b>ms</b>	millisecond
<b>MSB</b>	most significant bit
<b>N/A</b>	not applicable
<b>VS</b>	vendor specific

### 3.3.2 Symbols

Unless indicated otherwise, the following symbols have the listed meaning.

$\mu$	micro (e.g., $\mu\text{m}$ = micrometer)
-------	------------------------------------------

### 3 Definitions and conventions

For SES, the following definitions, conventions, abbreviations, acronyms, and symbols apply.

#### 3.1 Definitions

The following cross-references are used in these definitions:

- **contrast with.** This refers to a term that has an opposed or substantively different meaning.
- **see.** This makes reference to multiple-word terms in which this term appears.
- **see also.** This makes reference to terms that have a related, but not synonymous, meaning.
- **synonym.** This indicates that the term has the same meaning as a preferred term, which is defined here.

**3.1.1 byte:** A group of eight bits.

**3.1.2 device:** A mechanical, electrical, or electronic contrivance with a specific purpose.

**3.1.3 error:** A discrepancy between a computed, observed, or measured value or condition and the true, specified, or theoretically correct value or condition. Contrast with *failure* and *fault*.

**3.1.4 failure:** An uncorrected hardware error. Contrast with *error* and *fault*.

**3.1.5 fault:** An accidental condition that causes a functional unit to fail to perform its required function. Contrast with *error* and *failure*.

**3.1.6 ignored:** A field that is not interpreted by the receiver.

**3.1.7 input/output (I/O):** (1) Pertaining to a device whose parts can perform an input and/or output process; (2) Pertaining to a functional unit or channel involved in an input process, output process, or both, concurrently or not, and to the data involved in such a process.

**3.1.8 interface:** A shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics as appropriate. The concept

includes the specification of the connection of two entities having different functions.

**3.1.9 I/O operation:** An operation involving the transfer of data between a channel and I/O device.

**3.1.10 reserved:** A field whose content and checking is specified by the accompanying text. Each bit in the reserved field is denoted by “r” or by being left blank.

NOTE – Reserved fields should not be checked or interpreted unless otherwise noted.

**3.1.11 vendor specific:** Functions, code values, and bits not defined by SES and set aside for private usage between parties using SES. Caution: Different implementations of SES may assign different meanings to these functions, code values, and bits.

#### 3.2 Editorial conventions

Certain words and terms used in this standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in clause 3.1 or in the text where they first appear. Names of messages, commands, statuses, sense keys, additional sense codes, and additional sense code qualifiers are in all uppercase (e.g. REQUEST SENSE). Lower case is used for words having the normal English meaning.

Fields containing only one bit are usually referred to as the [named] bit instead of the [named] field.

Numbered items in SES do not represent any priority. Any priority is explicitly indicated.

In case of any conflict between figure, table, and text, the text, then tables, and finally figures take precedence. Exceptions to this convention are indicated in the appropriate sections.

In all of the figures, tables, and text of this document, the most significant bit of a binary quantity is shown on the left side. Exceptions to this convention are indicated in the appropriate sections.

The term *shall* is used to indicate a mandatory rule. If such a rule is not followed, the results are unpredictable unless indicated otherwise.

The fields or control bits which are not applicable shall be reset to zero.

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draft proposed American National Standard  
for Information Systems —

## SCSI Enclosure Services (SES) command set

### 1 Scope

The SCSI Enclosure Services command set documents the commands and parameters necessary to manage and sense the state of

the power supplies, cooling devices, displays, indicators, and individual drives installed in an enclosure. The command set uses the SCSI SEND DIAGNOSTIC and RECEIVE DIAGNOSTIC RESULTS commands to obtain configuration information for the enclosure and then to set and sense standard bits for each type of component that may be installed in the enclosure.

### 2 Normative references

The following American National Standards contain provisions which, through reference in this text, constitute provisions of SES. 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. Members of IEC and ISO maintain registers of currently valid International Standards. ANSI performs a similar function for American National Standards.

ANSI X3.230-1994, *Fibre Channel Physical and*

*Signaling Interface (FC-PH)*

ANSI X3.nnn-199x, X3T10/995D rev 9, *SCSI-3 Primary Commands (SPC)*

ANSI X3.mmm-199x, X3T10/994D rev 18, *SCSI-3 Architecture Model (SAM)*

ANSI X3.269-1995, , *Fibre Channel Protocol for SCSI (FCP)*





## 0 Introduction

The SCSI Enclosure Services (SES) command set document is divided into 7 clauses and 2 annexes:

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 SCSI device model for SCSI devices that provide enclosure services.

Clause 5 defines the parameter data formats that may be implemented by a SCSI enclosure services device.

Clause 6 defines the individual element formats that can be presented in an enclosure services page.

Clause 7 provides a bibliography of reference publications

Annex A contains an outline of the minor modifications that are required in the SPC document. This annex will be removed in the final standard, since these modifications will have been included in SPC.

Annex B contains a description of the additional ASC/ASCQ values defined for the SES command set.



**Foreword** (This Foreword is not part of dpANS X3.xxx-199x, Rev 4.0.)

This standard describes a model for Small Computer System Interface (SCSI) access to services within an enclosure containing one or more SCSI devices. A SCSI command set is defined for managing various non-SCSI elements contained within the enclosure.

This standard was developed by Task Group X3T10 of Accredited Standards Committee X3 during 1996. The standards approval process started in 199n. This standard includes annexes, which are informative, and are not considered part of the standard.

Requests for interpretation, suggestions for improvement or addenda, or defect reports are welcome. They should be sent to the X3 Secretariat, Information Technology Industry Council, 1250 Eye Street, NW, Suite 200, Washington, DC 20005.

This standard was processed and approved for submittal to ANSI by Accredited Standard Committee on Information Processing Systems, X3. Committee approval of the standard does not necessarily imply that all committee members voted for approval. At the time it approved this standard, the X3 Committee had the following members:

- Richard Gibson, Chair
- Donald C. Loughry, Vice-Chair
- Joanne M. Flanagan, Secretary

NOTE: The developers of this standard have requested that holders of patents that may be required for the implementation of the standard, disclose such patents to the publisher. However neither the developers nor the publisher have undertaken a patent search in order to identify which if any patents may apply to this standard. No position is taken with respect to the validity of any claim or any patent rights that may have been disclosed. Details may be obtained from the publisher concerning any statement of patents and willingness to grant a license on a nondiscriminatory basis and with reasonable terms and conditions to applicants desiring to obtain such a license.

<i>Organization Represented</i>	<i>Name of Representative</i>
(list to be added) .....	(list to be added)

Task Group X3T10 on Lower Level Interfaces, which developed this standard, had the following participants:

- John B. Lohmeyer, Chair
- Larry J. Lamers, Vice-Chair
- Robert Snively, SES Technical Editor

(list to be added)

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draft proposed American National Standard  
for Information Technology —  
SCSI Enclosure Services (SES)  
Command Set

Secretariat  
**Information Technology Industry Council**

Approved \_\_\_\_\_, 199\_\_\_\_  
**American National Standards Institute, Inc.**

**Abstract**

This standard describes a model for Small Computer System Interface (SCSI) access to services within an enclosure containing one or more SCSI devices. A SCSI command set is defined for managing various non-SCSI elements contained within the enclosure.

### Changes from Revision 3.0:

- reformatted as a stand-alone standards document entitled SCSI Enclosure Services (SES)
- Includes corrections provided during March 1996 SCSI meeting



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# **SES**

## **SCSI-3 Enclosure Services**

### **Command Set**

#### **(SES)**

#### **REV 4.0**

working draft proposed  
American National Standard  
for Information Systems

March 31, 1996

Secretariat:  
Information Technology Industry Council

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**NOTE:**

**This is a draft proposed American National Standard of Accredited Standards Committee X3. As such, this is not a completed standard. The X3T10 Technical Committee may modify this document as a result of comments received during public review and its approval as a standard.**

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