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5 **Disk Drive Diagnostics Profile**

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106

107

Foreword

108 The *Disk Drive Diagnostics Profile* (DSP1113) was prepared by the Diagnostics Working Group of the
109 DMTF.

110 DMTF is a not-for-profit association of industry members dedicated to promoting enterprise and systems
111 management and interoperability. For information about the DMTF, see <http://www.dmf.org>.

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126

Introduction

127 A *profile* is a collection of Common Information Model (CIM) elements and behavior rules that represent a
128 specific area of management. The purpose of the profile is to ensure interoperability of web-based
129 enterprise management (WBEM) services for a specific subset of the CIM schema — in this case Disk
130 Drive diagnostics.

131 Diagnostics is a critical component of systems management. Diagnostic services are used in problem
132 containment to maintain availability, achieve fault isolation for system recovery, establish system integrity
133 during boot, increase system reliability, and perform routine proactive system verification. The goal of the
134 Common Diagnostic Model (CDM) is to define industry-standard building blocks, based on and consistent
135 with the DMTF CIM, which enables seamless integration of vendor-supplied diagnostic services into
136 system and SAN management frameworks.

137 The goal of the *Disk Drive Diagnostics Profile* is to define industry-standard building blocks that enable
138 seamless problem determination support for Disk Drives and to troubleshoot network problems involving
139 Disk Drives. The *Disk Drive Diagnostics Profile* extends the standard diagnostic profile by identifying a
140 base set of Disk Drive functions that should be diagnosed by provider implementations. Suppliers can
141 differentiate their diagnostic offering by providing this base set of diagnostics and developing diagnostics
142 to analyze proprietary features of the Disk Drive.

143 Document conventions

144 Typographical conventions

145 The following typographical conventions are used in this document:

- 146 • Document titles are marked in *italics*.
- 147 • Important terms that are used for the first time are marked in *italics*.

148 ABNF usage conventions

149 Format definitions in this document are specified using ABNF (see [RFC5234](#)), with the following
150 deviations:

- 151 • Literal strings are to be interpreted as case-sensitive Unicode characters, as opposed to the
152 definition in [RFC5234](#) that interprets literal strings as case-insensitive US-ASCII characters.

153

Disk Drive Diagnostics Profile

1 Scope

155 The *Disk Drive Diagnostics Profile* specializes the [Diagnostics Profile](#) by defining the set of classes,
156 properties, methods and default values needed to perform effective problem determination for Disk Drives
157 within a management domain.

158 The target audience for this specification includes implementers who are writing CIM-based Disk Drive
159 diagnostics or consumers of CIM-based diagnostics for the Disk Drive.

2 Normative references

161 The following referenced documents are indispensable for the application of this document. For dated or
162 versioned references, only the edition cited (including any corrigenda or DMTF update versions) applies.
163 For references without a date or version, the latest published edition of the referenced document
164 (including any corrigenda or DMTF update versions) applies.
165

166 DMTF DSP0004, *CIM Infrastructure Specification 2.6*,
167 http://dmft.org/sites/default/files/standards/documents/DSP0004_2.6.pdf

168 DMTF DSP0200, *CIM Operations over HTTP 1.3*,
169 http://dmft.org/sites/default/files/standards/documents/DSP0200_1.3.pdf

170 DMTF DSP1001, *Management Profile Specification Usage Guide 1.0*,
171 http://dmft.org/sites/default/files/standards/documents/DSP1001_1.0.pdf

172 DMTF DSP1002, *Diagnostics Profile Specification 2.0*,
173 http://dmft.org/sites/default/files/standards/documents/DSP1002_2.0.pdf

174 DMTF DSP1033, *Profile Registration Profile 1.0*,
175 http://dmft.org/sites/default/files/standards/documents/DSP1033_1.0.pdf

176 DMTF DSP1114, *RAID Controller Diagnostics 1.0.0a*,
177 http://dmft.org/sites/default/files/standards/documents/DSP1114_1.0.0a.pdf

178 INCITS, Technical Committee T10, *Small Computer System Interface (SCSI)*,
179 <http://www.t10.org/>

180 INCITS, Technical Committee T13, *AT Attachment (ATA) Storage Interface*,
181 <http://www.t13.org/>

182 IETF RFC5234, *ABNF: Augmented BNF for Syntax Specifications, January 2008*,
183 <http://tools.ietf.org/html/rfc5234>

184 ISO/IEC Directives, Part 2, *Rules for the structure and drafting of International Standards*,
185 <http://isotc.iso.org/livelink/livelink.exe?func=ll&objId=4230456&objAction=browse&sort=subtype>

186 Serial ATA, *Serial ATA (SATA) Storage Interface*, <http://www.serialata.org/>

187

188 SNIA, *Storage Management Initiative Specification (SMI-S) 1.4*,

225	4.7
226	HDD
227	Hard Disk Drive
228	4.8
229	LBA
230	Logical Block Addressing
231	4.9
232	ME
233	Managed Element
234	4.10
235	MOF
236	Managed Object Format
237	4.11
238	OS
239	Operating System
240	4.12
241	PD
242	Problem Determination
243	4.13
244	PFA
245	Predictive Failure Analysis
246	4.14
247	POST
248	Power-On Self-Test
249	4.15
250	QA
251	Quality Assurance
252	4.16
253	RAID
254	Redundant Array of Independent Disks
255	4.17
256	SAN
257	Storage Area Network
258	4.18
259	SATA
260	Serial Advanced Technology Attachment
261	4.19
262	SCSI
263	Small Computer System Interface

- 264 **4.20**
 265 **S.M.A.R.T.**
 266 Self-Monitoring, Analysis, and Reporting Technology
- 267 **4.21**
 268 **SSD**
 269 Solid State Drive
- 270 **4.22**
 271 **WBEM**
 272 Web-Based Enterprise Management

273 5 Synopsis

- 274 **Profile Name:** Disk Drive Diagnostics
- 275 **Version:** 1.0.0
- 276 **Organization:** DMTF
- 277 **CIM schema version:** 2.29
- 278 **Central Class:** CIM_DiskDriveDiagnosticTest
- 279 **Scoping Class:** CIM_ComputerSystem
- 280 **Specializes:** Diagnostic Profile 2.0.0

281 The *Disk Drive Diagnostics Profile* extends the management capability of referencing profiles by adding
 282 common methods for determining that the Disk Drive is operating normally in a managed system.

283
 284 CIM_DiagnosticTest shall be the Central Class of this profile. The instance of CIM_DiagnosticTest shall
 285 be the Central Instance of this profile. CIM_ComputerSystem shall be the Scoping Class of this profile.
 286 The instance of CIM_ComputerSystem with which the Central Instance is associated through an instance
 287 of CIM_HostedService shall be the Scoping Instance of this profile.

288
 289 The CIM_ManagedElement is CIM_DiskDrive or a subclass of it.

290
 291 NOTE: When the physical drive is part of a RAID configuration, please refer to the RAID Controller Diagnostics
 292 Profile.

293 Table 1 identifies profiles on which this profile has a dependency.

294 **Table 1 – Referenced profiles**

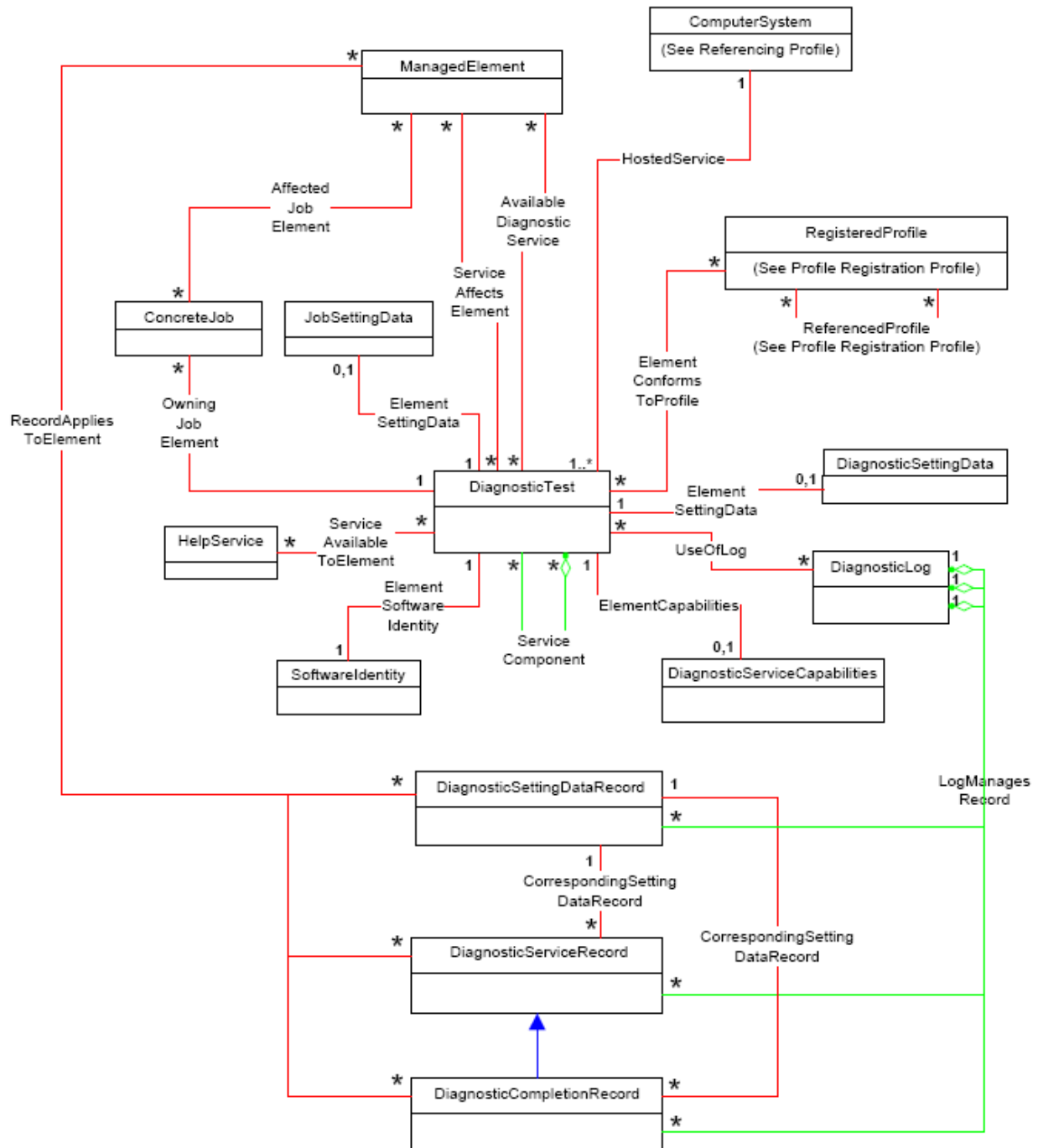
Profile name	Organization	Version	Description
Diagnostics	DMTF	2.0	Specializes
Profile Registration	DMTF	1.0	Mandatory
Disk Drive Lite	SNIA	1.3.0	Optional

295 6 Description

296 Diagnostic programs can be developed to verify that the Disk Drive is behaving properly, to identify its
 297 faulty components or to diagnose any components. Such tests are run in two distinct environments: 1) at

298 a vendor facility during development or manufacturing as part of their QA process, or 2) at an end-user
299 location. In end-user environments, certain diagnostic tests will not be practical to run because they might
300 modify or destroy data or they might take too long to run.

301 This specification attempts to cover a range of disk drive technologies and interfaces (for example, ATA,
302 SATA, SCSI, SSD, etc.), although some defined tests may only apply to certain technologies. For
303 example, the disk vendor industry has defined a set of tests for ATA interface drives called Self-
304 Monitoring, Analysis, and Reporting Technology (S.M.A.R.T.).



305

306

Figure 1 – Disk Drive Diagnostics Profile: Profile class diagram

307 7 Implementation

308 This clause details the requirements related to the arrangement of instances and their properties for
 309 implementations of this profile.

310 **7.1 Disk drive test information**

311 Table 2 provides general information for each test type.

312 **Table 2 – Test type information**

Test Name	Test Information	
Short Self-Test	Coverage Area	The diagnostic performs a small set of vendor-specific tests to verify that the disk is operating properly.
	Coverage Range	The entire disk drive is covered.
	User Control	None
	Execution Time	The diagnostic runs on order of seconds.
	Built into Device	Yes
	Details	For SCSI, a Self-Test is initiated using a Send Diagnostic command (operation code = 1D) while the results of the Self-Test are retrieved using a Receive Diagnostics Results command (operation code = 1C) A drive may support vendor-specific internal self-tests. The test results are written to a self-test log.
Extended Self-Test	Coverage Area	The diagnostic performs an extended set of vendor-specific tests to verify that the disk is operating properly.
	Coverage Range	The entire disk drive is covered.
	User Control	The user may also specify that the extended self-test run for a specified period of time using CIM_DiskDriveDiagnosticSettingData.LoopControl = 4 (Timer) and CIM_DiskDriveDiagnosticSettingData.LoopControlParameter
	Execution Time	The diagnostic runs on order of minutes to hours depending upon the capacity and disk speed.
	Built into Device	Yes
	Details	If a time duration is specified, the diagnostic simply stops at whatever test in the set of self-tests it happens to be running at the time.
Selected Self-Test	Coverage Area	The diagnostic performs an extended set of vendor-specific tests to verify that the disk is operating properly, but limited to a specific range of the disk.
	Coverage Range	The selected LBA range is covered.
	User Control	The user may specify a selected LBA range
	Execution Time	The diagnostic runs on order of minutes to hours depending upon the region selected and disk speed.
	Built into Device	Yes
	Details	All of the tests of the extended self-test are run but only against the selected LBA range
Sequential Read	Coverage Area	This diagnostic performs a read operation from disk sectors in sequential order for a selected LBA range
	Coverage Range	The selected LBA range is covered.
	User Control	The user may specify the LBA range and the size of data to be transferred for each read operation.
	Execution Time	The diagnostic runs on order of minutes to hours depending upon the region selected and disk speed.

Test Name	Test Information	
	Built into Device	Yes
	Details	Data is transferred from disk to host.
Random Read	Coverage Area	This diagnostic performs a read operation from disk sectors in random order within a selected LBA range.
	Coverage Range	The selected LBA range is covered.
	User Control	The user may specify the seed to use and the size of data to be transferred for each read operation.
	Execution Time	The diagnostic runs on order of minutes to hours depending upon the region selected and disk speed.
	Built into Device	Yes
	Details	Data is transferred from disk to host.
Sequential Read-Write-Read Compare	Coverage Area	This diagnostic verifies that the read and write operations are performed properly for a selected LBA range. Disk sectors are tested in sequential order.
	Coverage Range	The selected LBA range is covered.
	User Control	The user may specify an LBA range to be tested and the size of the data to be transferred.
	Execution Time	The diagnostic runs on order of minutes to hours depending upon the selected LBA range, the size of I/O operations to perform, and disk speed.
	Built into Device	Yes
	Details	The diagnostic reads a block and then writes the read data back to the block. The diagnostic then reads data a second time and verifies that the data has not changed. Because data might be modified unintentionally by an errant write operation, CIM_DiskDriveDiagnosticTest.Characteristics shall include 5 (Is Risky). Data is transferred to/from host and disk.
Random Read-Write-Read Compare	Coverage Area	This diagnostic verifies that read and write operations are performed properly for a selected LBA range. Disk sectors are tested in random order.
	Coverage Range	The selected LBA range is covered.
	User Control	The user may specify an LBA range, the data transfer size and the seed.
	Execution Time	The diagnostic runs on order of minutes to hours depending upon the region selected and disk speed.
	Built into Device	Yes
	Details	The diagnostic reads a block and then writes the read data back to the block. The diagnostic then reads data a second time and verifies that the data has not changed. Because data might be modified unintentionally by an errant write operation, DiagnosticTest.Characteristics shall include 5 (Is Risky). Data is transferred to/from host and disk.
Sequential Internal Verify	Coverage Area	This diagnostic verifies the ability to perform read and verify operations from track to track and head to head in sequential order.
	Coverage Range	The entire disk drive is covered.

Test Name	Test Information	
	User Control	None
	Execution Time	The diagnostic runs on order of minutes to hours but depends upon disk capacity and disk speed.
	Built into Device	Yes
	Details	Data is not transferred from disk to host; that is, this test is internal to the disk.
Status	Coverage Area	This diagnostic returns information about the relative health of the disk drive based upon internal analysis of failure statistics
	Coverage Range	The entire disk drive is covered.
	User Control	None
	Execution Time	The diagnostic returns immediately.
	Built into Device	Yes
	Details	Analysis of failure statistics is performed by the disk drive, not by the diagnostic test, which simply returns an overall status value.
Grown Defect	Coverage Area	The diagnostic retrieves statistics (such as the number of remapped sectors) collected by the disk drive regarding its sector remap mechanism.
	Coverage Range	The entire disk drive is covered.
	User Control	None
	Execution Time	The diagnostic returns immediately.
	Built into Device	Yes
	Details	For SCSI drives, the Read Defect Data command (B7) might be used. For SATA drives, the S.M.A.R.T. Reallocated Sector Count (ID = 5) command might be used.
4K Alignment	Coverage Area	For disk drives that support this feature, the diagnostic verifies that blocks can be properly aligned on 4K boundaries.
	Coverage Range	The entire disk drive is covered.
	User Control	None
	Execution Time	The diagnostic runs on order of seconds.
	Built into Device	Yes
	Details	
Power Management	Coverage Area	The diagnostic verifies that disk power management features can be set and that they operate properly; for example, standby, sleep, lower power idle, etc.
	Coverage Range	The entire disk drive is covered.
	User Control	None.
	Execution Time	The diagnostic runs on order of minutes.
	Built into Device	Yes.
	Details	

Test Name	Test Information	
Performance	Coverage Area	The diagnostic verifies that the disk operates within the vendor/product specific performance ranges for read operation transfer rates, sequential seek times and random seek times.
	Coverage Range	The entire disk drive is covered.
	User Control	The user may select the data transfer size.
	Execution Time	The diagnostic runs on the order of hours depending upon the disk capacity and disk speed.
	Built into Device	Yes
	Details	

313 7.2 CIM_DiskDriveDiagnosticTest

314 The CIM_DiskDriveDiagnosticTest can be used for a variety of tests necessary for diagnosing Disk Drive
 315 issues. Table 3 defines the valid property values and whether or not the test is mandatory or optional. An
 316 implementation may extend this class and add vendor-defined tests using the vendor-defined range of the
 317 DiskDriveTestType valuemap.

318 The current values for TestType array property are: 0 (Unknown), 1 (Other), 2 (Functional), 3 (Stress), 4
 319 (Health Check), 5 (Access Test), 6 (Media Verify), 7 (DMTF Reserved), 8 (Vendor Reserved).

320 **Table 3 – CIM_DiskDriveDiagnosticTest property requirements**

Test Name	Criteria	ElementName *	DiskDriveTestType	TestType *
Short Self-Test	Mandatory	Disk Drive Short Self-Test	2	2 (Functional) 6 (Media Verify)
Extended Self-Test	Optional	Disk Drive Extended Self-Test	3	2 (Functional) 6 (Media Verify)
Selective Self-Test	Optional	Disk Drive Selective Self-Test	4	2 (Functional) 6 (Media Verify)
Sequential Read	Mandatory	Disk Drive Sequential Read	5	2 (Functional) 6 (Media Verify)
Random Read	Optional	Disk Drive Random Read	6	2 (Functional) 6 (Media Verify)
Sequential Read-Write-Read Compare	Mandatory	Disk Drive Sequential Read-Write-Read Compare	7	2 (Functional) 6 (Media Verify)
Random Read-Write-Read Compare	Optional	Disk Drive Random Read-Write-Read Compare	8	2 (Functional) 6 (Media Verify)
Sequential Internal Verify	Optional	Disk Drive Sequential Internal Verify	9	2 (Functional) 6 (Media Verify)

321

Status	Mandatory	Disk Drive Status	10	4 (Health Check)
Grown Defects	Optional	Disk Drive Grown Defects	11	2 (Functional)
4K Alignment	Optional	Disk Drive 4K Alignment	12	2 (Functional)
Power Management	Optional	Disk Drive Power Management	13	2 (Functional)
Performance	Optional	Disk Drive Performance	14	2 (Functional) 6 (Stress)

322 An asterisk (*) indicates that the property is inherited from the parent class CIM_DiagnosticTest.

323 The current values for the Characteristics array property inherited from the CIM_DiagnosticTest parent
 324 class are: 0 (Unknown), 1 (Other), 2 (Is Exclusive), 3 (Is Interactive), 4 (Is Destructive), 5 (Is Risky), 6 (Is
 325 Package), 7 (Reserved), 8 (Is Synchronous), 9 (Media Required), 10 (Additional Hardware Required).
 326 The OtherCharacteristicsDescription property is used to provide additional information about the nature of
 327 the test. The content of the OtherCharacteristicsDescription property is vendor-specific.

328 **Table 4 – CIM_DiskDriveDiagnosticTest property requirements**

Test Name	Characteristics*	OtherCharacteristicsDescriptions*	Comment
Short Self-Test			
Extended Self-Test			
Selective Self-Test			
Sequential Read	5(Is Risky)		
Random Read	5(Is Risky)		
Sequential Read-Write-Read Compare	4 (Is Destructive) 5(Is Risky)		
Random Read-Write-Read Compare	4 (Is Destructive) 5(Is Risky)		
Sequential Internal Verify	4 (Is Destructive) 5(Is Risky)		
Status			
Grown Defects			
4K Alignment			
Power Management			
Performance			

329 An asterisk (*) indicates that the property is inherited from the parent class CIM_DiagnosticTest.

330 **7.3 CIM_DiskDriveDiagnosticSettingData**

331 A diagnostic test may require parameters to run. Some parameters may affect how the test is run while
 332 other parameters provide the values to be used by the test.

333 CIM_DiagnosticSettingData contains properties that affect how a diagnostic test is run (for example,
 334 LoopControl, QuickMOMode), how errors are handled (for example, HaltOnError), or how results are logged

335 (for example, LogOptions). CIM_DiagnosticSettingData is an argument to the
 336 CIM_DiagnosticTest.RunDiagnosticService() extrinsic method. If additional properties are needed that
 337 control the behavior of the diagnostic test, they should be defined in a subclass of
 338 CIM_DiagnosticSettingData.

339 The CIM_DiskDriveDiagnosticSettingData class defines additional parameters that may be used by some
 340 of the disk drive tests. Table 5 lists these test parameters and shows which tests might use them. An
 341 implementation may extend this class and define additional parameters for any vendor-defined tests.

342 **Table 5 – CIM_DiskDriveDiagnosticSettingData property requirements**

Test Name	ElementName*	LBA Start	LBA End	Seed	Data Sizes	Data Patterns
Short Self-Test	Disk Drive Short Self					
Extended Self-Test	Disk Drive Extended Self					
Selective Self-Test	Disk Drive Region Self	Used	Used			
Sequential Read	Disk Drive Sequential Read	Used	Used		Used	
Random Read	Disk Drive Random Read	Used	Used	Used	Used	
Sequential Read-Write-Read Compare	Disk Drive Sequential Read-Write-Read Compare	Used	Used		Used	Used
Random Read-Write-Read Compare	Disk Drive Random Read-Write-Read Compare	Used	Used	Used	Used	Used
Sequential Internal Verify	Disk Drive Sequential Internal Verify	Used	Used			
Status	Disk Drive Status					
Grown Defect	Disk Drive Grown Defect					
4K Alignment	Disk Drive 4K Alignment					
Power Management	Disk Drive Power Management					
Performance	Disk Drive Performance				Used	

343 An asterisk (*) indicates that the property is inherited from the parent class CIM_DiagnosticSettingData.

344 If any CIM_DiskDriveDiagnosticSettingData property does not have a value when passed as an argument
 345 to the CIM_DiagnosticTest.RunDiagnosticService() extrinsic method, the default values for the test
 346 arguments shall be used. The default values are defined by the test implementer.

347 **7.3.1 CIM_DiskDriveDiagnosticSettingData.LBAStart**

348 This property is used by a client to specify the start of a region to be test. If LBAStart is NULL, the default
 349 value of 0 is used. To specify the entire disk, both LBAStart and LBAEnd shall be NULL.

350 **7.3.2 CIM_DiskDriveDiagnosticSettingData.LBAEnd**

351 This property is used by a client to specify the end of a region to be test. If LBAEnd is NULL, the default
 352 value is the number of the last disk sector. To specify the entire disk, both LBAStart and LBAEnd shall be
 353 NULL.

354 7.3.3 CIM_DiskDriveDiagnosticSettingData.Seed

355 This property is used by a client to specify the seed that initiates the random number sequence used by
 356 the test. In order to replicate the same random number sequence for successive tests, one should use
 357 the same seed value. If this property is NULL, the diagnostic randomly selects its own seed using a
 358 vendor-specific algorithm.

359 7.3.4 CIM_DiskDriveDiagnosticSettingData.DataSizes

360 This array property is used by a client for the tests shown in Table 5 to specify the data buffer sizes to be
 361 used for read or write operations by the diagnostic test. If this property is NULL, the default size of 512
 362 bytes is used.

363 The vendor-defined default value(s) is optionally advertised by the provider using the default instance of
 364 CIM_DiskDriveDiagnosticSettingData.

365 If both properties have values, they shall have the same number of values because the diagnostic test will
 366 treat them as value pairs. That is the test is run with the first value in DataSizes and the first value in
 367 DataPatterns, and so on. Test behavior is illustrated by the following examples:

- 368 1. DataSizes = {1024,1024}, DataPatterns = {5555555555555555,AAAAAAAAAAAAAAAA}
- 369 2. DataSizes = {1024,2048}, DataPatterns = {AAAAAAAAAAAAAAAA,5555555555555555}

370 For the first data pair, the diagnostic test will run twice, first using DataSizes=1024 and
 371 DataPatterns=5555555555555555 and then using DataSizes=1024 and
 372 DataPatterns=AAAAAAAAAAAAAAAA.

373 For the second data pair, the diagnostic test will run twice, first using DataSizes=1024 and
 374 DataPatterns=AAAAAAAAAAAAAAAA and then using DataSizes=2048 and
 375 DataPatterns=5555555555555555.

376 NOTE: If CIM_DiskDriveDiagnosticServiceCapabilities.DataSizes has values, a client can specify only one or more
 377 of those values.

378 7.3.5 CIM_DiskDriveDiagnosticSettingData.DataPatterns

379 This array property is used by a client for the tests shown in Table 5 to specify the data pattern(s) to be
 380 used for write operations by the diagnostic test. If this property is NULL, the vendor-specific data
 381 pattern(s) is used.

382 The vendor-defined default value(s) is advertised by the provider using the default instance of
 383 CIM_DiskDriveDiagnosticSettingData

384 A data pattern is a string interpreted as a 16-digit hex value. For example, a data pattern of all ones would
 385 be FFFFFFFFFFFFFFFF while alternating ones and zeros would be 5555555555555555 or
 386 AAAAAAAAAAAAAAAAAA. The pattern will be replicated as needed to fill the specified data size.

387 NOTE: If CIM_DiskDriveDiagnosticServiceCapabilities.DataPatterns has values, the user can specify only one or
 388 more of those values.

389 7.4 CIM_DiskDriveDiagnosticServiceCapabilities

390 The SupportedLoopControl property is inherited from CIM_DiagnosticServiceCapabilities. It lists the loop
 391 controls that are supported by the Diagnostic Service. The values are: 0 (Unknown), 1 (Other), 2
 392 (Continuous), 3 (Count), 4 (Timer), 5 (ErrorCount), 0x8000 (No Loop Control). For all disk drive diagnostic
 393 tests, SupportedLoopControl has a value of 0x8000 (No Loop Control) except for the Extended Self-Test
 394 which has the value of 4 (Timer).

395

Table 6 - CIM_DiskDriveDiagnosticServiceCapabilities property requirements

Test Name	ElementName*	Region	Seed	DataSizes	DataPatterns
Short Self-Test	Disk Drive Short Self				
Extended Self-Test	Disk Drive Extended Self				
Selective Self-Test	Disk Drive Region Self	Used			
Sequential Read	Disk Drive Sequential Read	Used		Used	
Random Read	Disk Drive Random Read	Used	Used	Used	
Sequential Read-Write-Read Compare	Disk Drive Sequential Read-Write-Read Compare	Used		Used	Used
Random Read-Write-Read Compare	Disk Drive Random Read-Write-Read Compare	Used	Used	Used	Used
Sequential Internal Verify	Disk Drive Sequential Internal Verify	Used			
Status	Disk Drive Status				
Grown Defect	Disk Drive Grown Defect				
4K Alignment	Disk Drive 4K Alignment				
Power Management	Disk Drive Power Management				
Performance	Disk Drive Performance			Used	

396 An asterisk (*) indicates that the property is inherited from the parent class CIM_DiagnosticServiceCapabilities

397 7.4.1 CIM_DiskDriveDiagnosticServiceCapabilities.Region

398 This property is used by a provider to define whether or not the client can specify start and end disk
399 sectors for the region tests defined in Table 6.

400 If this property is TRUE, the client can use the values of CIM_DiskDriveDiagnosticSettingData.LBAStart
401 and CIM_DiskDriveDiagnosticSettingData.LBAEnd to control which disk sectors are tested.

402 7.4.2 CIM_DiskDriveDiagnosticServiceCapabilities.Seed

403 This property is used by a provider to define whether or not the client can specify the seed for the tests
404 defined in Table 6 that generate a random number sequence for testing.

405 If this property is TRUE, the client can use the value of CIM_DiskDriveDiagnosticSettingData.Seed to
406 initiate the random number sequence generation.

407 7.4.3 CIM_DiskDriveDiagnosticServiceCapabilities.DataSizes

408 This array property is used by a provider for the tests shown in Table 6 to specify the list of data sizes
409 supported by the test.

410 **7.4.4 CIM_DiskDriveDiagnosticServiceCapabilities.DataPatterns**

411 This array property is used by a provider for the tests shown in Table 6 to specify the list of data patterns
412 supported by the test.

413 A data pattern is a string interpreted as a 16-digit hex value. For example, a data pattern of all ones would
414 be FFFFFFFFFFFFFFFFFF while alternating ones and zeros would be 5555555555555555 or
415 AAAAAAAAAAAAAAAAAA. The pattern will be repeated as necessary to fill the specified data size.

416 **8 Methods**

417 This clause details the requirements for supporting intrinsic operations and extrinsic methods for the CIM
418 elements defined by this profile.

419 **8.1 CIM_DiagnosticTest.RunDiagnosticService()**

420 The RunDiagnosticService() method shall return one of the return code values defined in “Table 2 –
421 RunDiagnosticsService() Method: Return Code Values” of [DSP1002](#).

422 When failures occur during the execution of a diagnostic test, the failure shall be recorded in the instance
423 of CIM_DiagnosticServiceRecord associated with the test. The reason for the failure shall be recorded in
424 CIM_DiagnosticServiceRecord.ErrorCode[] and the corresponding
425 CIM_DiagnosticServiceRecord.ErrorCount[] shall be incremented. Other occurrences of the same failure
426 during the same test shall not create additional entries in CIM_DiagnosticServiceRecord.ErrorCode[], but
427 they shall cause the corresponding CIM_DiagnosticServiceRecord.ErrorCount[] to be incremented.
428 Profile Conventions for Operations.

429 Support for operations for each profile class (including associations) shall be as mandated in [DSP1002](#)
430 clauses 8.5 through 8.29.

431 **8.1.1 CIM_DiskDriveDiagnosticTest**

432 All operations are supported as for CIM_DiagnosticTest in [DSP1002](#).

433 **8.1.2 CIM_DiskDriveDiagnosticSettingData**

434 All operations are supported as for CIM_DiagnosticSettingData in [DSP1002](#).

435 **8.1.3 CIM_DiskDriveDiagnosticServiceCapabilities**

436 All operations are supported as for CIM_DiagnosticServiceCapabilities in [DSP1002](#).

437 **8.2 Profile conventions for operations**

438 Support for operations for each profile class (including associations) shall be as mandated in [DSP1002](#)
439 clauses 8.5 through 8.29.

440 **9 Use cases**

441 This clause contains use cases for the *Disk Drive Diagnostics Profile*.

442 How to discover, configure and run the individual diagnostic tests is detailed in [DSP1002](#). This clause
443 focuses on how to use the Disk Drive diagnostic tests to diagnose common SAN issues.

444 **9.1 Use case summary**

445 Table 7 summarizes the use cases that are described in this clause. The use cases are categorized and
446 named, and references are provided to the body of the test that describes the use case.

447 NOTE: Although use case names follow the convention for naming classes, properties and methods in the
448 schema, this naming was done for readability only and does not imply any functionality attached to the name.

449 The CIM_ prefix has been omitted from the class names in the use cases for readability.

450 **Table 7 – Disk Drive Diagnostics Profile use cases**

Category	Tests	Description
Core device verification		Provides quick device verification with minimal to no user interaction required. See 9.2.
Full functional verification		Verifies complete functionality in a running environment. May require some user interaction, but should also provide default values to adequately diagnose the device under test. See 9.3.
Full functional verification (preboot)		A more complete functional verification allowed by the pre-boot environment. See 9.4.
Stress test		Stresses the device for a user-defined amount of time or iterations in an attempt to expose failures during heavy use. See 9.5.

451 Before performing the use cases in this profile, it is assumed that a client has already utilized the use
452 case methodology defined in [DSP1002](#) to discover the following instances

- 453
- ManagedSystemElement (that is, disk drive instance(s) to be tested
 - 454 • DiskDriveDiagnosticTest instance(s) to be used by this profile
 - 455 • DiskDriveDiagnosticSettingData instance(s) to be used by this profile that will be passed to the
456 DiskDriveDiagnosticTest.RunDiagnosticService() extrinsic method

457 **9.2 Core device verification**

458 To quickly verify that the disk is operating at a minimal functional level on a running system, a client
459 performs the following steps:

- 460
1. Select the ManagedSystemElement instance to be tested.
 - 461 2. Initialize the property values of DiagnosticSettingData as desired (for example, HaltOnError,
462 LogOptions, etc.).
 - 463 3. Initialize the DiskDriveDiagnosticTest instance to select the test to run (for example,
464 DiskDriveTestType = 1 (Stress).
 - 465 4. Invoke the DiskDriveDiagnosticTest.RunDiagnosticService() extrinsic method using the
466 instances from steps 1 and 2 as arguments.
 - 467 5. Repeat steps 2, 3 and 4 for running other tests.

468 **9.3 Full functional verification**

469 The use cases in this clause describe how the client can use the diagnostic tests to verify the health of
470 Disk Drives and to locate them. The CIM_ prefix has been omitted from the class names in the use cases
471 for readability.

472 To more completely verify the proper operation of a disk on a running system, a client performs the
473 following steps:

- 474 1. Select the ManagedSystemElement instance to be tested.
- 475 2. Initialize the property values of DiagnosticSettingData as desired (for example, HaltOnError,
476 LogOptions, etc.).
- 477 3. Initialize the DiskDriveDiagnosticTest instance to select the test to run (for example,
478 DiskDriveTestType = 1 (Stress)).
- 479 4. Invoke the DiskDriveDiagnosticTest.RunDiagnosticService() extrinsic method using the
480 instances from steps 1 and 2 as arguments.
- 481 5. Repeat steps 2, 3 and 4 for running other tests.

482 **9.4 Full functional verification (preboot)**

483 To more completely verify the proper operation of a disk, a client performs the following steps before the
484 system is booted:

- 485 1. Select the ManagedSystemElement instance to be tested.
- 486 2. Initialize the property values of DiagnosticSettingData as desired (for example, HaltOnError,
487 LogOptions, etc.).
- 488 3. Select the DiskDriveDiagnosticTest instance that tests the Instruction set, (for example,
489 DiskDriveTestType = 1 (Stress)).
- 490 4. Invoke the DiskDriveDiagnosticTest.RunDiagnosticService() extrinsic method using the
491 instances from steps 1 and 2 as arguments.
- 492 5. Repeat steps 2, 3 and 4 for running other tests.

493 **9.5 Stress test**

494 To more completely verify the proper operation of a disk, a client performs the following steps before the
495 system is booted:

- 496 1. Select the ManagedSystemElement instance to be tested.
- 497 2. Initialize the property values of DiagnosticSettingData as desired (for example, HaltOnError,
498 LogOptions, etc.).
- 499 3. Select the DiskDriveDiagnosticTest instance that tests the Instruction set, for example
500 DiskDriveTestType = 1 (Stress).
- 501 4. Invoke the DiskDriveDiagnosticTest.RunDiagnosticService() extrinsic method using the
502 instances from steps 1 and 2 as arguments.
- 503 5. Repeat steps 2, 3 and 4 for running other tests.

504 **10 CIM elements**

505 Table 8 shows the instances of CIM elements for this profile. Instances of the CIM elements shall be
 506 implemented as described in Table 8. Clause 7 (“Implementation”) and Clause 8 (“Methods”) may impose
 507 additional requirements on these elements.

508 **Table 8 – CIM elements: Disk Drive Diagnostics Profile**

Element name	Requirement	Description
Classes		
CIM_DiskDriveDiagnosticTest	Mandatory	See 10.1.
CIM_DiskDriveDiagnosticSettingData	Optional	See 10.2.
CIM_DiskDriveDiagnosticServiceCapabilities	Optional	See 10.3.
CIM_RegisteredProfile	Mandatory	See 10.4.
CIM_AffectedJobElement	Optional	See 10.5.
CIM_AvailableDiagnosticService	Mandatory	See 10.6.
CIM_ElementCapabilities	Optional	See 10.7.
CIM_ElementSettingData (DiagnosticSettingData)	Optional	See 10.8.
CIM_ElementSettingData (JobSettingData)	Optional	See 10.9.
CIM_ElementSoftwareIdentity	Mandatory	See 10.10.
CIM_HostedService	Mandatory	See 10.11.
CIM_OwningJobElement	Mandatory	See 10.12.
CIM_RecordAppliesToElement	Optional	See 10.13.
CIM_ServiceAffectsElement	Mandatory	See 10.14.
CIM_ServiceAvailableToElement	Optional	See 10.15.
CIM_ServiceComponent	Optional	See 10.16.
CIM_UseOfLog	Mandatory	See 10.17.
Indications		
None defined in this profile		

509 **10.1 CIM_DiskDriveDiagnosticTest (specializes CIM_DiagnosticTest)**

510 CIM_DiskDriveDiagnosticTest is used to represent the Diagnostic Testing for a Disk Drive. This class
 511 specializes CIM_DiagnosticTest as defined in the [Diagnostics Profile](#). The constraints listed in Table 9 are
 512 in addition to those specified in the [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory
 513 elements that must be implemented.

514 **Table 9 – Class: CIM_DiskDriveDiagnosticTest**

Elements	Requirement	Notes
ElementName	Mandatory	See 7.2.
Characteristics	Mandatory	See 7.2.

Elements	Requirement	Notes
OtherCharacteristicsDescriptions	Conditional	If Characteristics includes the value of 1 (Other), this property is Mandatory.
DiskDriveTestType	Mandatory	See 7.2.
OtherDiskDriveTestTypeDescription	Conditional	If DiskDriveTestType has a value of 1 (Other), this property is Mandatory.

515 **10.2 CIM_DiskDriveDiagnosticSettingData (specializes**
 516 **CIM_DiagnosticSettingData)**

517 CIM_DiskDriveDiagnosticSettingData is used to pass in test parameters and to specify other test control
 518 parameters. This class specializes CIM_DiagnosticSettingData as defined in the [Diagnostics Profile](#). The
 519 constraints listed in Table 10 are in addition to those specified in the [Diagnostics Profile](#). See the
 520 [Diagnostics Profile](#) for other mandatory elements that must be implemented.

521 **Table 10 – Class: CIM_DiskDriveDiagnosticSettingData**

Elements	Requirement	Notes
ElementName	Mandatory	See 7.3.
LBAStart	Optional	See 7.3.1.
LBAEnd	Optional	See 7.3.2.
Seed	Optional	See 7.3.3.
DataSizes	Optional	See 7.3.4.
DataPatterns	Optional	See 7.3.5.

522 **10.3 CIM_DiskDriveDiagnosticServiceCapabilities (specializes**
 523 **CIM_DiagnosticServiceCapabilities)**

524 CIM_DiskDriveDiagnosticServiceCapabilities is used to provide information on the capabilities for the Disk
 525 Drive Diagnostic Service. This class specializes CIM_DiagnosticServiceCapabilities as defined in the
 526 [Diagnostics Profile](#). The constraints listed in Table 11 are in addition to those specified in the [Diagnostics](#)
 527 [Profile](#). See the [Diagnostics Profile](#) for other mandatory elements that must be implemented.

528 **Table 11 – Class: CIM_DiskDriveDiagnosticServiceCapabilities**

Elements	Requirement	Notes
ElementName	Mandatory	See 7.4.
Region	Optional	See 7.4.1.
Seed	Optional	See 7.4.2.
DataSizes	Optional	See 7.4.3.
DataPatterns	Optional	See 7.4.4.

529 **10.4 CIM_RegisteredProfile**

530 The CIM_RegisteredProfile class is defined by the [Profile Registration Profile](#). The requirements denoted
 531 in Table 12 are in addition to those mandated by the [Profile Registration Profile](#). See the [Profile](#)
 532 [Registration Profile](#) for the other mandatory elements that must be implemented.

533

Table 12 – Class: CIM_RegisteredProfile

Elements	Requirement	Notes
RegisteredName	Mandatory	This property shall be "Disk Drive Diagnostics".
RegisteredVersion	Mandatory	This property shall be "1.0.0".
RegisteredOrganization	Mandatory	This property shall be 2 (DMTF).

534 **10.5 CIM_AffectedJobElement**

535 Although defined in the [Diagnostics Profile](#), the CIM_AffectedJobElement class is listed here because the
 536 AffectedElement reference is scoped down to a subclass of CIM_ManagedElement as specified in clause
 537 5. The constraints listed in Table 13 are in addition to those specified in the [Diagnostics Profile](#). See the
 538 [Diagnostics Profile](#) for other mandatory properties of CIM_AffectedJobElement that must be
 539 implemented.

540

Table 13 – Class: CIM_AffectedJobElement

Properties	Requirement	Notes
AffectedElement (overridden)	Mandatory	This property shall be a reference to an instance of the CIM_ManagedElement subclass specified in clause 5.
AffectingElement	Mandatory	This property shall be a reference to an instance of CIM_ConcreteJob.

541 **10.6 CIM_AvailableDiagnosticService**

542 Although defined in the [Diagnostics Profile](#), the CIM_AvailableDiagnosticService class is listed here
 543 because the ServiceProvided reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a
 544 subclass of CIM_DiagnosticTest, and the UserOfService reference is scoped down to a subclass of
 545 CIM_ManagedElement as specified in clause 5. The constraints listed in Table 14 are in addition to those
 546 specified in the [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 547 CIM_AvailableDiagnosticService that must be implemented.

548

Table 14 – Class: CIM_AvailableDiagnosticService

Properties	Requirement	Notes
ServiceProvided (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.
UserOfService (overridden)	Mandatory	This property shall be a reference to an instance of the CIM_ManagedElement subclass specified in clause 5.

549 **10.7 CIM_ElementCapabilities**

550 Although defined in the [Diagnostics Profile](#), the CIM_ElementCapabilities class is listed here because the
 551 ManagedElement reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a subclass of
 552 CIM_DiagnosticTest, and the Capabilities reference is scoped down to
 553 CIM_DiskDriveDiagnosticServiceCapabilities, which is a subclass of CIM_DiagnosticServiceCapabilities.
 554 The constraints listed in Table 15 are in addition to those specified in the [Diagnostics Profile](#). See the
 555 [Diagnostics Profile](#) for other mandatory properties of CIM_ElementCapabilities that must be implemented.

556

Table 15 – Class: CIM_ElementCapabilities

Properties	Requirement	Notes
ManagedElement (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.
Capabilities (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticServiceCapabilities.

557 **10.8 CIM_ElementSettingData (DiagnosticSettingData)**

558 Although defined in the [Diagnostics Profile](#), the CIM_ElementSettingData class is listed here because the
 559 ManagedElement reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a subclass of
 560 CIM_DiagnosticTest, and the SettingData reference is scoped down to
 561 CIM_DiskDriveDiagnosticSettingData, which is a subclass of CIM_DiagnosticSettingData. The constraints
 562 listed in Table 16 are in addition to those specified in the [Diagnostics Profile](#). See the [Diagnostics Profile](#)
 563 for other mandatory properties of CIM_ElementSettingData that must be implemented.

564

Table 16 – Class: CIM_ElementSettingData

Properties	Requirement	Notes
ManagedElement (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.
SettingData (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticSettingData.
IsDefault	Mandatory	If the instance of CIM_DiskDriveDiagnosticSettingData is the default setting, this property shall have the value of TRUE.

565 **10.9 CIM_ElementSettingData (JobSettingData)**

566 Although defined in the [Diagnostics Profile](#), the CIM_ElementSettingData class is listed here because the
 567 Dependent reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a subclass of
 568 CIM_DiagnosticTest, and the SettingData reference is scoped down to CIM_JobSettingData, which is a
 569 subclass of CIM_SettingData. The constraints listed in Table 17 are in addition to those specified in the
 570 [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 571 CIM_ElementSettingData that must be implemented.

572

Table 17 – Class: CIM_ElementSettingData

Properties	Requirement	Notes
ManagedElement (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.
SettingData (overridden)	Mandatory	This property shall be a reference to an instance of CIM_JobSettingData.
IsDefault	Mandatory	If the instance of CIM_JobSettingData is the default setting, this property shall have the value of TRUE.

573 **10.10 CIM_ElementSoftwareIdentity**

574 Although defined in the [Diagnostics Profile](#), the CIM_ElementSoftwareIdentity class is listed here because
 575 the Dependent reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a subclass of
 576 CIM_DiagnosticTest. The constraints listed in Table 18 are in addition to those specified in the
 577 [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 578 CIM_ElementSoftwareIdentity that must be implemented.

579 **Table 18 – Class: CIM_ElementSoftwareIdentity**

Properties	Requirement	Notes
Antecedent	Mandatory	This property shall be a reference to an instance of CIM_SoftwareIdentity.
Dependent (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.

580 **10.11 CIM_HostedService**

581 Although defined in the [Diagnostics Profile](#), the CIM_HostedService class is listed here because the
 582 Dependent reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a subclass of
 583 CIM_DiagnosticTest. The constraints listed in Table 19 are in addition to those specified in the
 584 [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of CIM_HostedService that
 585 must be implemented.

586 **Table 19 – Class: CIM_HostedService**

Properties	Requirement	Notes
Antecedent	Mandatory	This property shall be a reference to an instance of CIM_ComputerSystem.
Dependent (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.

587 **10.12 CIM_OwningJobElement**

588 Although defined in the [Diagnostics Profile](#), the CIM_OwningJobElement class is listed here because the
 589 OwningElement reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a subclass of
 590 CIM_DiagnosticTest. The constraints listed in Table 20 are in addition to those specified in the
 591 [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 592 CIM_OwningJobElement that must be implemented.

593 **Table 20 – Class: CIM_OwningJobElement**

Properties	Requirement	Notes
OwningElement (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.
OwnedElement	Mandatory	This property shall be a reference to an instance of CIM_ConcreteJob.

594 **10.13 CIM_RecordAppliesToElement**

595 Although defined in the [Diagnostics Profile](#), the CIM_RecordAppliesToElement class is listed here
 596 because the Dependent reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a subclass

597 of CIM_DiagnosticTest. The constraints listed in Table 21 are in addition to those specified in the
 598 [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 599 CIM_RecordAppliesToElement that must be implemented.

600 **Table 21 – Class: CIM_RecordAppliesToElement**

Properties	Requirement	Notes
Antecedent	Mandatory	This property shall be a reference to an instance of CIM_RecordForLog.
Dependent (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.

601 **10.14 CIM_ServiceAffectsElement**

602 Although defined in the [Diagnostics Profile](#), the CIM_ServiceAffectsElement class is listed here because
 603 the AffectedElement reference is scoped down to a subclass of CIM_ManagedElement as specified in
 604 clause 5, and the AffectingElement reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a
 605 subclass of CIM_DiagnosticTest. The constraints listed in Table 22 are in addition to those specified in
 606 the [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 607 CIM_ServiceAffectsElement that must be implemented.

608 **Table 22 – Class: CIM_ServiceAffectsElement**

Properties	Requirement	Notes
AffectedElement (overridden)	Mandatory	This property shall be a reference to an instance of the CIM_ManagedElement subclass specified in clause 5.
AffectingElement (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.

609 **10.15 CIM_ServiceAvailableToElement**

610 Although defined in the [Diagnostics Profile](#), the CIM_ServiceAvailableToElement class is listed here
 611 because the UsersOfService reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a
 612 subclass of CIM_DiagnosticTest. The constraints listed in Table 23 are in addition to those specified in
 613 the [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 614 CIM_ServiceAvailableToElement that must be implemented.

615 **Table 23 – Class: CIM_ServiceAvailableToElement**

Properties	Requirement	Notes
ServiceProvided	Mandatory	This property shall be a reference to an instance of CIM_HelpService.
UsersOfService (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.

616 **10.16 CIM_ServiceComponent**

617 Although defined in the [Diagnostics Profile](#), the CIM_ServiceComponent class is listed here because the
 618 GroupComponent reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a subclass of
 619 CIM_DiagnosticTest, and the PartComponent reference is scoped down to CIM_DiskDriveDiagnosticTest,
 620 which is a subclass of CIM_DiagnosticTest. The constraints listed in Table 24 are in addition to those

621 specified in the [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of
 622 CIM_ServiceComponent that must be implemented.

623 **Table 24 – Class: CIM_ServiceComponent**

Properties	Requirement	Notes
GroupComponent (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.
PartComponent (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.

624 10.17 CIM_UseOfLog

625 Although defined in the [Diagnostics Profile](#), the CIM_UseOfLog class is listed here because the
 626 Dependent reference is scoped down to CIM_DiskDriveDiagnosticTest, which is a subclass of
 627 CIM_DiagnosticTest. The constraints listed in Table 25 are in addition to those specified in the
 628 [Diagnostics Profile](#). See the [Diagnostics Profile](#) for other mandatory properties of CIM_UseOfLog that
 629 must be implemented.

630 **Table 25 – Class: CIM_UseOfLog**

Properties	Requirement	Notes
Antecedent	Mandatory	This property shall be a reference to an instance of CIM_DiagnosticLog.
Dependent (overridden)	Mandatory	This property shall be a reference to an instance of CIM_DiskDriveDiagnosticTest.

ANNEX A (informative)

S.M.A.R.T. Tests

631
632
633
634

635 S.M.A.R.T. includes disk diagnostic tests and attributes that can be used to monitor disk drive status,
636 collect statistics, test components or subsystems and predict upcoming failures. S.M.A.R.T. support is
637 available for many platforms (Linux, Windows, etc.). Many motherboard and disk drive vendors provide
638 S.M.A.R.T. utilities customized for the tests and attributes supported by their product.

639 S.M.A.R.T. defines a list of attributes identified by an ID number. The list of attributes can be categorized
640 into several functional groups. Some are counters for particular error conditions. Others are simply usage
641 counters that are not necessarily indicative of aberrant behavior.

642 A disk drive vendor may support one or more attributes. The disk will update the raw value of each
643 supported attribute. Each disk drive vendor defines their own alert threshold for each supported attribute.

644 Since implementations may use S.M.A.R.T. technology to perform some of the diagnostic tests,
645 information regarding S.M.A.R.T. is provided for convenience.

646 **A.1 Self Test**

647 S.M.A.R.T. defines a generic Self test that verifies that the disk is operating properly. The specific tests
648 performed by a Self test are dependent upon the vendor and individual product features. Typically, a user
649 may specify a short Self test that runs several minutes or an extended Self test that may run much longer.
650 Self tests may be run online or offline.

651 **A.2 Cache Test**

652 A Cache diagnostic verifies that the cache subsystem is operating properly. Typically, disks have
653 separate read-ahead cache and write cache. A user may choose to test either or both. S.M.A.R.T. defines
654 a cache related attribute called End-to-End Error (ID = 184). This error counter is incremented whenever
655 the disk detects that parity has changed after data has been transferred between the host and disk
656 through a cache.

657 **A.3 Seek Tests**

658 A Seek diagnostic verifies that all read and write heads of a disk can seek to all cylinders on their platter.
659 A user may choose to have the heads seek to cylinders in a sequential or random manner. A user may
660 also select a subset of disk sectors by specifying a starting and ending LBA.

661 S.M.A.R.T. defines an attribute, called Seek Error Rate (ID = 7), that monitors the frequency of head
662 positioning errors. A rising rate may indicate upcoming disk failure.

663 **A.4 Sector Remap Tests**

664 Over time, a percentage of physical disk sectors become unusable. A disk reserves a number of spare
665 sectors that can be used to dynamically replace permanently damaged sectors. When a disk detects a
666 permanent sector failure, it automatically remaps the logical sector from the failed physical sector to a
667 spare physical sector.

668 Additionally, some disk sectors cannot be used to store user data because they are reserved for use by
669 the operating system or other purpose.

670 S.M.A.R.T. defines several attributes related to bad block mapping. They are as follows:

- 671 • Reallocated Sector Count (ID = 5) – The count of reallocated sectors.
- 672 • Reallocation Event Count (ID = 196) – The count of sector remap operations
- 673 • Current Pending Sector Count (ID = 197) – The number of "unstable" sectors (waiting to be
674 remapped because of read errors).
- 675 • Uncorrectable Sector Count (ID = 198) – The number of unusable sectors.

676 **A.5 Read Tests**

677 A read diagnostic verifies that all read heads of a disk can read all disk sectors. A user may choose to
678 read sectors in a sequential or random manner. A user may also select a subset of disk sectors by
679 specifying a starting and ending LBA.

680 S.M.A.R.T. defines several attributes related to read operations. They are as follows:

- 681 • Raw Read Error Rate (ID = 1) – The frequency of errors occurred while reading raw data
- 682 • Soft Read Error Rate (ID = 13) – The number of uncorrected read errors reported to the OS
- 683 • TA Counter Detected (ID = 201) – The count of off-track errors
- 684 • Read Error Retry Rate (ID = 205) – The number of retries of read operations

685 **A.6 Write Tests**

686 A write diagnostic verifies that all write heads of a disk can write to all disk sectors. A user may choose to
687 write to sectors in a sequential or random manner. A user may also select a subset of disk sectors by
688 specifying a starting and ending LBA.

689 S.M.A.R.T. defines the following attribute related to write operations:

- 690 • Write Error Rate (ID = 200) – The number of write errors

691 **A.7 Disk Information**

692 Disks may support the capability to return device and product information, such as the following:

- 693 • Device Model
- 694 • Serial Number
- 695 • Firmware Version
- 696 • Capacity
- 697 • Interface type (for example, SCSI, SATA, PATA, etc.)

698 A Disk Information diagnostic verifies that such data can be retrieved and that the retrieved data is
699 accurate.

700 **A.8 Environmental Sensor Tests**

701 A disk must operate properly within a specified range of environmental parameters. Disks may have
702 sensors that monitor certain environmental conditions. An Environmental Sensor test verifies that these
703 sensors are operating properly.

704 S.M.A.R.T. defines several attributes related to environmental sensors built into the disk. They are as
705 follows:

- 706 • InducedOp-Vibration Detection (ID = 186)
- 707 • Airflow Temperature (ID = 190) – Current airflow temperature
- 708 • Disk Temperature (ID = 194) – Current disk temperature
- 709 • Thermal Asperity Count (ID = 205) – The number of errors caused by high temperature
- 710 • Vibration During Write (ID = 211)
- 711 • Shock During Write (ID = 212)
- 712 • G-Sense Error Rate (ID = 221) – The number of errors caused by external shock or vibration
- 713 • Free Fall Event Count (ID = 254) – The number of “free fall” (drops) suffered by the disk

714
715 Other environmental factors that may be tested are as follows:

- 716 • Altitude – that the disk properly operates at certain atmospheric pressures
- 717 • Electromagnetic Immunity – that the disk properly operates when subject to certain strengths of
718 electromagnetic fields
- 719 • Humidity – that the disk properly operates at certain levels of relative humidity

720 **A.9 Operation Sensor Tests**

721 A disk consists of many moving components (for example heads, platters, etc) which must operate within
722 a specified range of speed and motion. Most disks have sensors that monitor certain operating conditions
723 to detect when potentially harmful situations occur. An Operation Sensor test verifies that these sensors
724 are operating properly.

725 S.M.A.R.T. defines several attributes related to operation sensors built into the disk. They are as follows:

- 726 • Head stability (ID = 185)
- 727 • High Fly Writes (ID = 189) – The number of unsafe write operations outside the normal head
728 flying range
- 729 • Flying Height (ID = 206) – Current head flying height
- 730 • Spin High Current (ID = 207) – Amount of current used to spin up the drive
- 731 • Load Friction (ID = 224) – Resistance caused by friction of mechanical parts of magnetic head
732 armature
- 733 • Disk Shift (ID = 220) – Distance the disk has shifted relative to the spindle

734 **A.10 Power Management Tests**

735 Disks provide support for different power consumption modes such as:

- 736 • Active
- 737 • Active Idle
- 738 • Low Power Idle
- 739 • Standby
- 740 • Sleep/Hibernate

741 A Power Management diagnostic verifies that the disk can enter and return from each supported power
742 consumption mode.

743 **A.11 Malfunction Indicator Tests**

744 Disks collect data and statistics that can be used to alert the user of rising error rates or levels that may
745 indicate upcoming disk failure or degraded operation. The Malfunction Indicator test verifies that the disk
746 can accurately collect these statistics and data and return them upon request.

747 S.M.A.R.T. defines several attributes related to malfunction indicators. They are as follows:

- 748 • Read Channel Margin (ID = 6) – The number of read operations that occur in the read channel
749 margin
- 750 • Spin Retry Count (ID = 10) – The number of retries of spin start attempts
- 751 • Drive Recalibration Retry Count (ID = 11) – The number of attempts to recalibrate the drive
- 752 • Spin Buzz (ID = 208) – The number of buzz routines needed to spin up the drive due to
753 insufficient power
- 754 • Torque Amplification Count (ID = 227) – The number of attempts to compensate for platter
755 speed variations
- 756 • GMR Head Amplitude (ID = 230) – The amplitude of “thrashing” (distance of repetitive
757 forward/reverse head motion)

758 **A.12 Performance**

759 Disks collect performance data on various aspects of their operation that can be used to alert the user of
760 degrading performance that may indicate upcoming disk failure. The Performance test verifies that the
761 disk can accurately collect performance data and return them upon request.

762 S.M.A.R.T. defines several attributes related to performance measurement. They are as follows:

- 763 • Throughput performance (ID = 2) – General throughput performance. Degrading performance
764 may indicate upcoming motor, servo or bearing failure.
- 765 • Spin-Up Time (ID = 3) – Time needed by spindle to spin up to full RPMs. Degrading
766 performance may indicate upcoming motor or bearing failure.
- 767 • Seek Time Performance (ID = 8) – Average time of seek operations. Degrading performance
768 may indicate upcoming servo failure.
- 769 • Offline Seek Performance (ID = 209) – Drive performance as measured during a Self test

770 **A.13 Usage Meters**

771 Disks maintain counters that monitor the overall usage of the drive. These counters measure how often a
772 particular operation or event has occurred but do not necessarily indicated any error condition. The
773 Usage Meters test verifies that these counters are operating properly.

774 S.M.A.R.T. defines attributes related usage meters. They are as follows:

- 775 • Start/Stop Count (ID = 4) – The number of spindle start/stop cycles.
- 776 • Power-On Hours (ID = 9) – The amount of time the drive is powered on
- 777 • Power Cycle Count (ID = 12) – The number of power on/off cycles
- 778 • Power Off Retract Count (ID = 192) – The number of times when the heads are unloaded from
779 the media for a power off operation

- 780 • Load Cycle Count (ID = 193) – The number of time the head are moved to a landing zone
781 position
- 782 • Loaded Hours (ID = 222) – The amount of time the disk where the magnetic head armature is
783 active
- 784 • Load/Unload Retry Count (ID = 223) – The number of times read/write heads enter/exit a data
785 zone
- 786 • Load/Unload Cycle Count (ID = 225) – The number of load/unload cycles
- 787 • Load-In Time (ID = 226) – The amount of time read/write heads are in a data zone
- 788 • Power-Off Retract Cycle (ID = 228) – The number of times that the magnetic armature was
789 retracted automatically because power was turned off
- 790 • Head Flying Hours (ID = 240) – The total amount of time spent to position a head
- 791 • Total LBAs Written (ID = 241)
- 792 • Total LBAs Read (ID = 242)

793 **A.14 Error Counters**

794 Disks maintain counters for a set of detected errors. The Error Counters test verifies that these counters
795 are operating properly.

796 S.M.A.R.T. defines attributes related to monitor errors, some of which are included in other diagnostic
797 tests. These remaining error attributes are as follows:

- 798 • SATA Downshift Error Count (ID = 183)
- 799 • Reported Uncorrectable Errors (ID = 187) – The number of errors that could not be corrected
800 using hardware ECC
- 801 • Command Timeout (ID = 188) – The number of aborted operations caused by disk command
802 timeout
- 803 • UltraDMA CRC Error Count (ID = 199) – The number of detected data transfer errors across the
804 interface cable
- 805 • Data Address Mark Errors (ID = 202)
- 806 • Run Out Cancel (ID = 203) – The number of errors that were corrected using hardware ECC
- 807 • Soft ECC Correction (ID = 204) – The number of errors that were corrected using software ECC
- 808 • Transfer Error Rate (ID = 240) – The number of data transfer errors caused by a link reset

809 Table Table A-1 represents the list of tests that are used by one disk drive vendor.

Table A-1 – One vendor's disk drive tests

Test Name	Description
Device Information	This provides information about the HDD (model string, serial #, capacity, config verification, firmware revision)(can possibly get device info even though drive cannot perform I/O)(no user controls)
SMART Short Self-Test	<p>This executes the SMART (Self-Monitoring, Analysis, and Reporting Technology) drive self-test routine. This test runs only on SATA and SCSI drives that support off-line data collection or self-test. (runs just a subset, returns success/failure status only, no user control, a few minutes)</p> <p>For SCSI, a Self-Test is initiated using a Send Diagnostic command (operation code = 1D) while the results of the Self-Test are retrieved using a Receive Diagnostics Results command (operation code = 1C)</p>
SMART Status Test	This checks the status of predictive failures for SATA and SCSI hard disk drives that support SMART. (examines error/failure statistics collected by drive, no user control, immediate return)
SMART Extended Self-Test	This test runs the drive's SMART extended self-test for hard disk drives that support SMART technology (no user control, longer than short self-test, maybe an hour to run, full set of implemented tests)
SMART Selective (LBA) Self-Test	This test runs the drive's SMART extended self-test selectively - only for the specified Spans. There are 3 expected supported spans: Span1 is at the start of the drive, Span2 is in the middle of the drive and Span3 is at the end of the drive. This is for hard disk drives that support SMART technology (user selects the LBA range but not the tests to run)
SMART Timed Self-Test	This test runs the drive's SMART extended self-test only for the specified time. This is for hard disk drives that support SMART technology (runs through ordered list of tests and stops after a period of time at whatever test it is running)
Performance/Speed Test	Determines the data transfer rate, the sequential seek time, and the random seek time based on transfer size, seek count, and data transferred.
Sequential Read Test	This test checks the drive head's ability to read from sector to sector in a straight line, beginning from the first sector and continuing sequentially to the last sector. (user can specify LBA range, size of data transferred) (data is transferred to host)

811

Test Name	Description
Sequential Read-Write-Read-Compare	This test checks the drive head's ability to sequentially read specified range of blocks (start, end, and skip blocks) and writes the read data back. The test then reads the data a second time and compares it with the data that was originally read. (user specified LBA range and size of data transferred, data is not actually changed intentionally, is Risky, bad sector remap is transparent to this test)
Sequential Verify Test	This test verifies the drive's ability to read and verify sequentially from track to track and head to head. (uses ATA command) (no SCSI equivalent?) (data is not transferred to the host, internal verify)
Random Read Test	This test verifies the drive's ability to read data randomly from block to block. (user control by LBA range and size of data transferred, maybe random seed?)
Random Read-Write-Read-Compare	This test checks the drive head's ability to randomly read a specified range of blocks (begin, end and skip blocks) and writes the read data back. The test then reads the data a second time and compares it with the data that was originally read. (user specified LBA range and size of data transferred and maybe random seed(?), data is not actually changed intentionally, is Risky, bad sector remap is transparent to this test)
Region Test	The test performs reads a block of data, saves the data into a buffer, if read call passes, writes a specific pattern to that block, if write call passes, it reads it back, compares the data. Then, restores the original data. (is Risky, is Destructive, user specified LBA range and size of data transferred)
Grown Defects Test (B)	This test will find the number of grown defects on the drive. For ATA use ATA command. For SCSI use SCSI command.

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**ANNEX B
(informative)**

Change Log

Version	Date	Description
1.0.0	2011-09-16	DMTF Standard

816