

Hard Drive, SSD, NVMe Troubleshooting Flowchart

A guide to help you diagnose drive problems and recommended actions

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12 March 2025

How to use

- This is very important, read and understand these pages before moving forward. This is only a troubleshooting guide and it will assist with diagnosing the most common situations seen. It is NOT a guide to fix every little problem that can arise from a file system issue, this is focused on physical drive issues. I did include some basic ZFS troubleshooting because many people think these problems are drive failures and this will identify if it is a drive failure or not.
- **You MUST be a privileged user** such as ``root`` or you may need to use ``sudo``. If you enter a command and get the response that the command cannot be found, then you do not have the privileges to run that command.
- Often people see an error and jump to an incorrect conclusion, especially when experiencing ZFS errors. This guide will help reduce going down the wrong path.
- When an operation is requested, such as reading SMART data or performing a SCRUB, refer to Appendix B for what the command is and how to use the command. If you are uncomfortable doing this, then seek additional help.
- Refer to Appendix A for examples of Specific Measurable Achievable Relevant Time-bound (SMART) and Field Access Reliability Metrics (FARM) screen outputs.

There are four flowcharts:

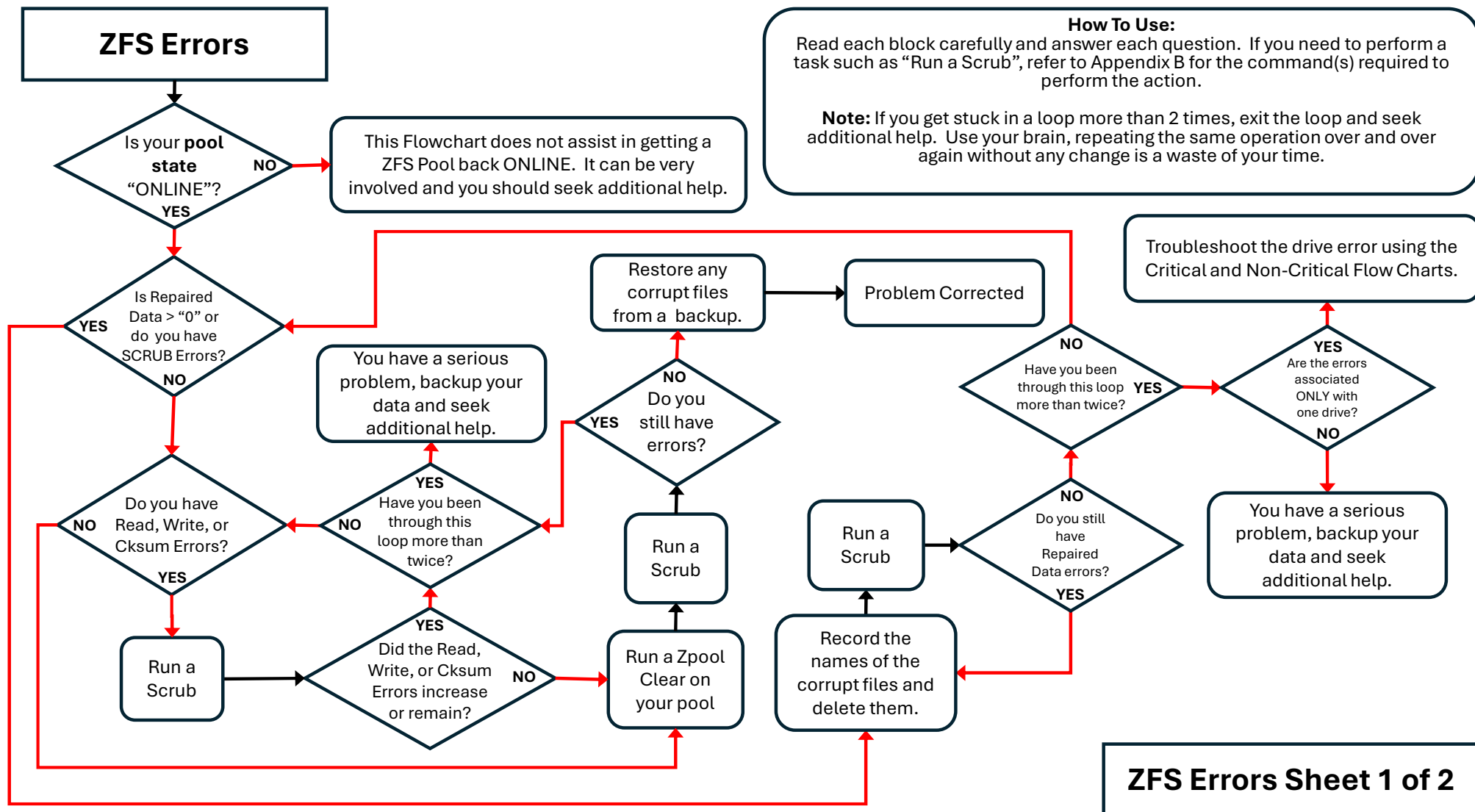
1. ZFS ERRORS
2. CRITICAL DRIVE ERRORS - This flowchart is for what the author considers critical errors.
3. NON-CRITICAL DRIVE ERRORS – This flowchart is for what the author considers are non-critical errors, however that doesn't mean they are to be ignored and pushed off. You still need to take action.
4. SUSPECT FOUL PLAY (ALTERED DRIVE DATA) – The Seagate Drive Issue Saga

If you have recommended changes, reach out to me. I will evaluate it and update if I agree. Sorry about a lot of the small font, I will probably rebuild this in the next few months. This does replace the Hard Drive Troubleshooting Guide Version 1. Version 2 will be out eventually and include this flowchart presentation.

Hey Doc, How do I do something?

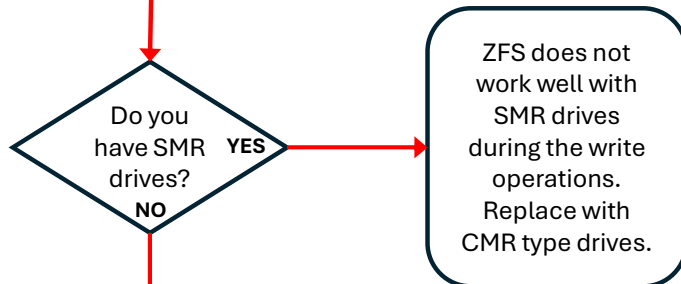
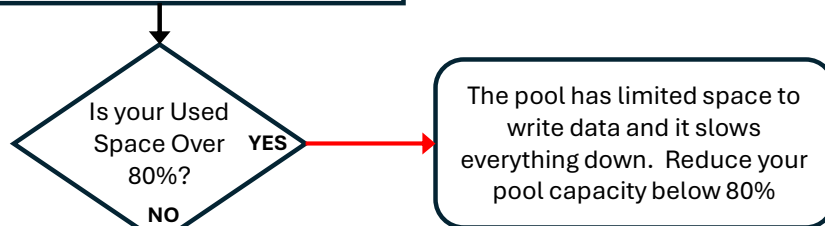
- This set of flowcharts is not designed to hold your hand and take you step by step to perform the troubleshooting, drive replacements, etc.
- Use the TrueNAS Guide to perform things like “How to replace a drive”. It is there and is well written.
- To check if you have an SMR drive, you need to play Detective on the internet and find out if your drive is SMR or CMR. If you have SMR, this could be your problem.
- These flowcharts will not help you put your pool back ONLINE. If your pool is ONLINE, then it will help with correcting the common ZFS problems seen, which many people attribute to a drive failure.

ZFS Errors



ZFS Slow Pool

(The pool is so slow today, what happened?)



1. Did you Reboot yet?
2. Check to see if your NAS is just Busy
3. Check SNAPSHOTS
4. Check SWAP SPACE
5. Seek Additional Help

How To Use:

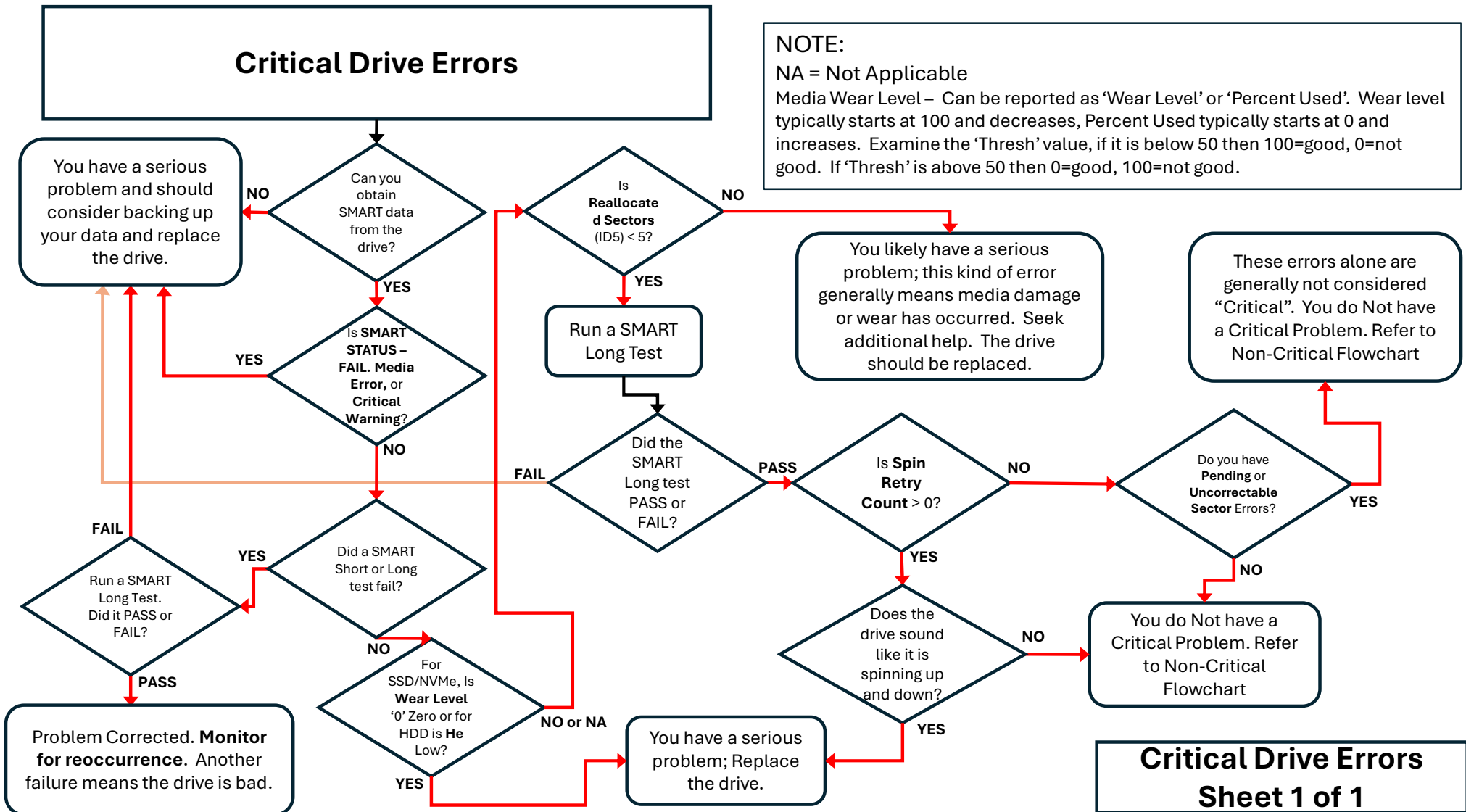
Read each block carefully and answer each question. If you need to perform a task such as “Run a Scrub”, refer to Appendix B for the command(s) required to perform the action.

Critical Drive Errors

NOTE:

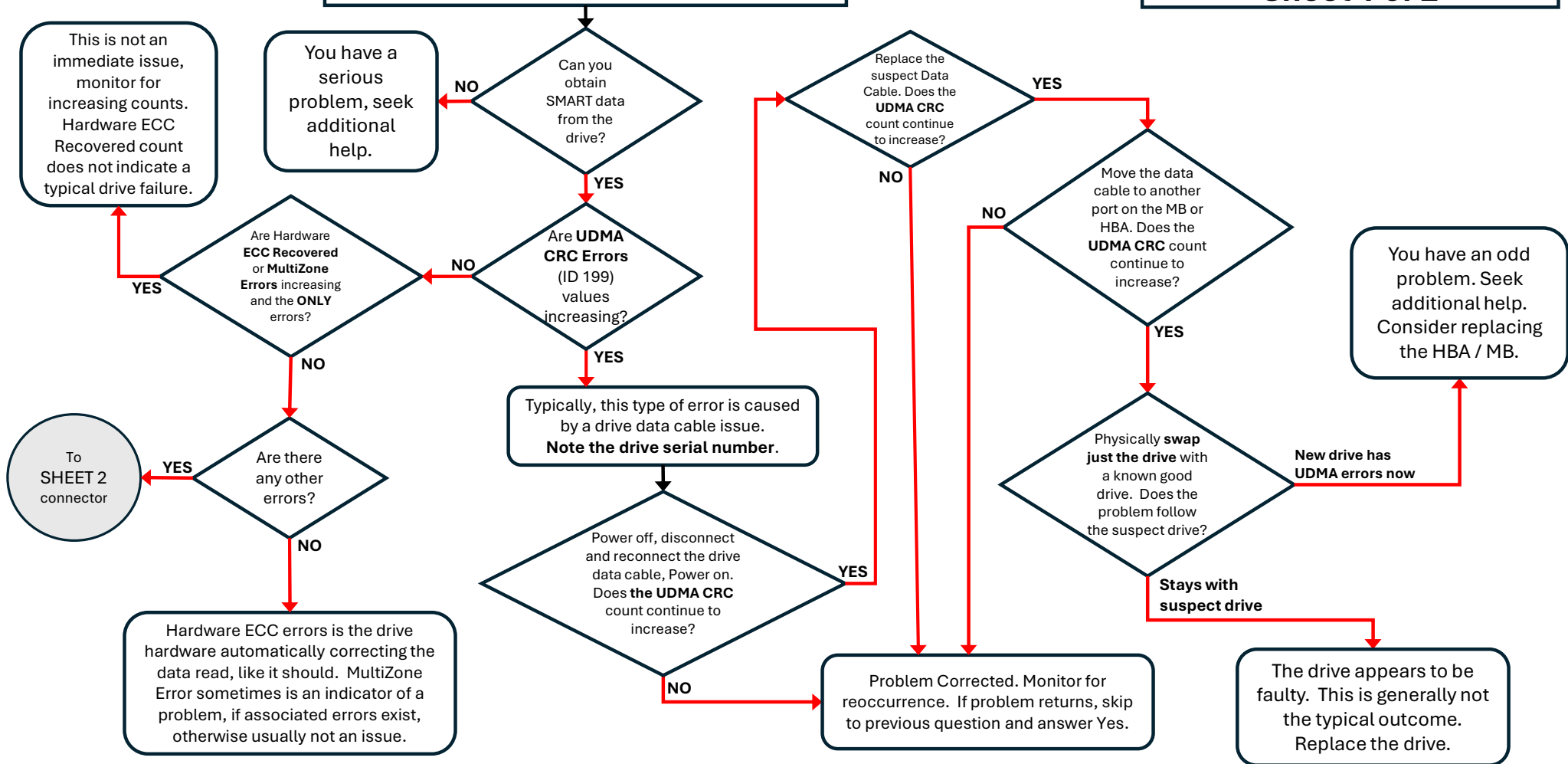
NA = Not Applicable

Media Wear Level – Can be reported as ‘Wear Level’ or ‘Percent Used’. Wear level typically starts at 100 and decreases, Percent Used typically starts at 0 and increases. Examine the ‘Thresh’ value, if it is below 50 then 100=good, 0=not good. If ‘Thresh’ is above 50 then 0=good, 100=not good.



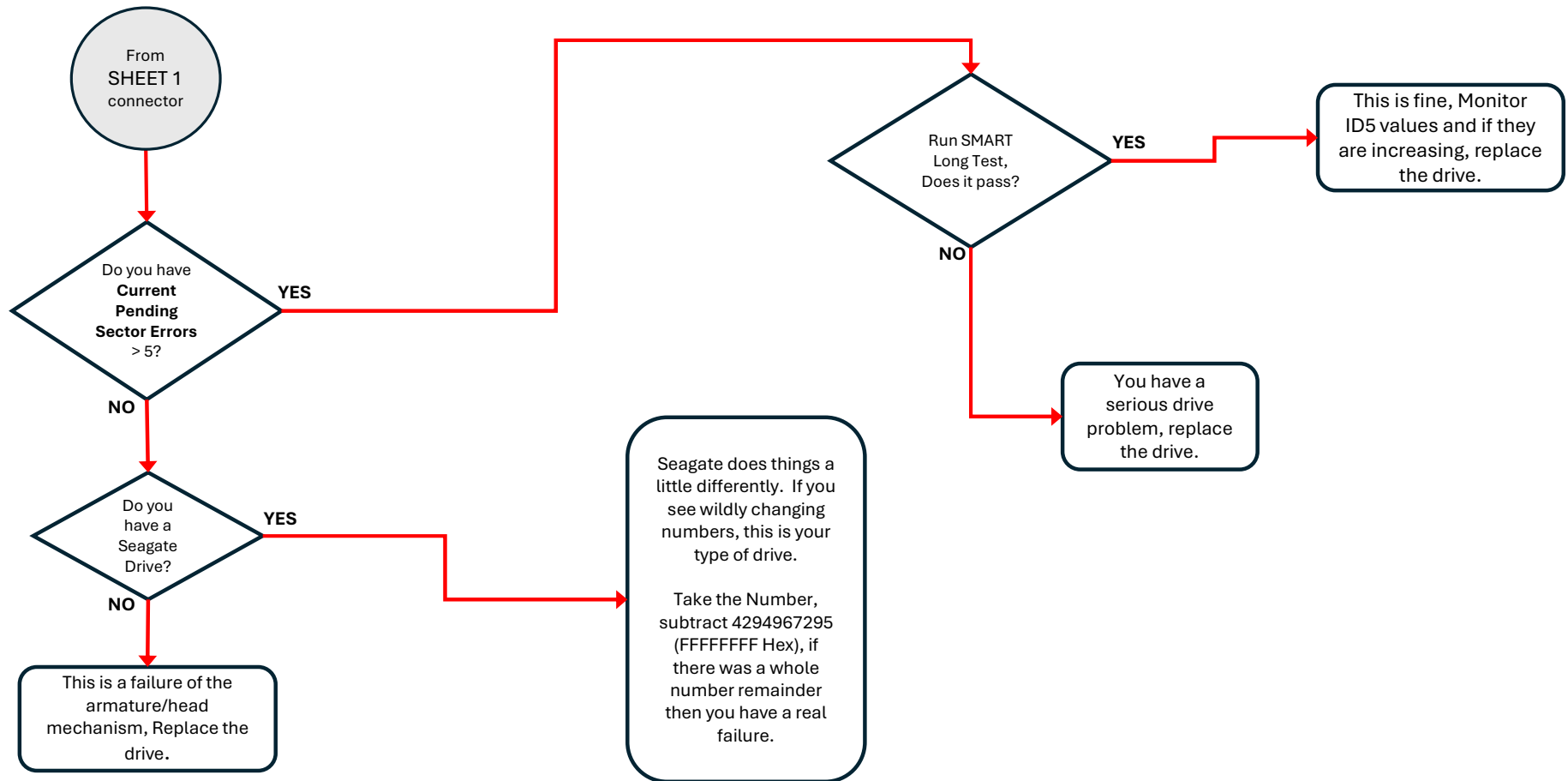
Non-Critical Drive Errors

Non-Critical Drive Errors Sheet 1 of 2



Non-Critical Drive Errors

Non-Critical Drive Errors Sheet 2 of 2



Suspect Foul Play (Altered Drive Data)

With the flood of used Seagate hard drives in the market in 2024/2025, if you bought a new drive, you should verify that it is actually new. The steps to do that are here and I **Highly Recommend** you do this check. Unfortunately, only Seagate at this time has this FARM data so this will not work for other drive manufacturers. (Shameless Plug -- Multi-Report V3.15 (and later) has this check built-in.)

Procedure:

1. Check which version of smartmontools is installed. ``smartctl``

Is
smartmontools
version 7.4 or
greater?

NO

YES

You will need
smartmontools 7.4 or later
to read the FARM data.

Procedure:

2. OBTAIN SMART DRIVE DATA ``smartctl -a /dev/driveid``
3. OBTAIN FARM DATA ``smartctl -l /dev/driveid`` (-l is a lower case L)
4. From both pieces of data, write down the following data:
 - a. Serial Number
 - b. Power On Hours
 - c. Spindle Power On Hours
 - d. Head Flight Hours
 - e. LBAs Read and Written

Compare the
data between
the two reports,
is there a
discrepancy?

NO

YES

You are one of the lucky
ones, your drive appears to
be valid.

You Likely have an altered
drive. Seek additional help.

Appendix A

How to read SMART Output

- SMART Data is not terribly difficult to read and understand. Below is a typical output for a Hard Drive. Not all look the same. Some will display different Attributes (some are manufacturer specific as well), the format may look significantly different for SAS drives.
- Whatever the format is of the SMART data, it will contain similar values, pay attention to what you are reading.
- If you have a question about an attribute, Google is your friend. Use “S.M.A.R.T.” and the attribute name.

```
root@freenas:~ # smartctl -a /dev/ada1
smartctl 7.4 2023-08-01 r5530 [FreeBSD 13.3-RELEASE-p4 amd64] (local build)
Copyright (C) 2002-23, Bruce Allen, Christian Franke, www.smartmontools.org

=== START OF INFORMATION SECTION ===
Model Family:      HGST Deskstar NAS
Device Model:      HGST HDN726060ALE614
Serial Number:     K1JRSWLD
LU WWN Device Id:  5 000cca 255e688da
Firmware Version:  APGNW7JH
User Capacity:     6,001,175,126,016 bytes [6.00 TB]
Sector Sizes:     512 bytes logical, 4096 bytes physical
Rotation Rate:    7200 rpm
Form Factor:      3.5 inches
Device is:        In smartctl database 7.3/5528
ATA Version is:   ACS-2, ATA8-ACS T13/1699-D revision 4
SATA Version is:  SATA 3.1, 6.0 Gb/s (current: 6.0 Gb/s)
Local Time is:    Thu Feb 20 14:23:14 2025 EST
SMART support is: Available - device has SMART capability.
SMART support is: Enabled

=== START OF READ SMART DATA SECTION ===
SMART overall-health self-assessment test result: PASSED
```

This provides manufacturer specific data. It also includes if SMART is supported or not.

This is the typical location to obtain the drive serial number, which you will use to replace a drive, hint hint.

```
=== START OF READ SMART DATA SECTION ===
```

```
SMART overall-health self-assessment test result: PASSED
```

```
General SMART Values:
```

```
Offline data collection status: (0x82) Offline data collection activity  
was completed without error.  
Auto Offline Data Collection: Enabled.
```

```
Self-test execution status: ( 0) The previous self-test routine completed  
without error or no self-test has ever  
been run.
```

```
Total time to complete Offline  
data collection: ( 113) seconds.
```

```
Offline data collection  
capabilities: (0x5b) SMART execute Offline immediate.  
Auto Offline data collection on/off support.  
Suspend Offline collection upon new  
command.
```

```
Offline surface scan supported.  
Self-test supported.  
No Conveyance Self-test supported.  
Selective Self-test supported.
```

```
SMART capabilities: (0x0003) Saves SMART data before entering  
power-saving mode.  
Supports SMART auto save timer.
```

```
Error logging capability: (0x01) Error logging supported.  
General Purpose Logging supported.
```

```
Short self-test routine  
recommended polling time: ( 2) minutes.
```

```
Extended self-test routine  
recommended polling time: ( 825) minutes.
```

```
SCT capabilities: (0x003d) SCT Status supported.  
SCT Error Recovery Control supported.  
SCT Feature Control supported.  
SCT Data Table supported.
```

These two boxes show if the SMART drive power on self-tests PASSED or FAILED. A PASSED does not mean the drive is good. This is an assumption many people make which is very wrong.

The lower box identifies how long it takes for a 'typical undisturbed' SMART Short and Long test should take. Any drive activity (data access or scrub for example) slows this down as SMART testing has the lowest priority so it will take longer with drive activity.

Current Normalized Value

These are typically not used during troubleshooting.

Worst Normalized Value

The worst value seen by the drive.

Raw Value

This is the “actual” value, not a “normalized” value.

THRESH

If Current Value reaches this number, then it is failing.

ID and Attribute Name

These are the numbers to read when troubleshooting.

SMART Attributes Data Structure revision number: 16

Vendor Specific SMART Attributes with Thresholds:

ID#	ATTRIBUTE_NAME	FLAG	VALUE	WORST	THRESH	TYPE	UPDATED	WHEN_FAILED	RAW_VALUE
1	Raw_Read_Error_Rate	0x000b	100	100	016	Pre-fail	Always	-	0
2	Throughput_Performance	0x0005	137	137	054	Pre-fail	Offline	-	104
3	Spin_Up_Time	0x0007	151	151	024	Pre-fail	Always	-	482 (Average 389)
4	Start_Stop_Count	0x0012	100	100	000	Old_age	Always	-	324
5	Reallocated_Sector_Ct	0x0033	100	100	005	Pre-fail	Always	-	0
7	Seek_Error_Rate	0x000b	100	100	067	Pre-fail	Always	-	0
8	Seek Time Performance	0x0005	128	128	020	Pre-fail	Offline	-	18
9	Power On Hours	0x0012	093	093	000	Old_age	Always	-	55428
10	Spin_Retry_Count	0x0013	100	100	060	Pre-fail	Always	-	0
12	Power_Cycle_Count	0x0032	100	100	000	Old_age	Always	-	134
192	Power-Off_Retract_Count	0x0032	097	097	000	Old_age	Always	-	4156
193	Load_Cycle_Count	0x0012	097	097	000	Old_age	Always	-	4156
194	Temperature_Celsius	0x0002	171	171	000	Old_age	Always	-	35 (Min/Max 19/45)
196	Reallocated_Event_Count	0x0032	100	100	000	Old_age	Always	-	0
197	Current_Pending_Sector	0x0022	100	100	000	Old_age	Always	-	0
198	Offline_Uncorrectable	0x0008	100	100	000	Old_age	Offline	-	0
199	UDMA_CRC_Error_Count	0x000a	200	200	000	Old_age	Always	-	0

SMART Error Log Version: 1

No Errors Logged

Error Log Status


```
SMART Self-test log structure revision number 1
Num  Test_Description      Status                    Remaining  LifeTime(hours)  LBA_of_first_error
# 1  Short offline          Completed without error   00%        55391            -
# 2  Extended offline       Completed without error   00%        55380            -
# 3  Short offline          Completed without error   00%        55343            -
# 4  Short offline          Completed without error   00%        55328            -
# 5  Short offline          Completed without error   00%        55319            -
# 6  Short offline          Completed without error   00%        55295            -
# 7  Short offline          Completed without error   00%        55271            -
# 8  Short offline          Completed without error   00%        55265            -
# 9  Short offline          Completed without error   00%        55265            -
#10  Short offline          Completed without error   00%        55265            -
#11  Short offline          Completed without error   00%        55264            -
#12  Short offline          Completed without error   00%        55264            -
#13  Short offline          Completed without error   00%        55264            -
#14  Short offline          Completed without error   00%        55264            -
#15  Short offline          Completed without error   00%        55264            -
#16  Short offline          Completed without error   00%        55264            -
#17  Short offline          Completed without error   00%        55264            -
#18  Short offline          Completed without error   00%        55264            -
#19  Short offline          Completed without error   00%        55263            -
#20  Short offline          Completed without error   00%        55263            -
#21  Short offline          Completed without error   00%        55263            -
```

```
SMART Selective self-test log data structure revision number 1
```

SPAN	MIN_LBA	MAX_LBA	CURRENT_TEST_STATUS
1	0	0	Not_testing
2	0	0	Not_testing
3	0	0	Not_testing
4	0	0	Not_testing
5	0	0	Not_testing

```
Selective self-test flags (0x0):
```

```
After scanning selected spans, do NOT read-scan remainder of disk.
```

```
If Selective self-test is pending on power-up, resume after 0 minute delay.
```

```
The above only provides legacy SMART information - try 'smartctl -x' for more
```

```
root@freenas:~ # █
```

SMART Self-test Results

This is a list of the most recent SMART self-tests and the results.

It lists what type of SMART test was performed, if it completed without error, Failed, or Aborted.

If a test is in progress, you will see how much if the test remains.

When the test completes/fails/aborts, the Power On Hours value is recorded so you know when this test occurred.
(note: I have tested this drive a lot for script development hence the multiple entries for the same hour.)

And if there is a failure, typically you will see a number which identifies the LBA (Logical Block Address) where the failure occurred. There is likely problems right after that LBA as well, it is rarely one minor bad spot.

```
root@freenas:~ # smartctl -l farm /dev/ada0
smartctl 7.4 2023-08-01 r5530 [FreeBSD 13.3-RELEASE-p4 amd64] (local build)
Copyright (C) 2002-23, Bruce Allen, Christian Franke, www.smartmontools.org
```

```
Seagate Field Access Reliability Metrics log (FARM) (GP Log 0xa6)
```

```
FARM Log Page 0: Log Header
```

```
FARM Log Version: 1.9
```

```
Pages Supported: 6
```

```
Log Size: 98304
```

```
Page Size: 16384
```

```
Heads Supported: 24
```

```
Number of Copies: 0
```

```
Reason for Frame Capture: 0
```

```
FARM Log Page 1: Drive Information
```

```
Serial Number: ZR13JRL0
```

```
World Wide Name: 0x5000c500e46da4fe
```

```
Device Interface: SATA
```

```
Device Capacity in Sectors: 11721045168
```

```
Physical Sector Size: 4096
```

```
Logical Sector Size: 512
```

```
Device Buffer Size: 268435456
```

```
Number of Heads: 8
```

```
Device Form Factor: 3.5 inches
```

```
Rotation Rate: 5425 rpm
```

```
Firmware Rev: SC60
```

```
ATA Security State (ID Word 128): 0x01621
```

```
ATA Features Supported (ID Word 78): 0x016cc
```

```
ATA Features Enabled (ID Word 79): 0x00000000000000044
```

```
Power on Hours: 16298
```

```
Spindle Power on Hours: 16291
```

```
Head Flight Hours: 16288
```

```
Head Load Events: 766
```

```
Power Cycle Count: 29
```

```
Hardware Reset Count: 610
```

```
Spin-up Time: 8 ms
```

```
Time to ready of the last power cycle: 0 ms
```

```
Time drive is held in staggered spin: 0 ms
```

```
Model Number:
```

```
Drive Recording Type: UNKNOWN
```

```
Max Number of Available Sectors for Reassignment: 0
```

```
Assembly Date (YYWW):
```

```
Depopulation Head Mask: 0
```

FARM Results

This is a list of the FARM results on a Seagate drive (currently only supported by Seagate).

Items to note are:

Serial Number:

Power on Hours:

Spindle Power on Hours:

Head Flight Hours:

Assembly Date: (if provided)

Compare to the SMART data:

1. Serial Number and Power on Hours
2. Spindle Power On Hours and Head Flight Hours should be reasonably close to Power On Hours, especially for a new drive, unless you Sleep the drive a lot. Reasonable for a new drive would be less than 100 hours (should be closer to almost zero).
3. Assembly Date, if provided should match. My drive does not have this data.

APPENDIX B

COMMANDS TO HELP YOU

Below is a list of common commands for both CORE (FreeBSD) and SCALE (Debian) which help diagnose the possible drive issue. Unless specifically identified as CORE or SCALE, the commands work for both. These commands are used in the troubleshooting procedures. Some commands can be dangerous and I will bold those in **RED font**. But can be simply means, don't misuse the command, and be very precise and press the correct keys.

FORMAT: Each command will be surrounded by an apostrophe ('), the same way we post commands on the TrueNAS Forum. **Blue Font** represents the name of your pool, so replace pool with the name of your pool. **Orange font** indicates your Drive Ident. **Green font** is Extra Information.

SAFETY OF COMMANDS: These commands are all safe to use as outlined below. Some of the commands have do have destructive power, however you would have to **significantly** deviate from the examples provided.

ZPOOL COMMANDS

<code>`zpool status -v`</code>	Provides the pool status for all pools.
<code>`zpool scrub pool`</code>	Starts a SCRUB operation on the selected pool.
<code>`zpool clear pool`</code>	Clears all Read, Write, and Chsum errors for the designated pool.

IDENTIFY DRIVE BY GPTID or DRIVE IDENT

Note: Drives may have multiple partitions so when cross referencing by GPTID, you just need to look for a Drive ID, not the different partitions. Drive ada0p1 is the same physical drive as ada0p2.

Example “gptid/d0f8a4fe-bf79-11ed-a0df-000c296fd555 N/A ada0p2” This is Drive ID ada0 partition 2.

``lsblk -o +PARTUUID,NAME,LABEL,SERIAL``

[SCALE]: Provides a listing of your disks, partitions, drive ident, and drive serial numbers so you can cross reference all these identifying areas so you replace the correct drive using the serial number.

``glabel status``

[CORE]: Provides the GPTID and Drive Ident. “nvd0” = “nvme0” To obtain the Drive Serial Number, use the “OBTAIN DRIVE SMART DATA” section to cross reference the DRIVE IDENT to the DRIVE SERIAL NUMBER.

OBTAIN DRIVE SMART DATA INTERFACE

``smartctl --scan``

[CORE/SCALE]: Lists the interface types for all available drive. If running the smartctl commands below, there is an error reading the drive, try adding the interface type.

Format: ``smartctl -d interface_type`` command string

Example: ``smartctl -d scsi -a /dev/sda``

OBTAIN DRIVE SMART DATA

``smartctl -a /dev/sda``

[SCALE]: Provides a BASIC listing of the drive SMART data. Most diagnosis can be made using this data. The Orange indicates the Drive Ident.

``smartctl -a /dev/da0`` or ``ada0``

[CORE]: Same as above.

``smartctl -x /dev/sda``

[SCALE]: Provides EXTENDED listing of the drive SMART data.

``smartctl -x /dev/da0`` or ``ada0``

[CORE]: Same as above.

OBTAIN DRIVE FARM DATA

``smartctl -l farm /dev/sda``

[SCALE]: Provides Field Access Reliability Metrics log 'FARM'. This data can be useful in determining if a drive has had the SMART data reset.

``smartctl -l farm /dev/da0` or `ada0``

[CORE]: Same as above.

START/STOP A SMART TEST (HDD/SSD/Most NVMe)

SHORT TEST

``smartctl -t short /dev/sda``

[SCALE]: Run a "short" SMART test on the drive.

``smartctl -t short /dev/da0` or `ada0``

[CORE]: Same as above.

LONG TEST

``smartctl -t long /dev/sda``

[SCALE]: Run a "long" SMART test on the drive.

``smartctl -t long /dev/da0` or `ada0``

[CORE]: Same as above.

STOP TEST

``smartctl -X /dev/sda``

[SCALE]: This will abort the current SMART test if one is running.

``smartctl -X /dev/da0` or `ada0``

[CORE]: Same as above.

START/STOP a SMART TEST (NVME UNIQUE, IF SMARTCTL DOES NOT WORK)

These commands if misused could be destructive, enter as written.

SHORT TEST

`nvme device-self-test /dev/nvme0 -s 1` [SCALE]: Run a “short” SMART test on the drive.

`nvmecontrol selftest -c 1 nvme0` [CORE]: Same as above.

LONG TEST

`nvme device-self-test /dev/nvme0 -s 2` [SCALE]: Run a “long” SMART test on the drive.

`nvmecontrol selftest -c 2 nvme0` [CORE]: Same as above.

STOP SMART TEST

`nvme device-self-test /dev/nvme0 -s 0xf` [SCALE]: This will abort the current SMART test if one is running.

`nvmecontrol selftest -c 0xf nvme0` [CORE]: Same as above.