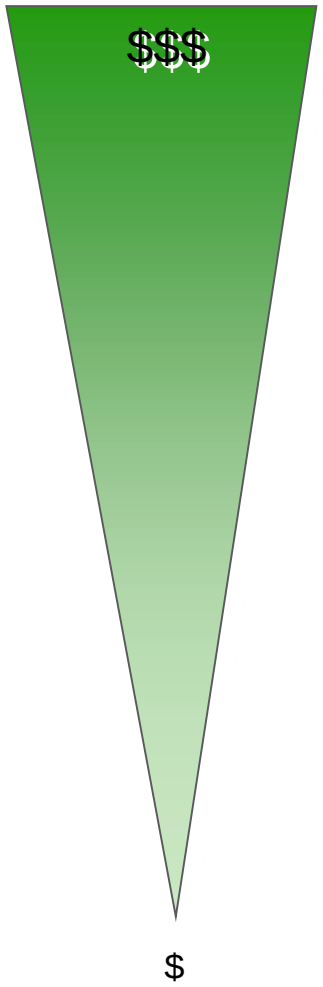
SpecTek NAND Buyers Guide

Rev. D 12/07/2018

SpecTek Product Grades Offered



- AS grade
  - AS grade for SSD strict Bad block requirements.
  - Fully tested material, full density, 95% Valid blocks
  - Functional, High Quality NAND
  - Able to use in High Performance (multi-plane mode) applications.
- AF Grade
  - Fully tested material, full density 94% Valid blocks
    - Valid blocks not optimal for Multi-plane applications
  - Can be used as either as either Density Optimized or Speed Optimized (but not both):
    - Less than full density in a high performance application or
    - Full density in a lower performance application or
    - Use single plane operation or Firmware better structured lower grades.
- AR grades
  - Quick scan tested Material to identify gross bad blocks.
  - Sorted by the initial Valid blocks after scan
  - Customer is expected to test remaining unmarked blocks.
- SS, SG, S7, S1 grades
  - Untested Material, limited return policy
  - Customer is expected to test all blocks

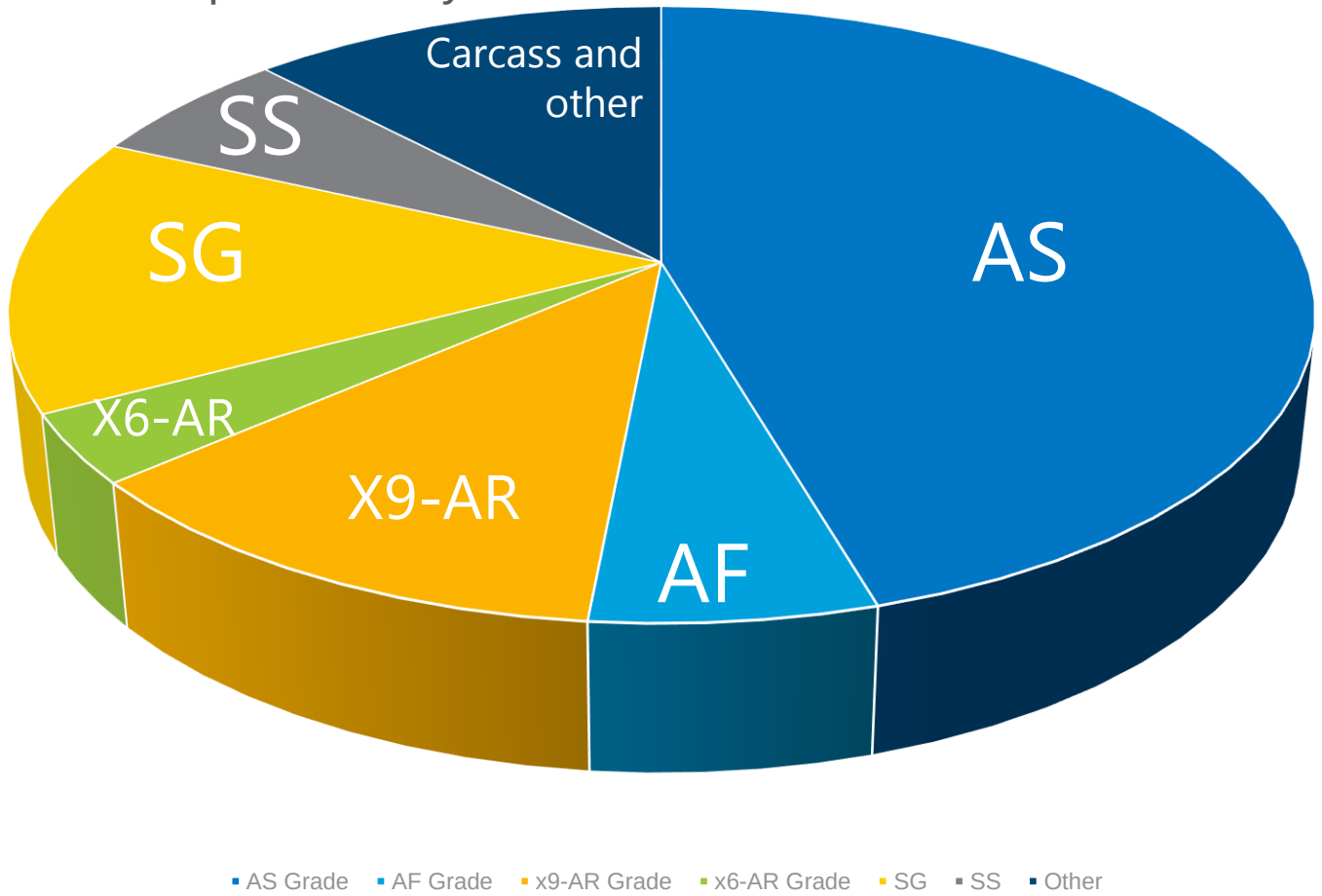
Quick comparison by Grade

	Buyer's Guide: SpecTek NAND Grade Properties															
Description	-AS	-AL	-AF		x9-AR	x6-AR		-BL	-S5	-S6	-S7	-S8	-S9	-SG	-SS
Estimated Effective Yield	100%	100%	100%		~90%	~60%		~25%	~50%	~60%	~75%	~85%	~90%	~35%	~25%
Cosmetic defects?	No	No	No		No	No		Not Guaranteed to be Cosmetically clean							
Valid READ_ID	Yes	Yes	Yes		Yes	Yes		Not Guaranteed							
% of Valid blocks [3]	~95%	~95%	~94%		~90%	~60%		Not Guaranteed							
Customer Required testing?	No	No	No		Required	Required		Required							
Use Factory marked blocks	Required	Required	Required		Required	Suggested		Erase all Blocks prior to testing							
Multi-plane operations	Yes	Yes	Yes		Allowed [4]	Allowed [4]		Use at Risk							
Warranty	Yes	Yes	Yes		Limited [5]	Limited [5]		None	Limited [5]						
Datasheet	Yes	Yes	Yes		Yes	Yes		Use the datasheet for the same Cell Technology and Process node as reference only.							

Notes	
1:	Number of Valid Block values are component based.
2:	Number of Valid Block yields are expected to be averaged across the entire lot. Note the Effective YIELD comment in each cell. See Slide 16.
3:	~ = Approximately
4:	Allowed , but may experience slightly higher Raw Bit Error over single plane mode.
5:	Limited Warranty parts requires customer to test 100% of the batch. Warranty/return is only allowed if batch's Effective Yield is far below Estimated Effective Yield. All parts must be returned together, in original physical condition.

Typical volumes by Grade

Values are typical and change over the maturity of the design
SpecTek Volumes are a fraction of Micron production and therefore inherently limited to the volume produced by Micron.



Customer to SpecTek Grades Alignment

Customer's Model:	Recommended Product Grade
for low-cost Client SSD, build and go	-AS
for Aggressive low-cost Client-SSD, willing to screen and adjust FW	-AF
for low-cost USB or SD, build and go	-AF
for Aggressive low-cost USB or SD, willing to screen and adjust FW	-AR, -SG, -SS, -S8, etc

SpecTek Product Grades Offered (cont)

- **AS grade** (example:FBMB27A512G1KTBAFJ4-37AS)
  - Targeted for SSD applications.
  - Fully Tested with temperature and voltage guardbands.
  - All initial bad blocks marked.
  - Grade guarantees:
    - READ ID Byte 0 is 0x2C,
    - >95% valid blocks per device
  - With an approved controller, customer should be able to assembly, initialize and ship product.

SpecTek Product Grades Offered (cont)

- **AL grade** (example:FBNL06B256G1KDBABJ4-6AL)
  - Legacy Grade Targeted for USB/SD Removable Market.
  - Really Low End SSD Consumer Grade Market
  - Fully Tested with temperature and voltage guardbands.
  - All initial bad blocks marked.
  - Grade guarantees:
    - READ ID Byte 0 is 0x2C,
    - >95% valid blocks per device
  - With an approved controller, customer should be able to assembly, initialize and ship product.
  - Grade not offered on B17A or newer products (AL Limited to **very** early B16A)

SpecTek Product Grades Offered (cont)

- **AF grade** (example:FBNB27A512G1KTBAFJ4-37AF)
  - Targeted for USB/SD and really low-end SSD.
  - Fully Tested with temperature and voltage guardbands.
  - All initial bad blocks marked.
  - Grade guarantees:
    - READ ID Byte 0 is 0x2C,
    - >94% valid blocks per device
  - With an approved controller, customer should be able to assembly, initialize and ship product.

SpecTek Product Grades Offered (cont)

- **AR grades** (example:FBNB27A512G9KTBAFJ4-37AR)
  - SpecTek Customer will receive device with memory array fully tested
- with relaxed test conditions: temperature, voltages, patterns.
  - Reduced Program/Erase endurance.
  - SpecTek provides marked bad blocks but,
  - x9-AR grade
    - Valid blocks, across gross batch**, to achieve > 90% potential density.
  - x6-AR grade
    - Valid blocks, across gross batch**, to achieve > 60% potential density.
    - Minimum 50% valid blocks per part, but gross batch average over 60%
  - With an approved controller, customer is expected to be able to initialize and scan for bad blocks and test for their level of quality.
- ** Gross batch, represent purchased batches from OEM

SpecTek Product Grades Offered (AR grades continued)

- Application Specific Testing Recommended (examples)

  - SpecTek does some preliminary testing of the blocks. SpecTek identifies and marks those blocks that would be failures in most applications.
  - The customer is expected to verify the remaining unmarked (erased) blocks to their specific application(s).
  - More bad blocks may be found by those in-app testing. Those additional bad blocks are NOT covered by the warranty because the application testing is not controlled by SpecTek. That application testing may be too tough causing poor yields or too weak creating field failures.
  - WEAR IN is highly recommend (see slide 14).

SpecTek Product Grades Offered (cont)

- **-S? grades**
  - Limited warranted material.
  - Use the datasheet from the same Cell Technology and Process Node for reference purposes only
  - With an approved controller, customer is expected be able to assembly, initialize, scan for bad blocks, bin by density, test for their quality level before shipping product.
    - -S8 := based on previous experiments, we expect the parts to yield better than 80%.
    - -S7 := based on previous experiments, we expect the parts to yield better than 70%.
    - -S2 := based on previous experiments, we expect the parts to yield better than 20%. \
    - Etc.
    - Note- The average yield over the entire population All good, partial good, and no good parts (failures) Will be no less than the state value.
    - This grade should be considered as Untested. Blocks are in random states and may be programmed already. It is recommended to Erase all the blocks before doing any application Specific testing.
    - More bad blocks may be found by those applications. Those additional bad blocks are NOT covered by the warranty because the application testing is not controlled by SpecTek. That application testing may be too weak creating field failures or have too much overkill causing poor yields.
    - WEAR IN is highly recommend (see slide 14)

Wafer Sales

- Any wafer sale may be accompanied by a Wafer Map or Bonding diagram if requested.
    - Micron Prime only
        - Determined by Micron Probe testing and is not retested or verified by SpecTek
    - SpecTek Maps
        - Determined from Probe testing data, historical statistical data and limited application/controller verification.
    - Yield Expectation's https://www.spectek.com/my/login.aspx?ReturnUrl=%2fmenus%2fsecure%2fAcceptNDA.aspx%3fobject_name%3dSpecTek_Yield_Expectation.pdf

Carcass Wafers

Carcass is the die left on the blue tape after Micron and SpecTek have removed any die that they wish to process.

Please be aware that Carcass wafers are the lowest level of product that SpecTek sells. Use the datasheet from the same Cell Technology and Process Node for reference purposes only.

No warranty of any kind is provided.

Die/Wafer Yield Expectations

Requirement	Values	Notes
Required number of Full Chip P/E cycles (WEAR IN)	15	1
Expected Manufacturing yield loss	5%	2-7
Expected Manufacturing yield		2-7

1. This is the number of Full Array Program/Erase cycles communicated to SpecTek that would be performed during the standard manufacturing process. This testing should be performed in order to see results similar to the numbers provided within this document for Field DPM for components.
2. These numbers can vary with choice of controllers, the Error Management strategies employed by the controller, ECC capability of the controller etc. Refer to the device datasheet for additional details on the controller requirements required for supporting this device.
3. These numbers are estimates and are NOT guaranteed.
4. Yield numbers and Field DPM estimations is an average. Individual lots/wafers performance may vary and hence may or may not match the numbers provided here.
5. Includes only NAND related yield and does not include any defects introduced with packaging/ assembly process.
6. With additional Program/Erase cycles (more P/E cycles than the Required number of Full Chip P/E cycles), the Field DPM numbers may get lowered, but this might decrease the manufacturing yields.
7. Field DPM numbers are measured AFTER the required number of cycles have been performed, that is, it is measured on P/E cycle = Required number of Full Chip P/E cycles +1.

How to Calculate Effective Yield

Effective Yield is average density of a large group of parts where the density is subdivided into 100%, 90%, 80%, etc. Any part with a density of less than 10% of the Parent Density can be considered 0%. A large group of parts is considered to be ~3,000 or more.

As a simple example:

10 pcs at 100% of Parent Density
10 pcs at 70% of Parent Density
10 pcs at 50% of Parent Density
10 pcs at 0%

55% = Effective Density

References

RMA: All quality and RMA requests will need to go through the RMA rapid response page:

- RMA Rapid Response

Controllers:

- SpecTek Approved Controller List

Decoders:

- NAND Flash MPN Decoder
- NAND Wafer/Die MPN Decoder
- Online Decoder
- Device Markings

Sample Request Form:

- NAND Sample Request Page

Datasheets and More on SpecTek NAND page…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