Analysis of Factors affection of the accuracy of the WPE measurement

Niruemon Yimvilai

***Abstract*—**WPE (write plus erase) is a key parameter of the recording hard disk drive. This parameter is tested at the HGA operation to measure the magnetic writer width before the HGA is shipped to drive. The median WPE is measure twice on each of the 10 chunks from each wafer containing thousands of recording heads. The initial median WPE measurement is from the pi lot which consists of approximately 8 bars of slider from a give chunk. The second WPE measurement is from the remaining bars from the chunk referred to the child lot. The value of the WPE of the pi lot is used as a reference for the child lot WPE. This paper uses six sigma methods to determine the accuracy of the WPE of the pi lot.

***Keywords*—**WPE (write plus erase), HGA, Chunk, Pi-lot, Child lot, Six sigma

I. Introduction

THE process of manufacturing a hard disk beginning from wafer to drive is show in Fig1. The wafer can be cut in approximately 100,000 sliders. The majority of the sliders are built into HGA's. The active part of the recording head consists primarily of two parts, namely the reader and the writer. This paper considers only the writer. The physical writer width is measured as part of the wafer build process. Later the electrical or magnetic writer width is measured in HGA from.

One wafer consists of 10 chunks. The median WPE of each chunk is measured at HGA level twice. The sliders from the initial bars from a given chunk are referred to as the pi lot. The sliders from the pi lot slider are tested at HGA to check the writher performance and to determine a median WPE value in order to process the child lot. The difference between the target WPE and the pi lot WPE can be used to determine the tilt value for the remaining bars known as the child bars. The Slider plant tilts the remaining bar appropriately and then ships the child lot sliders to HGA. The process flow is show in Fig2.

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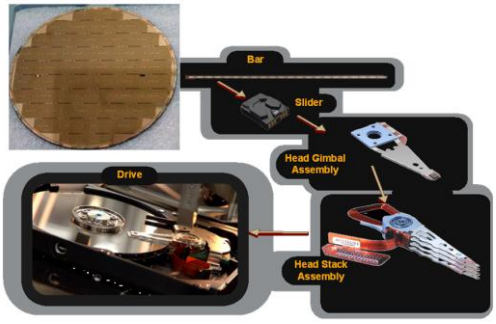

Fig 1 Hard disk drive manufacturing flow

This paper presents the study of factor affecting the increase in efficiency of WPE on Pi lot along with the result of the analysis to improve the efficiency and development HGA process.

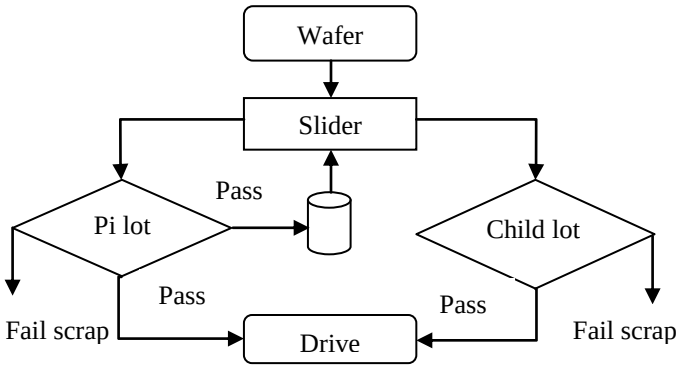

Fig 2 Micro process

II. Operations

A. Factors analysis

To analysis of the factors affecting the accuracy of WPE of the pi lots is indicated by the 4M analysis tool in fish bone diagram in Fig3. Machined can refer to media variation which has an impact on the WPE measurement. Method can refer to the electrical test loading operation. In this analysis the variation of Material refers to chunk-to-chunk WPE difference or to incoming differences from difference slider sites. The operators in each shift can be considered as Man. These factors were the result of an FMEA (Failure Modes and Effects Analysis). The FMEA result is show as a Pareto Chart in Fig [4].

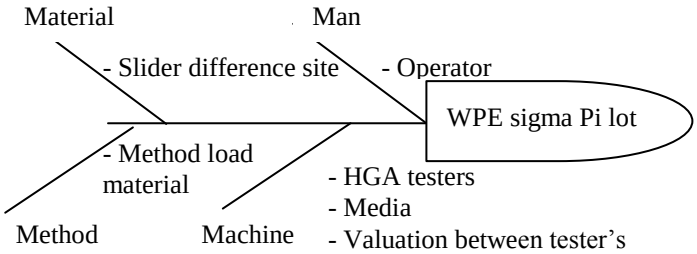

Fig 3 Fish bone diagram

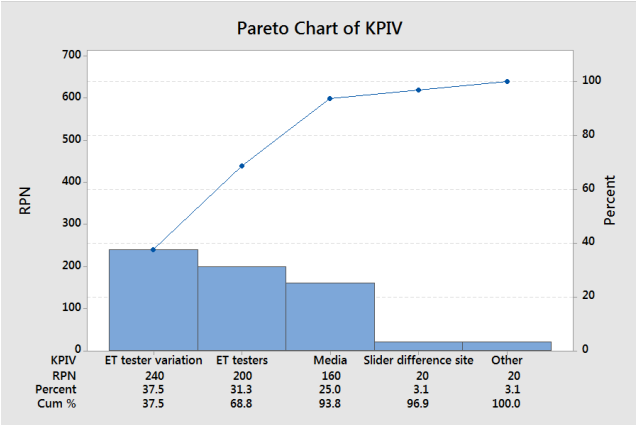

Fig 4 Pareto Chart

B. Pareto chart

The top 3 factors which explain 90% of the variation in the WPE of the pi lot are ET tester variation, ET tester and media. ET tester variation in the case refers to the variation between testers. ET tester refers to the variation within a given tester. Media refers to media to media variation within a given media lot.

III. Experiment Factors Definition

Control variable: Wafer, using difference wafer from the same chunk.

Dependence variable: Tester and Media

Analysis of variance (ANOVA):

$$\delta Total^2 = \delta Tester^2 + \delta BetweenTester^2 + \delta Media^2 + \delta Materail^2$$

$\delta Total$ = Total of WPE sigma on Pi lot

$\delta Tester$ = WPE sigma on Pi lot in each tester

$\delta BetweenTester$ = WPE sigma on Pi lot between testers

$\delta Materail$ = Variation of material from upstream

At the HGA level, we can improve the sigma between testers, sigma within testers and the WPE sigma of the media. After we reduce the sigma, the improvement is show in Fig5. The hypothesis test on sigma applies the F test.

$$H_0 : H_0 : \delta population1 = \delta population2$$

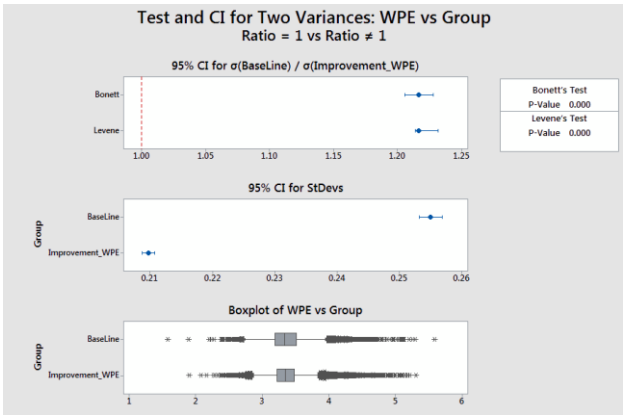

Fig 5 F test variance

IV. Result

The hypothesis test of the F test shows a P-Value < α where alpha is frequently set at 0.05. In this case, the P-Value is smaller than 0.05 which means the WPE Sigma after implementing t improvement on the pi lots is significantly different (0.025 and 0.020)

V. Conclusion

The analysis showed that WPE sigma between testers has the greatest effect on the WPE sigma of the pi lots. Other root causes come from variation within testers and media variation. The analysis can be used as guideline to reduce the WPE sigma of the pi lots, to improve the accuracy of the WPE mean of the pi lots and to help improve quality, reduce product variation and increase factory yield.

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