



De La Salle University – Dasmariñas
GRADUATE PROGRAM

The Effectiveness of ESD Safety Shoes Over ESD Low Booties

A Thesis

Presented to the Dean and Faculty

of the Graduate School of Business

De La Salle University, Dasmariñas, Cavite, Philippines

In Partial Fulfillment

of the Requirements for the Degree

Techno-Master of Business Administration

by

Joseph Rodriguez Estiller

February 2003

112 JUN 2003



De La Salle University – Dasmariñas
GRADUATE PROGRAM

ABSTRACT

Title : The Effectiveness of ESD Safety Shoes Over ESD Low Booties

Total No. of Pages : 99

Proponent : Joseph R. Estiller

Adviser : Prof. Marilou Jopillo

Type of Document : Masteral Thesis

Summary:

The advances in semiconductor technology have made electronic devices more sensitive to *electrostatic discharge (ESD)* and in turn requiring semiconductor companies to implement better and tighter ESD control programs.

Electrostatic discharge failure caused by human physical contact has been a major concern in all semiconductor companies like Intel Technology Philippines Inc (ITPI). An *ESD footwear*, like the *ESD Low Booties*, is one of the garments being worn by Intel manufacturing people to prevent ESD occurrence.

In year 2000, a significant number of ITPI manufacturing people were experienced and observed failing in ESD testing using *ESD Low Booties* footwear. Year 2001 when a formal study was conducted to check the *effectiveness* of ESD Low Booties as compared to an alternative footwear called *ESD Safety Shoes*.

^This paper was designed to analyze and evaluate the ESD Low Booties' *effectiveness* against the *ESD Safety Shoes*. Specifically, this study was aimed to determine which of the two types of footwear would be better in terms of ESD *dissipative* performance. It also aimed to determine whether the utilization of ESD



De La Salle University – Dasmariñas
GRADUATE PROGRAM

Safety Shoes' would bring an effect in *ITPI's* manufacturing specifications.

There were two experiments conducted on this study. The first experiment was meant to compare the *ESD dissipative performances* of the two ESD footwear by testing sample manufacturing people using both footwear. This first experiment was done in two shifts covering day and night during actual ITPI manufacturing production activities. The experiment used quota sampling as determined by ITPI and had at least 40 sample personnel who conducted 5 ESD footwear testing for both types of footwear. *Gross Reality Check* was the statistical analysis tool for the first experiment. This tool was used to compare the ESD dissipation passing rates of both types of ESD footwear. The analysis was simple i.e. the footwear with higher passing rate would be concluded as better in terms of *ESD dissipative performance*.

The second experiment was meant to determine whether the ESD Safety Shoes would bring negative effect in *manufacturing specifications* required and maintained by ITPI. This experiment was executed by implementing *ESD Safety Shoes* for at least three weeks and analyzed its effect to *ITPI's manufacturing specifications* in reference to the previous three or more weeks when *ESD Low Booties* was still being utilized. This experiment used 100% of the data gathered during the said number of weeks. *One sample t-test* was the statistical analysis tool for this experiment. This statistical tool was used to compare the significant difference between the means of the two observed events of ESD Low Booties and ESD Safety Shoes utilization. The analysis was thoroughly discussed in Chapter IV, under Statistical Treatment. All these experiments were conducted in year 2001.



Conclusion and Findings:

The results of this study evidently showed the *effectiveness* of ESD Safety Shoes over ESD Low Booties. The first experiment revealed that the ESD Safety Shoes was 22% better than the ESD Low Booties in terms of *ESD dissipative performance*. The second experiment, on the other hand, revealed equal to better performance of the ESD Safety Shoes which only means that it brought no negative effect to *ITPI manufacturing specifications*.

In addition, a simple cost computation showed that the utilization of ESD Safety Shoes could provide a cost-avoidance of more than 4 million pesos a year in ITPI.

Recommendation:

Based on the study findings, it was highly recommended to implement ESD Safety Shoes in ITPI factories utilizing ESD Low Booties i.e. Factory A assembly, Factory A test, and Factory B test areas.

To cover Factory B assembly area where ESD High Booties is still being utilized, it is also recommended to perform another research study about the “*Effectiveness of ESD Safety Shoes Over the ESD High Booties*”.



De La Salle University – Dasmariñas
GRADUATE PROGRAM



© 2003

Joseph R. Estiller

ALL RIGHTS RESERVED



TABLE OF CONTENTS

	Page
List of Tables	vi
List of Figures	viii
Chapter	
I. Introduction	
A. Background of the Problem	
1. Background of Intel Corporation	1
2. ESD Phenomenon Explained	3
3. ESD Damage Explained.....	4
4. ITPI ESD Footwear Explained	5
B. Statement of the Research Problem	6
C. Research Objectives	7
D. Scope and Limitation	7
E. Significance of the Study	9
F. Operational Definition of Terms	10
II. Review of Related Literature	16
III. Theoretical, Operational Frameworks and Hypothesis	
A. Theoretical Framework of the Study	22
B. Operational Framework of the Study	23
C. Hypotheses of the Study	26



IV. Research Methodology

A. Research Design

- 1. Sample Data Selection 27
- 2. Testing Environment..... 28
- 3. Experiment Period Covered 29
- 4. Experimental Design and Processes 29

B. Data Collection Methodology 32

C. Statistical Treatment

- 1. Descriptive Statistics 33
- 2. Inferential Statistics
 - a. Gross Reality Check (GRC) 34
 - b. One Sample T-test Method 34

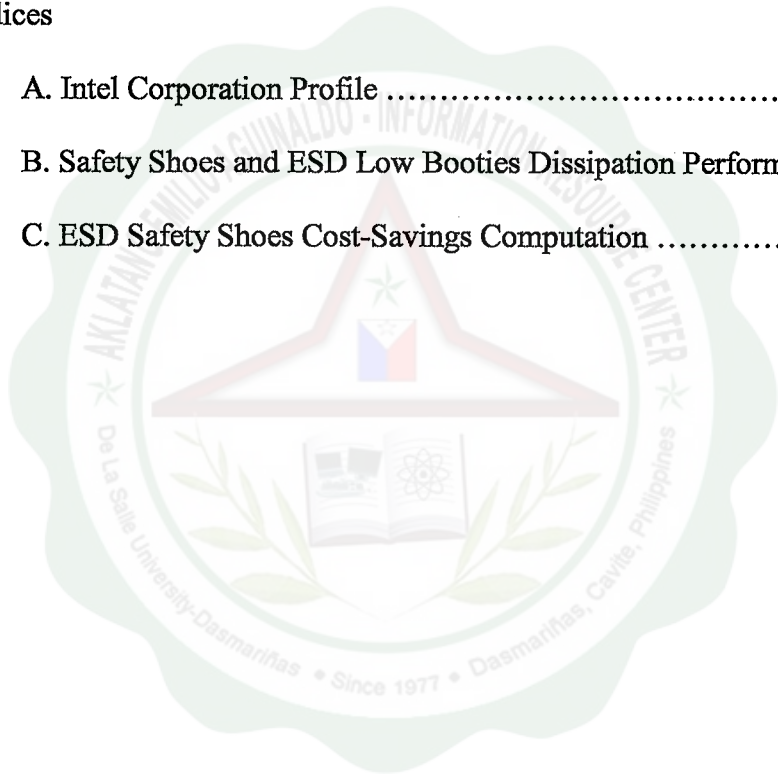
V. Presentation and Analysis of Findings

- A. Experiment 1: ESD Dissipation Evaluation Result 38
- B. Experiment 2.1: Air Particle Count Evaluation Result 40
- C. Experiment 2.2: ESD/FM-Related Electrical Failures Test
Evaluation Result 45
- D. Experiment 2.3: FM-Related Visual Inspection Failures Result 72
- E. Cost Comparison Result 73
- F. Overall Summary of Findings and Analyses 74



De La Salle University – Dasmariñas
GRADUATE PROGRAM

VI. Conclusions and Recommendations	
A. Conclusions	77
B. Recommendations	78
Bibliography	79
Appendices	
A. Intel Corporation Profile	81
B. Safety Shoes and ESD Low Booties Dissipation Performance	91
C. ESD Safety Shoes Cost-Savings Computation	97





TABLES

Tables	Page
1 ESD Dissipation Passing Rate: ESD Safety Shoes vs ESD Low Booties.....	38
2 Factory A: Assembly Particle Count Result	40
3. Factory A: Test 1 Particle Count Result	41
4. Factory A: Test 2 Particle Count Result	42
5. Factory B: Test Particle Count Result	43
6. Particle Count Summary Comparison	44
7. Factory A: Product A1 Bin8 Result	45
8. Factory A: Product A1 Bin9 Result	46
9. Factory A: Product A2 Bin8 Result	47
10. Factory A: Product A2 Bin9 Result	48
11. Factory A: Product A3 Bin8 Result	49
12. Factory A: Product A3 Bin9 Result	50
13. Factory A: Product A4 Bin8 Result	51
14. Factory A: Product A4 Bin9 Result	52
15. Factory B: Product B1 Bin9 Result	53
16. Factory B: Product B1 Bin10 Result	54
17. Factory B: Product B1 Bin15 Result	55



De La Salle University – Dasmariñas
GRADUATE PROGRAM

List of Tables (continuation)	Page
18. Factory B: Product B2 Bin9 Result	56
19. Factory B: Product B2 Bin10 Result	57
20. Factory B: Product B2 Bin15 Result	58
21. Factory B: Product B3 Bin9 Result	59
22. Factory B: Product B3 Bin10 Result	60
23. Factory B: Product B3 Bin15 Result	61
24. Factory B: Product B4 Bin9 Result	62
25. Factory B: Product B4 Bin10 Result	63
26. Factory B: Product B4 Bin15 Result	64
27. Factory B: Product B5 Bin9 Result	65
28. Factory B: Product B5 Bin10 Result	66
29. Factory B: Product B5 Bin15 Result	67
30. Factory B: Product B6 Bin9 Result	68
31. Factory B: Product B6 Bin10 Result	69
32. Factory B: Product B6 Bin15 Result	70
33. Factory A: FM/ESD-Related Electrical Test Failures Results	71
34. Factory B: FM/ESD-Related Electrical Test Failures Results	72
35. Factory A: FM-Related Visual Inspection Failures Results	73
36. ESD Safety Shoes vs ESD Low Booties Summary Findings	76
37. ESD Safety Shoes vs ESD Low Booties Dissipation Evaluation Result....	91



FIGURES

Figures

1. Intel Microprocessors and Memory Devices Production Flow	2
2. Semiconductor Circuit Illustrated Before and After an ESD Event.....	4
3. ESD Safety Shoes and ESD Low Booties Sample Pictures	5
4. Conceptual Framework Illustration.....	25
5. ESD Footwear Tester and Air Particle Counter Sample Pictures.....	30
6. ESD Dissipation Passing Rate Comparison.....	39
7. ESD Safety Shoes Cost-Savings Summary	73