
Contents

Foreword	xi
Phillipe EUDELINÉ	
Preface	xiii
Abdelkhalak EL HAMI, David DELAUX, Henri GRZESKOWIAK	
Chapter 1. Durability Approach: Applied to a Vehicle Lighting Control System	1
Medoune NDIAYE and Caroline RAMUS-SERMENT	
1.1. Introduction.	1
1.2. Example of a vehicle lighting control system.	2
1.2.1. Risks and reliability requirements	3
1.2.2. From failure modes to failure mechanisms	3
1.2.3. From failure mechanisms to physical damage factors	5
1.2.4. From physical damage factors to mission profiles or customer usage	6
1.2.5. From failure mechanisms to component part strength distribution	7
1.2.6. Resistance distribution chart	11
1.2.7. Proposal and study of a validation plan using the stress–strength method: various real-world examples	14
1.3. Conclusion	19
1.4. References	19

Chapter 2. Structural Diagrams to Validate the Reliability of Mechanical Components	21
Paul SCHIMMERLING	
2.1. Introduction	21
2.2. Choice of methods	22
2.2.1. Criteria selection	22
2.2.2. Four basic methods	23
2.2.3. An applied example: the validation of disc brake pads	24
2.3. Feasibility study on the four methods	25
2.3.1. Animation principle	25
2.3.2. Comparison of Weibull laws under testing and in service	25
2.3.3. Comparing degradation under testing and in service	28
2.3.4. Stress–strength method	30
2.4. Conclusion	34
2.5. References	35
Chapter 3. How to Put an Efficient Methodology to Design Innovative Products in Place	39
Claire SCHAYES, Ludovic NGAVOUKA and Eric MANOUVRIER	
3.1. Introduction	39
3.1.1. Reliability	39
3.1.2. Variability	40
3.1.3. “Lean Six Sigma”	40
3.1.4. Quality according to the “Lean Six Sigma” approach “is conforming to requirements”	41
3.2. DFSS	42
3.3. DMAIC	46
3.3.1. Introduction to DMAIC	46
3.3.2. Why launch DMAIC projects?	46
3.4. Feedback	50
3.4.1. Feedback on the define phase	50
3.4.2. Feedback on the measure phase	50
3.4.3. Feedback on the analyze phase	51
3.4.4. Feedback on the innovation phase	52
3.4.5. Feedback on the control phase	53
3.4.6. Can DMAIC be customized?	54
3.5. How to design a reliable welding process with control over the design of experience?	57
3.6. Definition of the objectives	58
3.6.1. Determining the study space	59
3.6.2. Building the DOE	65

3.6.3. Conducting the tests	66
3.6.4. Analyzing the results	67
3.6.5. Process optimization	68
3.6.6. Validation	69
3.7. Big Data and process?	69
3.8. Conclusion	74
3.9. Appendix 1: example of an ANOVA study	74
3.10. Appendix 2: studying the variability of cycle times	79
3.11. Appendix 3: example for the use of traditional statistics in Big Data	87
3.12. References	90
Chapter 4. Reliability Study of the High Electron Mobility Transistor (HEMT)	91
Abdelhamid AMAR, Bouchaïb RADI and Abdelkhalak EL HAMI	
4.1. Introduction	91
4.2. HEMT technology	92
4.3. HEMT thermal modeling	94
4.4. Reliability methods	96
4.4.1. Reliability study	96
4.4.2. Calculating the probability of failure	97
4.5. Thermo-reliability coupling	101
4.6. Calculating HEMT reliability	102
4.7. Conclusion	103
4.8. References	103
Chapter 5. Warranty Cost	107
David DELAUX	
5.1. Introduction	107
5.1.1. The evolution of the warranty	107
5.1.2. The warranty cost	108
5.2. Warranty and reliability	111
5.2.1. Qualitative analysis	111
5.2.2. Quantitative analysis	112
5.3. Reliability estimation models	113
5.3.1. Parametric, non-parametric and other models	113
5.3.2. Mixed models	114
5.3.3. Advantages and disadvantages	116
5.4. New models for estimating reliability from warranty costs	117
5.4.1. Assumptions	117

5.4.2. Definition of the transition between “random” and “wear-and-tear” phases	120
5.4.3. New operational reliability model for the “random” phase	125
5.4.4. New operational reliability model for the “wear-and-tear” phase	125
5.5. Applied automotive case studies	126
5.6. Conclusion	128
5.7. References	128
 Chapter 6. Reliability Evaluation of a Luxury Watch Product: Application of the Stress–Strength Method to a Mechanical Component	135
Matthieu SALLIN and Anthony PONCET	
6.1. Introduction.	135
6.2. Presentation of the watch and its case study	136
6.2.1. The mechanical watch	136
6.2.2. Case study of the barrel spring	137
6.2.3. Identification of failure modes and damaging factors.	137
6.3. Evaluation of the customer usage profile	138
6.3.1. Classifying usage typologies	138
6.3.2. Statistical quantification of usage	139
6.4. Characterizing experimental reliability	140
6.4.1. Performance of failure tests	140
6.4.2. Evaluation of the accelerated lifetime law	141
6.4.3. Constructing the law of resistance	142
6.5. Reliability evaluation of customers.	143
6.5.1. Reliability calculation using the stress–strength method	143
6.5.2. Transformation of the stress profile	144
6.5.3. Numerical application to the barrel case study.	146
6.6. Conclusion	147
6.7. References	148
 Chapter 7. RBDO of the High Electron Mobility Transistor	149
Abdelhamid AMAR, Bouchaïb RADI and Abdelkhalak EL HAMI	
7.1. Introduction.	149
7.2. Description of the HEMT technology	151
7.3. Electrothermomechanical modeling of HEMT	152
7.3.1. Electrothermal modeling of HEMT	152
7.3.2. Thermomechanical modeling of HEMT	154
7.4. Reliability methods	156

7.5. Reliability analysis of HEMT	156
7.6. Reliability optimization of systems	158
7.6.1. The classic RBDO approach	158
7.6.2. The hybrid RBDO approach	159
7.7. HEMT reliability optimization using the hybrid RBDO approach	160
7.7.1. Description of the optimization problem	160
7.7.2. Results and discussion	160
7.8. Conclusion	161
7.9. References	162
List of Authors	167
Index	169
Summaries of other volumes	171