

Contents

Preface xv

Preface to First Edition xix

List of Acronyms xxi

1 What is Avionics Flight Test and Why Do We Need It 1

- 1.0** Avionics Flight Test 1
- 1.1** Historical Background 2
- 1.2** Flight Test Organization 4
- 1.3** Flight Test Objectives 5
- 1.4** The Need for Flight Test 6
- 1.5** Classifying the Program 8
- 1.6** Contractual Requirements 9
- 1.7** Test Team Composition 11
- 1.8** Team Member Responsibilities 13
- 1.9** Understanding Terms 15
- 1.10** Contractor and Subtier Specifications 20
- 1.11** Customer Expectations 21
- 1.12** Formulating the Program 22
- 1.13** Summary 25
- 1.14** Selected Questions for Chapter 1 26

2 Time, Space, Position Information 29

- 2.0** An Overview of Time, Space, Position Information 29
- 2.1** Sources of TSPI 30
- 2.2** Ground-Based Tracking Radar 30
- 2.3** Radar Characteristics 32
- 2.4** Radar Accuracies 35
- 2.5** Geometric Dilution of Precision 38
- 2.6** Earth Models 39
- 2.7** Theodolites 41
- 2.8** Theodolite Limitations 44
- 2.9** Global Positioning System 44
- 2.10** Stand-Alone GPS Receivers 44

2.11	Inertial-Aided GPS Receivers	46
2.12	Differentially Corrected GPS	48
2.13	Sensor Fusion	48
2.14	Ranges	49
2.15	Range Assets	49
2.16	Unique Services	50
2.17	Interfacing with the Range	51
2.18	Time Alignment	53
2.19	Summary	55
2.20	Exercises	55
2.21	Answers to Exercises	55
2.22	Selected Questions for Chapter 2	58
<hr/>		
3	MIL-STD-1553 and Digital Data Busses: Data Reduction and Analysis	61
3.0	Overview	61
3.1	Historical Background	62
3.2	1553 System Architecture	62
3.3	A Bit About Bits	65
3.4	1553 Word Types	67
3.5	Data Encoding	67
3.6	Word Formats	68
3.7	Command Words	68
3.8	Anomalous Command Word Conditions	70
3.9	Command Word Summary	71
3.10	Status Words	71
3.11	Data Words	73
3.12	Message Contents	74
3.13	Bus Controller Design	75
3.14	Sample Bus Configurations	76
3.15	The Flight Tester's Task	79
3.16	MIL-STD-1553 Summary	80
3.17	Other Data Busses	81
3.18	Potential Problems for the Analyst	122
3.19	Data Acquisition, Reduction, and Analysis	124
3.20	Selected Questions for Chapter 3	136
<hr/>		
4	Communications Flight Test	139
4.0	Overview	139
4.1	Communications Basics	140

4.2	Aircraft Communications Equipment	142
4.3	Test Requirements	144
4.4	The Three Steps in Avionics Testing	144
4.5	Communications Test Plan Matrix	146
4.6	Executing the Matrix	148
4.7	Other Considerations in Communications Tests	149
4.8	Effects of Stores, Landing Gear, and Flaps	149
4.9	Effects of Weather	149
4.10	Logistics	150
4.11	Boredom	151
4.12	Speech Intelligibility	151
4.13	Electromagnetic Interference/Electromagnetic Compatibility	154
4.14	EMI/EMC Testing	158
4.15	EMI/EMC Test Issues	161
4.16	EMI/EMC Elimination	161
4.17	Selected Questions for Chapter 4	164
<hr/>		
5	Navigation Systems	167
5.0	Introduction	167
5.1	History	168
5.2	Basic Navigation	168
5.3	Radio Aids to Navigation	175
5.4	Radio Aids to Navigation Testing	184
5.5	Inertial Navigation Systems	191
5.6	Doppler Navigation Systems	207
5.7	Global Navigation Satellite Systems (GNSS)	213
5.8	Identification Friend or Foe	234
5.9	Data Links	238
5.10	Selected Questions for Chapter 5	259
<hr/>		
6	Part 23/25/27/29 Avionics Civil Certifications	267
6.0	Introduction	267
6.1	FAA Type Certification History	268
6.2	Federal Aviation Regulations in the Code of Federal Regulations	270
6.3	Other Rules and Guidance	273
6.4	FAA Type Certification Process	274
6.5	Avionics Software Considerations in the Technical Standard Order Process	282
6.6	Certification Considerations for Highly Integrated or Complex Systems	285

6.7	Important Notes for Evaluators Concerning Documentation	298
6.8	Differences between EASA and FAA Documentation	300
6.9	Cockpit Controls and Displays Evaluations	301
6.10	Weather RADAR Certification	322
6.11	Airworthiness Approval of Positioning and Navigation Systems	329
6.12	Reduced Vertical Separation Minimums	348
6.13	Proximity Warning Systems	356
6.14	Terrain Awareness and Warning System	382
6.15	Flight Guidance Systems	410
6.16	Landing Systems	459
6.17	Flight Management Systems	504
6.18	Enhanced Vision Systems (EVS)	520
6.19	Summary	527
6.20	Selected Questions for Chapter 6	528

7 Electro-optical and Infrared Systems 535

7.0	Introduction	535
7.1	Infrared History	536
7.2	IR Radiation Fundamentals	547
7.3	IR Sources	552
7.4	The Thermal Process	554
7.5	Atmospheric Propagation of Radiation	556
7.6	Target Signatures	562
7.7	EO Components and Performance Requirements	567
7.8	Passive EO Devices	581
7.9	Laser Systems	588
7.10	Passive EO Flight Test Evaluations	594
7.11	Active EO Systems	614
7.12	Selected Questions for Chapter 7	618

8 Radio Detection and Ranging – Radar 625

8.0	Introduction	625
8.1	Understanding Radar	626
8.2	Performance Considerations	629
8.3	Radar Utility	630
8.4	Radar Detections	636
8.5	Maximum Radar Detection	641
8.6	Radar Sample Applications	645
8.7	Pulse Delay Ranging Radar Modes of Operation and Testing	652

8.8	Doppler and Pulse Doppler Modes of Operation and Testing	668
8.9	Air-to-Ground Radar	694
8.10	Millimetric Wave Radar	710
8.11	Miscellaneous Modes of Radar	712
8.12	Some Final Considerations in Radar Testing	712
8.13	Selected Questions for Chapter 8	714
<hr/>		
9	Electronic Warfare	719
9.0	Introduction	719
9.1	Electronic Warfare Overview	720
9.2	The Threat	724
9.3	Air Defense Systems	728
9.4	Electronic Attack	729
9.5	Noise Jamming	734
9.6	Deception Jamming	738
9.7	Chaff Employment	742
9.8	Flare Employment	743
9.9	Electronic Protection Measures	745
9.10	Electronic Warfare Systems Test and Evaluation	748
9.11	Finally	760
9.12	Selected Questions for Chapter 9	760
<hr/>		
10	Air-to-Air/Air-to-Ground Weapons Integration	763
10.0	Introduction	763
10.1	Weapons Overview	764
10.2	Stores Management System	767
10.3	Air-to-Air Missiles	785
10.4	Air-to-Ground Weapons	803
10.5	MIL-HDBK-1763 Test Requirements	812
10.6	AGARD Flight Test Techniques Series, Volume 10 Requirements	820
10.7	Weapons Delivery Considerations for Helicopters	824
10.8	Selected Questions for Chapter 10	828
<hr/>		
11	A Typical Avionics Integration Flight Test Program	831
11.0	Introduction	831
11.1	Vehicle Test Requirements	831
11.2	Avionics Test Requirements	833
11.3	Test Planning	835

11.4	Responsibilities of the Test Team	843
11.5	Analysis and Reporting	848
11.6	Selected Questions for Chapter 11	849
<hr/>		
12	Unmanned Aerial Vehicles (UAV)	851
12.0	Introduction	851
12.1	UAV Types	852
12.2	Interoperability	856
12.3	The Airworthiness Certificate	857
12.4	UAS Communications Architecture	860
12.5	Navigation	886
12.6	Autopilots	889
12.7	Sense and Avoid Systems	892
12.8	Payload	899
12.9	Optionally Piloted Aircraft (OPA)	901
12.10	Summary	902
12.11	Selected Questions for Chapter 12	902
<hr/>		
13	Night Vision Imaging Systems (NVIS) and Helmet Mounted Displays (HMD)	907
13.0	Introduction	907
13.1	Overview	908
13.2	Image Intensification (I^2) Technology	909
13.3	NVG Human Factors Issues	918
13.4	Lighting Specifications	920
13.5	Interior NVIS Lighting Methods	924
13.6	Exterior Lighting Methods	929
13.7	Test and Evaluation of NVIS Equipment	931
13.8	Some Final Considerations	938
13.9	Helmet Mounted Display Systems (HMD)	939
13.10	HMD Components	942
13.11	Test and Evaluation of HMD Equipment	949
13.12	Selected Questions for Chapter 13	954
<hr/>		
14	Acquisition, Test Management, and Operational Test and Evaluation	957
14.0	Overview	957
14.1	Applicable Documentation	958

14.2	The Acquisition Process	958
14.3	The Operational Requirements Document (ORD)	965
14.4	The Test and Evaluation Master Plan (TEMP)	966
14.5	Operational Test and Evaluation	967
14.6	OT&E Test Plan Structure	970
14.7	Reliability, Maintainability, Logistics Supportability, and Availability (RML&A)	978
14.8	Summary	981
14.9	Selected Questions for Chapter 14	981
Index	983	