

Table of Contents

Chapter 1.	Introduction.....	1
1.1.	General.....	1
1.2.	Scope.....	1
1.3.	Airport construction safety.....	1
1.4.	Mixing of light source technologies.....	1
1.5.	Airports Geographical Information Systems (GIS) database.....	2
Chapter 2.	Runway and Taxiway Edge Lighting Systems.	3
2.1.	General.....	3
Chapter 3.	Runway Centerline and Touchdown Lighting Systems.	15
3.1.	Introduction.....	15
3.2.	Selection criteria.....	15
3.3.	Configuration.....	15
3.4.	Design.....	16
3.5.	Equipment and material.....	17
Chapter 4.	Taxiway Lighting Systems.	19
4.1.	Introduction.....	19
4.2.	Implementation criteria.....	19
4.3.	Taxiway centerline.....	20
4.4.	Runway Guard Lights (RGLs).....	23
4.5.	Runway stop bar.....	25
4.6.	Combination in-pavement stop bar and RGLs.....	26
4.7.	Clearance bar configuration.....	26
4.8.	Design.....	27
4.9.	Equipment and material.....	36
4.10.	Installation.....	37
Chapter 5.	Land and Hold Short Lighting Systems.....	39
5.1.	Introduction.....	39
5.2.	Background.....	39
5.3.	Definitions.....	39
5.4.	Implementation criteria.....	39
5.5.	Configuration.....	39
5.6.	Design.....	40
5.7.	Equipment and material.....	42
5.8.	Installation.....	42
Chapter 6.	Airfield Miscellaneous Aids.	45
6.1.	Airport rotating beacons.....	45
6.2.	System design.....	45
6.3.	Installation.....	46
6.4.	Maintenance.....	47
6.5.	Beacon towers.....	47
6.6.	Wind cones.....	48
6.7.	Obstruction lights.....	49
6.8.	Equipment and materials.....	51
Chapter 7.	Economy Approach Aids.....	53
7.1.	Introduction.....	53
7.2.	Types of economy approach lighting aids.....	53

7.3.	Selection considerations.....	53
7.4.	Configurations.....	54
7.5.	Design.....	56
7.6.	Equipment and material.....	67
7.7.	Installation.....	68
Chapter 8.	Radio Control Equipment.....	73
8.1.	Radio control equipment.....	73
Chapter 9.	Standby Power – Non-FAA.....	77
9.1.	Background.....	77
9.2.	Definitions.....	77
9.3.	FAA policy.....	77
9.4.	Electrical power configurations.....	78
9.5.	Design.....	79
9.6.	Equipment and material.....	80
9.7.	Installation.....	82
9.8.	Inspection.....	83
9.9.	Tests.....	84
9.10.	Maintenance.....	84
9.11.	Reducing electrical power interruptions.....	85
9.12.	Engine generator equipment performance requirements.....	85
Chapter 10.	Pavement Types.....	87
10.1.	General.....	87
10.2.	New pavement – rigid (concrete).....	87
10.3.	New pavement – flexible (bituminous).....	89
10.4.	Overlay – rigid.....	90
10.5.	Overlay – flexible.....	91
Chapter 11.	Fixture Mounting Bases.....	93
11.1.	General.....	93
11.2.	L-868 mounting bases.....	93
11.3.	Direct-mounted (inset) fixtures.....	95
11.4.	Field adjustable L-868 mounting bases.....	97
11.5.	Installation.....	97
Chapter 12.	Equipment and Material.....	101
12.1.	General.....	101
12.2.	Light bases, transformer housings and junction boxes.....	101
12.3.	Duct and conduit.....	101
12.4.	Cable, cable connectors, plugs and receptacles.....	102
12.5.	Counterpoise (lightning protection system).....	103
12.6.	Light base ground.....	106
12.7.	Light fixture bonding.....	107
12.8.	Concrete.....	107
12.9.	Steel reinforcement.....	107
12.10.	Adhesive and sealants.....	107
12.11.	Load-bearing lighting fixtures.....	107
12.12.	Inspection.....	108
12.13.	Testing.....	109
12.14.	Auxiliary relays.....	110
12.15.	Vault.....	110

12.16.	Maintenance.....	110
Chapter 13.	Power Distribution and Control Systems.....	111
13.1.	Introduction.....	111
13.2.	Power distribution.....	111
13.3.	Control systems.....	112
Appendix 1.	Figures 1-113.....	117
Appendix 2.	Airport Technical Advisory.....	231
Appendix 3.	Terms and Acronyms.....	233
Appendix 4.	Bibliography.....	239
Appendix 5.	Typical Installation Drawings for Airport Lighting Equipment (includes Figures 114-139).....	245
Appendix 6.	Application Notes (includes Figures 140-143).....	281
Appendix 7.	Runway Status Light (RWSL) System (includes Figures 144-147).....	293

List of Figures

Figure 1.	Legend and general notes.....	117
Figure 2.	Runway and threshold lighting configuration (LIRL runways and MIRL visual runways)....	118
Figure 3.	Runway and threshold lighting configuration (HIRL precision instrument approach - runway centerline not shown for HIRL. Non-precision instrument approach for MIRL). ..	119
Figure 4.	Runway with taxiway at end.....	120
Figure 5.	Runway with blast pad (no traffic).....	121
Figure 6.	Lighting for runway with displaced threshold.....	122
Figure 7.	Normal runway with taxiway.....	123
Figure 8.	Lighting for runway with displaced threshold.....	124
Figure 9.	Lighting for runway with displaced threshold/usable pavement.....	125
Figure 10.	Lighting for runway with displaced threshold not coinciding with opposite runway end.....	126
Figure 11.	Lighting for runway with stopway.....	127
Figure 12.	Lighting for runway with displaced threshold and stopway.....	128
Figure 13.	Runway with end taxiway.....	129
Figure 14.	Lighting for runway with end taxiway and shortened ASDA.....	130
Figure 15.	Lighting for runway with end taxiway and displaced threshold not coinciding with opposite runway end.....	131
Figure 16.	Typical straight taxiway sections (less than 200 ft. (61 m)).....	132
Figure 17.	Spacing of lights on curved taxiway edges.....	133
Figure 18.	Typical single straight taxiway edges (more than 200 ft. (61 m)).....	134
Figure 19.	Typical single straight taxiway edges (less than 200 ft. (61 m)).....	135
Figure 20.	Typical edge lighting configuration.....	136
Figure 21.	Typical edge lighting for portions of runways used as taxiway (when taxiway lights are "ON").....	137
Figure 22.	Typical edge lighting for portions of runways used as taxiway (when runway lights are "ON").....	138
Figure 23.	Light fixture wiring.....	139
Figure 24.	Typical wiring diagram utilizing L-828 step-type regulator with external remote primary oil switch.....	140
Figure 25.	Typical wiring diagram utilizing L-828 step-type regulator with internal control power and primary oil switch.....	141

Figure 26. Typical basic 120-volt AC remote control system	142
Figure 27. Alternative 120-volt AC remote control system.....	143
Figure 28. Typical 120-volt AC remote control system with L-847 circuit selector switch.....	144
Figure 29. Typical 48 VDC remote control system with 5-step regulator and L-841 relay panel.....	145
Figure 30. Typical 48 VDC remote control system with 3-step regulator and L-841 relay panel.....	146
Figure 31. Curves for estimating loads in high intensity series circuits.	147
Figure 32. Curves for estimating loads in medium intensity series circuits.	148
Figure 33. Runway centerline lighting layout.....	149
Figure 34. Touchdown zone lighting layout.....	150
Figure 35. Section through non-adjustable base and anchor, base and conduit system, rigid pavement.	151
Figure 36. Section through non-adjustable base and anchor, base and conduit system, flexible pavement.	152
Figure 37. Runway centerline light – shallow base and conduit installation.....	153
Figure 38. Saw kerf wireway details.....	154
Figure 39. Saw kerf orientation details – R/W centerline and TDZ lights.....	155
Figure 40. Transformer housing installation details inset type lighting fixtures.	156
Figure 41. Typical equipment layout, inset type lighting fixtures.	157
Figure 42. Junction box for inset fixture installation.	158
Figure 43. Typical taxiway centerline lighting configuration for non-standard fillets (centerline light spacing for operations above 1,200 ft. (365 m) RVR).	159
Figure 44. Color-coding of exit taxiway centerline lights.	160
Figure 45. Taxiway centerline lighting configuration for acute-angled exits.	161
Figure 46. Controlled stop bar design and operation – “GO” configuration.	162
Figure 47. Typical taxiway centerline lighting configuration for standard fillets (centerline light spacing for operations above 1,200 ft. (365 m) RVR).	163
Figure 48. Taxiway centerline light beam orientation.	164
Figure 49. In-pavement runway guard light configuration.	165
Figure 50. Elevated RGL and stop bar configuration.	166
Figure 51. Typical light beam orientation for in-pavement RGLs and stop bars.....	167
Figure 52. Clearance bar configuration at a low visibility hold point.....	168
Figure 53. Curves for estimating primary load for taxiway centerline lighting systems.	169
Figure 54. Typical elevated RGL installation details.....	170
Figure 55. Typical in-pavement RGL external wiring diagram – power line carrier communication, one light per remote.	171
Figure 56. Typical in-pavement RGL external wiring diagram – power line carrier communication, multiple lights per remote.....	172
Figure 57. Typical in-pavement RGL external wiring diagram – dedicated communication link.	173
Figure 58. In-pavement RGL alarm signal connection.	174
Figure 59. Controlled stop bar design and operation – “STOP” configuration.	175
Figure 60. Controlled stop bar design and operation – intermediate configuration.....	176
Figure 61. Controlled stop bar design and operation – “STOP” configuration for A/C 2.	177
Figure 62. Typical layout for land and hold short lights.....	178
Figure 63. Typical wireway installation details for land and hold short lights.	179
Figure 64. Sawing and drilling details for in-pavement land and hold short lights.	180
Figure 65. Typical block diagram for land and hold short lighting system.	181
Figure 66. Typical curve for determining maximum separation between vault and control panel with 120-volt AC control.....	182
Figure 67. Beacon dimensions.	183
Figure 68. Calculations for determining wire size.	184
Figure 69. Typical automatic control.	185
Figure 70. 120-volt AC and 48-volt DC remote control.	186

Figure 71. Typical structural beacon tower	187
Figure 72. Typical tubular steel beacon tower.....	188
Figure 73. Typical airport beacon tip-down pole.....	189
Figure 74. Typical pre-fabricated beacon tower structure.....	190
Figure 75. Typical location of supplemental wind cone.....	191
Figure 76. Externally lighted wind cone assembly (frangible).....	192
Figure 77. Typical layout for MALSF.....	193
Figure 78. Typical layout for REIL.....	194
Figure 79. Typical ODALS layout.....	195
Figure 80. PAPI obstacle clearance surface.....	196
Figure 81. PAPI signal presentation.....	197
Figure 82. Correction for runway longitudinal gradient.....	198
Figure 83. General wiring diagram for MALSF with 120-volt AC remote control.....	199
Figure 84. Typical wiring diagram for MALSF controlled from runway lighting circuit.....	200
Figure 85. Typical field wiring circuits for MALSF.....	201
Figure 86. Typical installation details for frangible MALS structures – 6 foot (1.8 m) maximum.....	202
Figure 87. Typical wiring for REILs multiple operation.....	203
Figure 88. Typical wiring for REIL series operation.....	204
Figure 89. FAA L-880 Style B (constant current) system wiring diagram.....	205
Figure 90. FAA L-880 Style A (constant voltage) system wiring diagram.....	206
Figure 91. PAPI Light Housing Unit (LHU) installation detail.....	207
Figure 92. Typical installation details for Runway End Identifier Lights (REILs).....	208
Figure 93. Configuration "A" electrical power.....	209
Figure 94. Typical KVA input requirements.....	210
Figure 95. Typical wiring diagram for configuration "A" electrical power.....	211
Figure 96. Typical equipment layout for configuration "A" electrical power.....	212
Figure 97. Configuration "B" electrical power.....	213
Figure 98. Typical wiring diagram for Configuration "B" electrical power.....	214
Figure 99. Typical wiring diagram for Configuration "C" power.....	215
Figure 100. Flexible pavement or overlay installation.....	216
Figure 101. Use of alignment jig, no reference edge available, non-adjustable base and conduit system.....	217
Figure 102. Use of alignment jig, reference edge available, non-adjustable base and conduit system ..	218
Figure 103. In-pavement shallow base runway edge end or threshold light.....	219
Figure 104. In-pavement shallow base runway centerline or TDZ light	220
Figure 105. Sawing and drilling details for in-pavement taxiway centerline lights	221
Figure 106. Wiring details for direct- and base-mounted taxiway centerline lights	222
Figure 107. Typical transformer housing and conduit installation details for taxiway centerline lights.	223
Figure 108. Adjustment of edge light elevation for high snowfall areas.....	224
Figure 109. Cable and duct markers	225
Figure 110. Counterpoise installation	226
Figure 111. Power and control system block diagram	227
Figure 112. Typical PLC control system block diagram	228
Figure 113. PC control system block diagram	229
Figure 114. Typical standard details for runway and taxiway edge lights –high intensity light – non-adjustable base-mounted	246
Figure 115. Typical standard details for runway and taxiway edge lights –medium / high intensity light – non-adjustable base-mounted	247
Figure 116. Typical standard details for runway and taxiway edge lights –medium intensity light – stake-mounted	248
Figure 117. Typical counterpoise and ground rod connections	249

Figure 118. Identification (ID) tag detail	250
Figure 119. Standard details for underground cable installation – typical multiple bank layout.....	251
Figure 120. Standard details for underground cable installation – Type A.	252
Figure 121. Standard details for underground cable installation – Type B.....	253
Figure 122. Standard details for underground cable installation – Type C.....	254
Figure 123. Standard details for underground cable installation – plowed cable.	255
Figure 124. Standard details for underground cable installation – plowed cable.	256
Figure 125. Standard details for taxiway hold and guidance sign – sign – single pedestal.	257
Figure 126. Standard details for taxiway hold and guidance sign – sign – multiple pedestal.	258
Figure 127. Standard details for taxiway hold and guidance sign – Detail A.....	259
Figure 128. Standard details for pivoting rotating beacon pole – rotating beacon and mounting bracket detail.	260
Figure 129. Standard details for pivoting rotating beacon pole – locking device detail.....	261
Figure 130. Standard details for pivoting rotating beacon pole – pivot detail.	262
Figure 131. Standard details for pivoting rotating beacon pole.	263
Figure 132. Standard details for wind cone foundation (L-807).....	264
Figure 133. Standard details for wind cone – 12 ft. (3.7 m) wind cone.....	265
Figure 134. Standard details for Precision Approach Path Indicators (PAPIs) – PAPI light unit locations.	266
Figure 135. Standard details for Precision Approach Path Indicators (PAPIs).	267
Figure 136. Standard details for Precision Approach Path Indicators (PAPIs) – Section A-A.	268
Figure 137. Standard details for runway end identifier light power and control derived from runway circuit – profile view.	269
Figure 138. Standard details for runway end identifier light power and control derived from runway circuit – plan view.....	270
Figure 139. Location of entrance-exit lights (in lieu of guidance signs).	271
Figure 140. Controlled output sign block diagram.	281
Figure 141. Typical power line carrier system.....	283
Figure 142. Load example for in pavement RGL circuit.	288
Figure 143. ALCMS block diagram.	291
Figure 144. REL configuration for taxiways at 90 degrees.	295
Figure 145. Angled configuration.	296
Figure 146. Takeoff/hold lights.	298
Figure 147. Runway intersection lights.	300

List of Tables

Table 2-1. Straight taxiway edge light spacing.....	8
Table 2-2. Edge lighting system design guide.	10
Table 2-3. Equipment and materials.	13
Table 4-1. Longitudinal dimensions.	21
Table 4-2. Equipment and material used for low visibility lighting systems.....	37
Table 5-1. Equipment and material used for land and hold short lighting systems.	42
Table 7-1. Threshold crossing heights.	61
Table 7-2. Aiming of Type L-880 (4 box) PAPI relative to pre-selected glide path.	61
Table 7-3. Aiming of Type L-881 (2 box) PAPI relative to pre-selected glide path.	61
Table 8-1. Interface of radio control with airport visual aids.	75
Table 13-1. AGL control system response times.	115