FLIT: FORCED LANDINGINTO **The Great GA Pilot** TREES

SURVIVAL RESET

Become the GREEN PIN

GA PILOT GUIDE FOR FORCED EMERGENCY LANDING V = 0mphOPTIONS USING TREES OF ALL t = 0.28s $F_{MAX} = 13G$ SHAPES AND SIZES / = 80mph Distance = 5m mass = 1100kg

Distance = 7m Stop in 500mm F_{MAX} = 14G V = 26mph

PAUL LUDICK

MSC IN AVIATION SAFETY (UK) - AVIATION SAFETY& **ACCIDENT INVESTIGATION - PILOT**

JOHN COMLEY

ENGINEER AND PILOT - INVENTOR OF THE GO-AROUND-JOE VISUAL GLIDESLOPE INDICATOR



Contents

W	'elcome	12
	sclaimer	13
cc	DPYRIGHT NOTICE	
ΑŁ	oout the Authors	15
	Paul Ludick MSc	15
	John Comley BSc	15
1.	Introduction to Forced Landing Into Trees	16
	The Great GA Pilot Survival RESET	18
	The Early History of Forced Landings Into Trees	19
	What does FAA say about Emergency Landings? Types of Emergency Landings Psychological Hazards	21
	What does the FAA say about Landing in Trees?	23
	The SIX General Aviation Pilot Imperatives	24
	What does a Perfect Forced Landing Into Trees Look Like? Single-Tree Offset Maneuver + Pinwheel into Tree Copse	25
	FLIT: Book, Online Training, and Certification Programme	28
	Two Fatal Accidents: Catalyst for FLIT (Forced Landing Into Trees) The Mountain View Fatal Event The Swartkops Fatal Event	29
	The Mental Agility Challenge with Forced Landing Into Trees	32
	Aircraft Insurance as a Prerequisite for Forced Landing Into Trees	33
2.	"Seriously, a Forced Emergency Landing INTO TREES?"	34
	Read Study Certify Practice Execute Survive	35
	Statistics Show Forced Landing Into Trees to be HIGHLY SURVIVABLE	37
	Viewing the Landscape Through New Eyes	
	SIX Top-of-Mind Checks on EVERY GA Pilot's Mind	42
	Aircraft Types and Sizes for Forced Landing Into Trees	44



The Hidden Dangers of Forced Emergency Landing Options	46
Forced Emergency Landing Options	53
Option #1: Airport/Airfield/Runway	55
Option #2: Freeways/Highways/Interstate	56
Option #3: Secondary/Dirt Roads	57
Option #4: Farmlands/Fields	58
Option #5: Open Land	59
Option #6: Water (Ditching)	60
Option #7: Other	61
Option #8: Trees (FLIT)	62
FLIT Statistics	63
FLIT Definitions	
FLIT Event Locations	
FLIT Statistics Including Air France A320	
FLIT Statistics Excluding Air France A320	68
Factors Affecting Forced Emergency Landings	71
Forced Emergency Landing Risks	
Forced Emergency Landing Fatality Indices	73
Forced Emergency Landing Combined Ranking (Overall Risk + Location Difficulty + Landing Con	nplexity) 74
Identifying FLIT-Trees from Above	76
Choose a FOREST rather than a SINGLE TREE!	78
'Crashing into Trees' versus 'Controlled Landing into Trees'	82
FLIT Skills: ESSENTIAL for Low-Level Flying	83
Using FLIT for EFATO: Case Study – Chicago Midway International Airport (KMDW)	84
Chicago Midway International Airport (KMDW) 4L	86
CMIA (KMDW) - FLIT OPTION # 1	
CMIA (KMDW) - FLIT OPTION # 2	90
CMIA (KMDW) - FLIT OPTION # 3	91
CMIA (KMDW) - FLIT OPTION # 4	92
CMIA (KMDW) - FLIT OPTION # 5	
CMIA (KMDW) - FLIT OPTION # 6	
CMIA (KMDW) - FLIT OPTION # 7	95
CMIA (KMDW) - FLIT OPTION # 8	96
CMIA (KMDW) - FLIT OPTION # 9	97
CMIA (KMDW) - FLIT OPTION # 10	98
CMIA (KMDW) - FLIT OPTION # 11	99
CMIA (KMDW) - FLIT OPTION # 12	100 101
CMIA (KMDW) - FLIT OPTION # 13 CMIA (KMDW) - FLIT OPTION # 14	101 102
CMIA (KMDW) - FLIT OPTION # 14	102 103
Forced Landing Into Trees Cannot Guarantee 'No Fatalities'	
3. Physics and Energy for Forced Landing Into Trees	
Forces in Aviation: The Four Forces of Flight	106



Optimising the Glide for a Forced Emergency Landing	_ 108
Best Glide Ratio & Factors Affecting Best Glide Ratio	109
With an Engine-Out, do you fly Best Glide or Minimum Sink?	111
Maximize Glide Range, or Time Aloft?	 112
•	
Energy in Aviation	_ 113
Understanding Kinetic Energy (E _K) and Potential Energy (E _P) in Aviation	114
Aircraft Energy at Different Heights AGL	116 117
Why Vertical Kinetic Energy (E _{K-V}) Will Kill You	_ 118
Case Studies for High Vertical Kinetic Energy (E _{K-V}) Accidents	_ 121
HIGH E _{K-V} Case Study # 01: Mid-Sized Aircraft into House – Hattiesburg, Mississippi, USA – Mitsubish	าi
MU-2 [Non-FLIT]	122
HIGH E _{K-V} Case Study # 02: Engine Problems, EFATO, Turn-Back, Possible Stall & Spin – North Perry	
Airport, Florida, USA – Beechcraft Bonanza B36 TC [Non-FLIT]	123
HIGH E _{K-V} Case Study # 03: Small Aircraft Collision with Terrain – near Wedderburn Airport, New So	
Wales, Australia – Glasair SH-2FT [Non-FLIT]	124
HIGH E _{K-V} Case Study # 04: Single-Engine Aircraft Possible Stall/Spin into Forrest at Whidbey Airpark	
Langley, Island County, Washington, USA – Cessna 177 Cardinal [Non-FLIT]	125
HIGH E _{K-V} Case Study # 05 : Business Jet Possible Stall & Spin into Reynold Way, Ponderosa Golf Cou	
Truckee, California, USA - Bombardier Challenger 605 [Non-FLIT]	126
USA - SIAI Marchetti SM-1019B [Non-FLIT]	5, 127
HIGH E _{K-V} Case Study # 07: Motor Glider Possible Stall and Spin on Take-off – Harvey Young Airport	_12/
(1H6), Tulsa, Oklahoma, USA – Monnet Moni Motor Glider [Non-FLIT]	128
HIGH E _{K-V} Case Study # 08: Possible Stall & Spin of Cessna 206 – Marlin Airport, Falls County, Texas,	
- Cessna TU206F Turbo Stationair [Non-FLIT]	129
HIGH E _{K-V} Case Study # 09: Possible Stall and Spin after Suspected Engine Failure – Whiteman Airpo	
(KWHP), Los Angeles County, California, USA – Cessna 337 Super Skymaster [Non-FLIT]	130
HIGH E _{K-V} Case Study # 10: Possible Overloaded Flight into Mountains, Suspected Canyon Turn-Back	 (,
Possible Stall and Spin – Cedar City, Iron Country, Utah, USA – Diamond DA40 [Non-FLIT]	131
HIGH E _{K-V} Case Study # 11: Tango & Juliet Tragedy – Late VFR Flight into Mountain Airfield – Possible	e Fuel
Shortage, Suspected Stall & Spin – H. A. Clark Memorial Field Airport, Sedona, Arizona, USA – Cessn	a 140
[Non-FLIT]	132
HIGH E _{K-V} Case Study # 12: Suspected Engine Failure, Possible Stall and Spin – Spruce Creek Airport	
(7FL6), Daytona Beach, Volusia County, Florida, USA – Cessna 140 [Non-FLIT]	133
HIGH E _{K-V} Case Study # 13: Suspected EFATO, followed by Possible Stall & Spin – Parys Airfield, Gaut	_
South Africa – Ravin 500 [Non-FLIT]	134
HIGH E _{K-V} Case Study # 14: Apparent Stall and Spin into Car Park – near Van Nuys Airport (VNY), Var	
Nuys, California, USA – Ryan Navion B [Non-FLIT]	135
HIGH EK-V Case Study # 15: Suspected EFATO, Possible Stall & Spin – Oroville Municipal Airport (KO	
Butte County, California, USA – Beechcraft 19A Musketeer Sport [Non-FLIT]	136
HIGH EK-V Case Study # 16 : Suspected Stall & Spin – close to Królewska Street, Rębielice Królewski, Poland - Cessna 152 [Non-FLIT]	137
The Units of Force and Energy Forces and Energy in Forced Landing Into Trees	_ 138
	139
The Pinwheel Effect	142



Translational Kinetic Energy (E _{K-T}) and Rotational Kinetic Energy (E _{K-R})	146
Where on the Wing to Strike a Tree for the Best Pinwheel Effect	149
Pinwheel Effect 'Virtual Crumple Zone'	153
Pinwheel Effect Case Study (FLIT Case Study #5)	155
Critical Elements for Surviving a Forced Emergency Landing	156
Critical Element #1: Aircraft Orientation	 157
Critical Element #2: G-Force from Impact	158
Critical Element #3: Blunt Force Trauma to PIC & PAX	159
Critical Element #4: Post-Impact Fire	160
Critical Element #5: PIC & PAX Egress	161
G-Forces and the Human Body	162
G-LOC and the Science behind Passing Out from a High G-Force	162
How many G-Forces can the Human Body Endure?	163
The Importance of Stopping Slowly	164
The Impact of Vertical Stopping Distance on PEAK VERTICAL G-LOAD (G _V)	
Highest G-Force on a Human (Survivable)	176
Everyday G-Forces Experienced by Humans	
G-Forces for Forced Landing Into Trees	178
Car Crashes into Trees	179
Using Obstacles and the Aircraft to Absorb Energy in a Crash	180
The Best Objects for Absorbing Energy	181
Aircraft Elements Best Suited for Absorbing Energy	182
Total Kinetic Energy in an Aircraft Crash	184
High Vertical Kinetic Energy: The Dale 'Snort' Snodgrass Crash	
The 9 Cardinal Rules for Surviving a Forced Emergency Landing	190
Crash Force Calculators	191
Aircraft Crash Tests at NASA Landing and Impact Research Facility (LandIR)	192
Testing of Forced Landing Into Trees	199
Testing of FLIT-Type Landings using Model Aircraft	200
ENERGY MANAGEMENT: The FIVE PHASES of Forced Landing Into Trees	205
PHASE I – Recognise the Emergency and the Need to Conduct a Forced Landing (ensure V _{DMMS})	206
PHASE II – Identify the Landing Zone (including FLIT options)	208
PHASE III – Reduce Potential Energy	210
PHASE IV – Reduce Kinetic Energy (maintain Best Glide Airspeed)	
PHASE V – Energy Adsorption (Impact)	212
How Real is Having to Land in Trees for a Forced Emergency Landing?	213
Using Trees for Forced Emergency Landings	
What Exactly Happens When You Land in a Tree?	214
Why Trees?	217
Understanding the Structure of a Tree	
The Most Important Property of a Tree	218
Tree Proportions	220



Tree Types for Forced Landings Into Trees	222
Is there a PERFECT Tree for Forced Landing Into Trees? Case Study of Perfect FLIT-Type Landing	
Collateral Damage from Forced Landing Into Trees	237
Where to HIT a Tree for MAXIMUM Energy Absorption Why NOT to hit the BOLE of a Tree	
Inconsistency of Trees	240
Small Forest or Copse of Trees	242
Copse of Trees DefinitionCase Study for Landing into a Forest: Airbus 320 Crash (1988)	243
The Seven FLIT Maneuvers for Maximum Kinetic Energy Absorption	247
FLIT Maneuver Simulation Training	248
Copyright Notice with respect to the Seven FLIT Maneuvers	
#1: FLIT Single-Tree Maneuver	249 256
#2: FLIT Double-Tree Maneuver	
#4: FLIT Tree Row (Pinwheel) Maneuver	200 270
#5: FLIT Tree Copse Maneuver	277
#6: FLIT Reed Corn Maneuver	284
#7: FLIT Side Branch (Pinwheel) Maneuver	
4. Executing a Successful Forced Landing Into Trees	296
4 Rules for Executing a Potentially Successful Forced Landing Into Trees Landing	296
Key Objectives when Executing a Forced Emergency Landing	297
First and Foremost: DO NOT STALL/SPIN-IN!	298
Defined Minimum Manoeuvring Speed	
How and When to SELECT Forced Landing Into Trees	301
Stage 1: Normal Flight, including scanning for Forced Emergency Landing Options	
Stage 2 Situation Arises for a Forced Emergency Landing	
Stage 3: Identify Land/Water Options for a Forced Emergency Landing	305 306
Stage 4: Identify Obstacles and Areas of Conflict Stage 5: Identify Options for Forced Landing Into Trees	300 310
Stage 6: Commit to the Best/Safest Option for the Forced Emergency Landing	
Stage 7: Possible Late Transition to Forced Landing Into Trees	
Forced Landing Into Trees as a Forced Emergency Landing 'Backstop'	315
Criteria for Conducting an Effective Forced Landing Into Trees	316
FLIT-Landing Options for EFATO	318
Case Study for using FLIT for EFATO (FLIT Case Study # 7)	319



Exploring Landscapes for FLIT-Type Landing Opportunities	331
Important Notes & Disclaimer for Practicing FLIT Maneuvers and Simulated FLIT-type Landings	331
FLIT Approach #01: Bekker School	333
FLIT Approach #02: Mhlabatini Gorge	338
FLIT Approach #03: Kalkheuwel Entrance (R512)	342
FLIT Approach #04: Bristolcone Nursery	346
FLIT Approach #05: Hartbeeshoek Road	350
FLIT Approach #06: Lion Park	354
FLIT Approach #07: Nakita	358
FLIT Approach #00: Macanage	362 366
FLIT Approach #09: Maropeng	
FLIT Approach #11: Henning Farm	370 374
FLIT Approach #12: The Coves	374 378
FLIT Approach #13: Pecan Nut Farm	382
FLIT Approach #14: Westlake	 386
FLIT Approach #15: Nash Farm	 390
FLIT Approach #16: Skeerpoort	394
FLIT Approach #17: Pelindaba	398
FLIT Approach #18: Jasmyn	402
FLIT Approach #19: Coves Side Branch	406
5. Pilot Psychology for Forced Landing Into Trees	411
Changing the Thinking of Pilots – The Great GA Pilot Reset	413
The Decision-Tree for Forced Landing Into Trees	414
Changing a Pilot's Forced Landing Options View of the Landscape	416
Speed of Response, a Function of HABIT STRENGTH!	419
FLIT versus Canyon Turnback: A Case Study Worth Contemplating (Pre-Emptive FLIT)	420
The GREEN PIN Club	425
6. Simulation Training for Forced Landing Into Trees	427
Training for Forced Emergency Landing Options	427
Practice FLIT Everywhere!	427
7. FLIT Online Training & Certification for Pilots	429
FLIT Online Training & Certification for Pilots	429
8. FLIT Certification Programme for Flight Instructors	431
FLIT Certification Programme for Flight Instructors	431
9. FLIT Certification for Flight Schools	433
FLIT Certification for Flight Schools	433



10. Affiliate Programme for ATOs and Flight Instructors	434
Affiliate Programme for ATOs and Flight Instructors	434
11. FLIT Events – Tracking & Reporting	435
FLIT Event Global Map	435
Logging a FLIT Event on the AV8TOR SAFETY Website	436
Thank You & Next Steps!	437
12. FLIT Case Studies	438
FLIT Case Study Data Recorded	438
FLIT Global Map and FLIT Event Legend	438
FLIT Global Man	44

