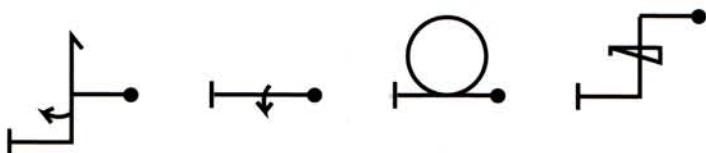
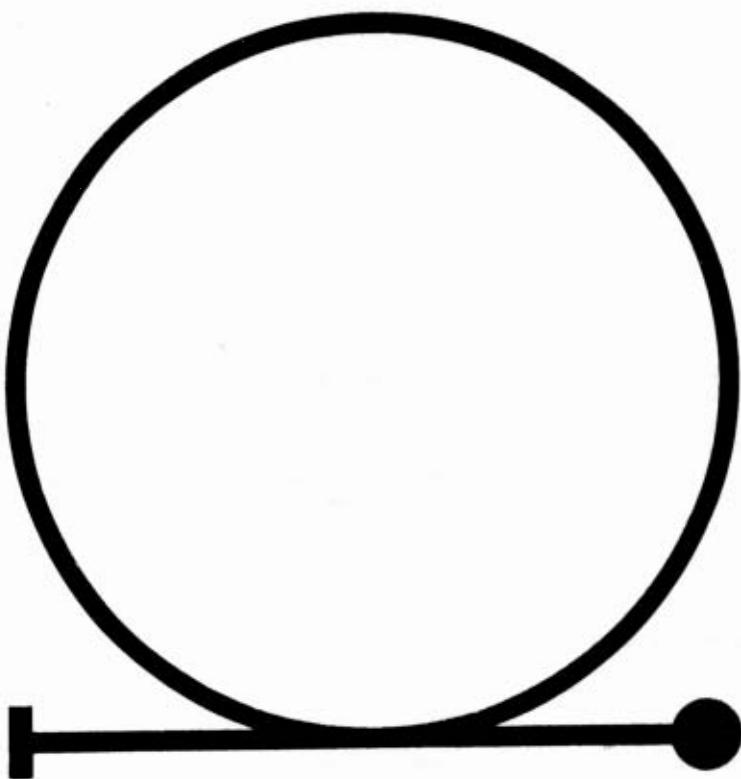


BASIC AEROBATICS



Geza Szurovy • Mike Goulian



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Geza Szurovy Mike Goulian

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Disclaimer

All material in this book should be used as a source of general information only. It is the responsibility of every pilot intending to learn aerobatics to receive appropriate comprehensive dual aerobatic instruction from a qualified aerobatic instructor and comply with all regulations and procedures in effect. It is the responsibility of the pilot in command to consult all official sources of information relevant to every aspect of a proposed flight and personally assure compliance with all laws, regulations, and procedures.

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*For Anya and Apa,
who understood my love of flight, always*

GS

*For my brother, Matt,
the other half of the team*

MG

Contents

Foreword ix

Acknowledgments xi

How to use this book xiii

Introduction xv

1 Getting started 1

- Aerobatics and the regulations 1
- Safety and the importance of professional instruction 6
- Health and physical condition 9
- Selecting an aerobatic training aircraft 10
- Aerobatics and aviation insurance 11

2 Loads and limits on machine and pilot 13

- Aerobatics is energy management 13
- Speed, velocity, and acceleration 16
- Structural design requirements 19
- The importance of angle of attack 27
- Forces specific to propeller-driven aircraft 32
- Acceleration and the human body 33

3 Preflight and airborne preparations 36

- The aerobatic preflight 36
- Pilot's pockets preflight 39
- In-flight preaerobatic preparation 39

4 Stalls 41

- Understanding it 41
- Flying it 44
- Common errors 46
- If things go wrong 46

5 Aileron rolls 49

- Understanding it 49
- Flying it 50

Common errors	51
If things go wrong	51
6 Slow rolls 57	
Understanding it	58
Flying it	59
Common errors	60
If things go wrong	60
7 Inverted flight 69	
Understanding it	69
Flying it	70
Common errors	72
If things go wrong	72
A word about inverted systems	73
8 Loops 78	
Understanding it	78
Flying it	79
Common errors	81
If things go wrong	82
9 Half loops 91	
Understanding it	92
Flying it	92
Common errors	93
If things go wrong	94
10 The Immelmann 95	
Understanding it	95
Flying it	96
Common errors	97
If things go wrong	97
11 The Cuban eight 106	
Understanding it	107
Flying it	108
Common errors	109
If things go wrong	110

12 The reverse Cuban eight 113

- Understanding it 113
- Flying it 114
- Common errors 116
- If things go wrong 116

13 The hammerhead 120

- Understanding it 120
- Flying it 121
- Common errors 124
- If things go wrong 124

14 Spins 131

- Understanding it 131
- Flying it 132
- Common errors 134
- Beggs/Müller emergency spin recovery technique 134
- Inadvertent inverted spins 135

15 Advanced maneuvers 144

- Snap rolls 144
- Outside snap rolls 145
- Tailslides 147
- Outside loops 147
- Inverted spins 147
- Vertical rolls 149
- Knife-edge flight 150
- Hesitation rolls 150
- Square loops 151
- Rolling circles 152
- Variations on the theme 154
- Gyroscopic maneuvers 154

16 Developing aerobatic sequences 155

- Aerobatic sequence flying is energy management 156
- Composing an aerobatic sequence 157
- Learning to fly an aerobatic sequence 158

17 Recreational aerobatics 164

- Keeping current, staying safe 165
- Choice of aircraft 167
- Passenger considerations 168
- Keeping informed 169

18 Competition aerobatics 173

- Origins 174
- International Aerobatic Club 176
- Aerobatic shorthand 178
- Your first competition 179
- Beyond Sportsman 182

19 Airshow display aerobatics 193

- The airshow scene 193
- Pilot qualification requirements 195
- Airshow display flying skills 196
- Developing your act 200
- Getting on the airshow circuit 201

20 Buying an aerobatic aircraft 202

- What aircraft to buy 202
- Where are they? 204
- What it will cost to buy and fly 205
- The partnership option 209
- Checking out and buying the aircraft 210
- Mechanical inspection 215
- Test flight 216

21 Aerobatic aircraft type directory 219

22 Aerobatic organizations 231

- Appendix A: Ten-hour aerobatic course 234**
- Appendix B: Five-hour aerobatic course 240**
- Appendix C: Organizations and aircraft manufacturers 244**
- Appendix D: The cost of aerobatic aircraft ownership 246**

Index 250

Foreword

When people ask me how to learn aerobatics I tell them to find a good instructor and a good aerobatic book. Flying aerobatics does not require a special license or rating—with good reason. People have such different motivations for learning aerobatics, perform aerobatics at so many different levels, and have access to such varying types of airplanes that it would be hard to standardize aerobatic training for a specific flight test. A comprehensive book, on the other hand, that allows you to customize your training to meet your specific needs is indispensable.

Why do aerobatics?

Are you interested in looping and rolling in an open-cockpit biplane over green fields on a summer day? Are you interested in professional airshow flying, entertaining hundreds or perhaps thousands of spectators? How about competition flying? Are you yearning to join one of the many IAC chapters around the world and fly a contest in your Clipped-Wing Cub?

Maybe you are an airshow spectator who loves to watch your favorite performer dance across the sky in a one-of-a-kind airplane and you would like to learn more about how it is done. Or perhaps you are an R/C modeler keen to improve your flying skills.

Whatever the motivation or personal goal, aerobatic lessons will give you increased confidence in the airplane you fly. An important facet of aviation since the earliest days of flying, the precision maneuvers of aerobatics are fun to learn, exciting to perform, and guaranteed to give the pilot a challenging reward. Whether you fly a Cub or a 747, aerobatic training will increase your competence and ability as a pilot as you begin to gain a new understanding of holistic flight—flight on all axes.

Basic Aerobatics is the definitive book on modern aerobatic flying for the 1990s. It will take you from the beginning of aerobatic history to the higher levels of modern-day aerobatic competition and airshows. You will learn to appreciate how the sport of aerobatics enhances the expression of the freedom of flight and how learning aerobatics promotes discipline in your flying, and teaches you judgment within the boundaries of a safe and controlled environment. You will gain a deeper understanding of how an airplane flies in all axes and of the real—not self-imposed—limits of the equipment you fly.

Now, as airshows, aerobatic competition flying, and recreational aerobatics are ever increasing in popularity, you can take advantage, through *Basic Aerobatics*, of the decades of experience gained by aerobatic pilots before you.

Mike Goulian and Geza Szurovy are an ideal team to write this book. Mike is one of America's premiere unlimited aerobatic competition and airshow pilots; Geza is an award-winning aviation writer and recreational aerobatic pilot. Both learned to fly before they knew how to drive a car.

FOREWORD

To write this book, Mike, who also runs his own aerobatic flight school, assumed the role of instructor and Geza acted as novice student pilot. They flew each maneuver again and again, carefully preparing for every flight in comprehensive preflight briefings and picking apart and documenting each sortie during lengthy post-flight sessions. To bring you the whole aerobatic experience, they started out in a standard basic trainer, worked up to the immortal Pitts Special, and finished up in a state-of-the-art unlimited two-seat monoplane.

As you sit down and begin your journey through *Basic Aerobatics*—a journey that will take you from the beginning of aerobatic history to today's high tech monoplanes—allow the pages to help you fly a little farther and spread your wings a little wider.

PATTY WAGSTAFF
Unlimited U.S. National Aerobatics Champion
1991, 1992, 1993



The unlimited U.S. national aerobatics championship is the highest award in U.S. aerobatics. Men and women compete for the single award; Ms. Wagstaff was the first woman to win the U.S. championship. To honor the accomplishment, the Smithsonian Institution acquired the Extra 260 monoplane that Ms. Wagstaff flew at the 1991 contest for permanent display in the National Air & Space Museum.

Acknowledgments

Mention aerobatics and the word “rugged individualist” more often than not sneaks into mind; yet aerobatics could not be what it is today without the solid cooperative spirit that is also so characteristic of the aerobatic community. Everyone we turned to was supportive, encouraging, and ready to help in every way possible. Several people went far beyond anything we dared to reasonably expect. To all we are greatly indebted.

A special thanks to Ian Groom for arranging the in-cockpit Sukhoi 29 photographs that illustrate many of the chapters, and for so patiently flying the maneuvers and accommodating the photographer’s many requests; to Patty and Bob Wagstaff, Clint McHenry, and Dennis Sawyer for reading the initial manuscript and greatly improving on it with their thorough comments and observations; to Jud Milgram for so going out of his way to set us straight on matters theoretical; to Brian Becker and Sue Besarick of Pompano Air Center for their warm hospitality, sound advice, and for making available many of the best photographs; to Mike Heuer for his comments on parts of the manuscript and for directing us to the right sources of information; to Lt. Col. Marc Nathanson (USAF, Ret.) for flying some of the photo missions and for dispelling the aerobatic mysteries of air combat; to Dorothy Cochrane of the National Air and Space Museum for her encouragement and advice; to Martin Berinstein for so generously letting us take over his delightful photo studio; to Bob Schuette and the staff at Impress Design for producing the airplane silhouettes used in the illustrations; and to all the staff, past and present, at Executive Flyers Aviation.

We would also both like to thank our families for being so supportive in so many ways of our flying antics over the years.

Thanks, also, to every aviator who ever taught us anything about this best way to fly.

GEZA SZUROVY & MIKE GOULIAN
Hanscom Field, Massachusetts
May, 1993

How to use this book

In addition to helping all readers understand how the sport of aerobatics developed and what it is all about, this book is also a primer for the student of basic aerobatics. It is intended to be used as a supporting text in a basic aerobatic course given by a qualified aerobatic instructor. The maneuver chapters describe in detail the aerodynamic forces acting on the aircraft in each maneuver, how to fly each maneuver, what the common errors are and how to correct them, and what to do before safety is compromised if things go wrong.

Take the theory—the “why”—to heart. If you intimately understand what is happening to your aircraft aerodynamically at all times, aircraft control—the “how”—will quickly become second nature.

The maneuvers are presented in a sequence designed to introduce the student to progressively greater challenges in an orderly building-block fashion. Stalls are explored first, in greater detail than in nonaerobic training, to get the student comfortable with what happens when the critical angle of attack is exceeded, and what it takes to exceed it under a variety of flight conditions. Special emphasis is placed on accelerated stalls, and stalls at various bank angles.

Rolls are introduced next, to expose the student to unusual attitudes in a low-G environment. The easiest and one of the most pleasant aerobic maneuvers, the aileron roll, is followed by the more challenging slow roll. (The barrel roll is not addressed because it is no longer widely practiced and is not a competition maneuver.)

When the student is comfortable with rolls, it is a good time to introduce inverted flight, entered by rolling inverted. At the completion of this stage, the student will feel at home in all attitudes, will have gained experience in the delicate handling of the controls, and will be ready to move on to higher G maneuvers.

The loop is introduced next, followed by half loops and Immelmanns, which begin to combine elements of the loop and the roll. Cuban eights and reverse Cuban eights, the most complex combination maneuvers of a basic aerobatic curriculum, complete this stage of the course.

In the final stage, hammerheads (stall turns) and spins are taught. The course culminates in the student composing a basic aerobatic sequence and learning to fly it to the International Aerobatic Club’s Sportsman Category competition standards in the aerobatic box.

A final maneuvers chapter briefly describes the advanced maneuvers that are the next step in the sport of aerobatics and the subject of an advanced aerobatic course to be covered in a subsequent book.

Two of the four appendices provide detailed sample curriculums of two basic aerobatics courses.

Introduction

August 19, 1913, is most often remembered by aviators because on that date the young Frenchman Adolphe Pegoud became the first person to parachute safely to earth from an airplane. He had deliberately abandoned his Bleriot monoplane at 650 feet in a daring experiment to find out if the fancy new linen escape device, successfully tested from tethered balloons, would be practical for the pilot of a heavier-than-air machine. Fortunately for Pegoud, the parachute blossomed into a full canopy and he floated gently to earth.

But what happened to Pegoud's abandoned Bleriot was equally remarkable, though less remembered. Free of human control the delicate monoplane twisted, turned, rolled on its back, and tumbled upright again and again, soaring, and diving in a fantastic aerial ballet, apparently none the worse for wear, and certainly not falling apart, contrary to contemporary expectations regarding such wild maneuvers.

Until that day, flying was largely a straight and level affair and shallow turns sent most pilots' adrenaline levels and pulse rates soaring. Some daredevils had titillated crowds with steep turns and dives, but none had deliberately rolled an airplane over on its back, or pulled its nose up past the vertical. The pilotless Bleriot's display was to change all that. By the time it crash-landed into the genteel French countryside, Pegoud was determined to duplicate the maneuvers it had performed, and aerobatics was on its way.

In quick succession Pegoud and his contemporaries mastered the basic maneuvers: the loop, the roll, the hammerhead, and by 1916 even the intentional spin. The variations on these building-block maneuvers have since been countless, nurtured by decades of barnstorming, dogfighting, airshow performances, and competition aerobatics. The result is today's flawless, gut-wrenching, eye-popping, cheek-sagging, unlimited aerobatic performance that leaves the stunned spectator wondering if there is anything these awesome machines can't do, and allows the aerobatic pilot to say that as far as the airplane is concerned, there is no such thing as being "out of control."

But just what is aerobatic flight? A wide range of interpretations run from Webster's rather unhelpful "performance of stunts in an airplane" (whatever stunts are) to the Federation Aeronautique Internationale's detailed definitions of competition aerobatic maneuvers. Most regulatory bodies worldwide consider an aircraft to be doing aerobatics whenever it deviates from the bank angles, pitch changes, and acceleration rates necessary to complete normal category maneuvers as defined or inferred by the flight manual, but the regulatory bodies are usually quite vague about where exactly the threshold into aerobatic flight is crossed. Under such a definition, any abrupt and substantial bank and pitch excursion qualifies as aerobatics, however ham-fisted or unintentionally uncoordinated.

Yet the word aerobatics implies a high degree of skill and full control by the pilot

over the machine in all dimensions. So, perhaps a more useful definition is “an intentional departure from straight and level flight to fly one maneuver or a series of pre-meditated maneuvers that require extremes of bank, pitch, and acceleration.” As Pegoud and his colleagues discovered so many years ago, the elements of aerobatic flight can be distilled to four basic aerobatic maneuvers: the roll, the loop, the hammerhead, and the spin. All other maneuvers are variations of these fundamentals.

The understanding of the fundamental maneuvers and the development of derivatives gave rise over the years to the sport of competitive aerobatics, the performance of aerobatic maneuvers to predetermined standards. The big contribution of competitive aerobatics to aerobatics as a whole is this set of standards, the benchmarks of perfection to which all properly instructed aerobatic pilots are trained and by which they are thereafter measured and measure themselves.

This book focuses on understanding and performing aerobatic maneuvers as defined by the standards of competitive aerobatics. These standards require the highest degree of precision and competence and are the foundation of basic aerobatic courses throughout the country. There is no substitute for sound aerobatic training to make a pilot understand the limits of an aircraft and teach a pilot to fly with absolute confidence throughout the performance envelope.

Many pilots who take an aerobatics course will never fly in aerobatic competitions. They might just want to enjoy romping about the skies for the fun of it on sunny summer days. They might opt for the exciting world of airshow display flying. Or they might find themselves in a jet fighter doing such combat maneuvers as the yo-yo or a high-G roll. But if they learned the basics as defined by the standards of competition aerobatics they will easily, enjoyably, and safely meet the challenges of their choice.

It might seem ironic that a sport that promises boundless freedom in all dimensions, in fact demands ironclad discipline, intense concentration, and a dogged adherence to prescribed practices and procedures. But this irony doesn’t stand the test of experience and in the end aerobatics delivers its promise. Yes, the demands are ever present, but through hard work and a lot of practice, meeting them eventually becomes second nature and the airplane does indeed become an extension of your body throughout every maneuver.

In this respect aerobatics is just like any other aspect of learning to fly. Remember how little time you had to savor the freedom of flight on your first few cross-countries or solo touch-and-go patterns? You wondered what you were doing there, but you stuck with it and it paid off—and so will aerobatics. Meet its demands long enough and one day, all alone, you will do a perfect Immelmann on a whim only to realize that you did everything right without one conscious thought about it. At that moment you will truly know what aerobatics is all about.

1

Getting started

IF YOU ARE READY FOR THE CHALLENGE AND REWARDS OF AEROBATICS, IT is almost time to head for the airport and the aerobatic training machine awaiting you. But before you go, you must consider regulations, safety, the importance of getting professional instruction, selecting a training aircraft, and insurance questions.

AEROBATICS AND THE REGULATIONS

There is no escaping Federal Aviation Regulations (FARs), and it is best to clearly understand their applicability right up front. Aerobic flight shares the airspace with all other forms of flight, so all relevant FARs covering normal nonaerobatic flight apply. In addition, there are regulations created specifically for aerobatics, and regulations that cover other special areas of aviation but also apply to aerobatics due to the characteristics of aerobic flight. The FARs applicable to aerobatics can be divided into two general categories:

- aircraft operations
- construction and certification of aerobatic aircraft

First let's consider what the regulations do not require. There is no requirement in the United States for an aerobic rating. It is the pilot's responsibility to seek competent aerobatic instruction prior to solo aerobatics. Accident statistics indicate that this policy is by and large effective—let's keep it that way. There is no airspace set aside by regulation specifically for aerobic flight; as long as you stay out of airspace where aerobatics is not authorized, all you need to do is keep a good lookout and you are in business. There is no special additional medical certificate requirement; the standard

medical requirements apply to the pilot in command, based upon whether the flight is private or commercial.

Operation of aircraft in aerobatic flight

Only two paragraphs of the entire Federal Aviation Regulations cover the aerobatic operation of aircraft. Only one paragraph directly and exclusively addresses aerobatic operations. It is under Part 91, Subpart D, Special Flight Operations and it is quite straightforward:

§91.303 Aerobic Flight

No person may operate an aircraft in aerobatic flight-

- (a) Over any congested area of a city, town, or settlement;
- (b) Over an open air assembly of persons;
- (c) Within the lateral boundaries of the surface areas of Class B, Class C, Class D, and Class E airspace designated for an airport;
- (d) Within four nautical miles of the centerline of any federal airway;
- (e) Below an altitude of 1,500 feet above the surface; or
- (f) When flight visibility is less than three statute miles.

For the purpose of this section, aerobatic flight means an intentional maneuver involving an abrupt change in an aircraft's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight.



Fig. 1-1. The classic Stearman evokes an age that is long gone.



Fig. 1-2. Aerobatics unlimited: U.S. National Champion Patty Wagstaff putting her Extra 300S through its paces.

The other aerobatic paragraph applies to the use of parachutes (§91.307). It was not written exclusively for aerobatics, but is equally important because it specifically defines the conditions under which parachutes must be carried and the intervals and conditions under which they must be periodically repacked. For aerobatic flight the bottom line is that if there is more than one person in the aircraft and a bank angle will exceed 60° or a pitch angle will exceed 30° relative to the horizon, parachutes must be worn by both occupants. Specifically, §91.307(c) reads:

Unless each occupant of the aircraft is wearing an approved parachute, no pilot of a civil aircraft carrying any person (other than a crew member) may execute any intentional maneuver that exceeds-

- (1) A bank of 60 degrees relative to the horizon, or
- (2) A nose-up or nose-down attitude of 30 degrees relative to the horizon.



Fig. 1-3. Former European championship competitor Ian Groom practices his airshow routine in his brand-new Sukhoi SU-26M.

The next subparagraph exempts flight tests being given for a rating, instruction in spins, and other maneuvers required by the regulations given by an appropriately authorized instructor. There is also an exemption if the second person is a legally required crew member, but in most cases this does not apply to civilian aircraft licensed for aerobatics because practically none of them have a legal requirement for a second crew member. The parachute repacking requirement of §91.307 is self-explanatory.

Other regulations apply as they do to normal, nonaerobic flight. Because many aerobatic aircraft are taildraggers, it is especially worthwhile to review taildragger checkout and currency requirements.

Upon reading the regulations, aspiring aerobatic and airshow display pilots might wonder how aerobatics can be flown at competitions and airshows, where performances are routinely flown below 1,500 feet agl and in the vicinity of large crowds, and how competition aerobatics can be practiced at the required low altitudes. Such activity is made possible by waivers obtained from the FAA specifically for each event and by the establishment of FAA-approved aerobatic practice zones. A highly detailed proposal must be submitted describing the practice zone or proposed event. For proposed events, the information must include details on flight paths, crowd areas, participating acts, and flight crew experience. The FAA also conducts site visits and if a waiver is granted for an event, inspectors will be on hand to see that everything goes as agreed.

It is interesting to note that strictly for the purpose of considering an aviation event waiver, the FAA's *Inspector's Handbook of Guidelines* instructs the users to take a narrower interpretation of aerobatics than is provided in the FARs. Inspectors are advised that for an airshow, aerobatics is inverted flight and all the standard aerobatic maneuvers, such as slow rolls, snap rolls, loops, Immelmanns, Cuban eights, hammerhead turns, and the like, which cannot be performed over congested areas or spectators.



Jackie Laphier/Atlantic Flyer

Fig. 1-4. The delightful little Decathlon, first aerobatic mount of many pilots.

Certification of aircraft for aerobatics

The regulatory definitions of aerobatics and the conditions under which you may fly aerobatics in the airspace is only one aspect of the FARs in which you must be well versed. It is equally important to know what aircraft may be legally flown aerobatically.

Production aircraft must be approved for aerobatics during the certification process. The requirements the aircraft must meet are covered in FARs 21 and 23. In addition to being approved in a specific aerobatic category, the aircraft must also be approved for each specific aerobatic maneuver it is to fly. For general instructional purposes, some aircraft not approved in the aerobatic category might be approved for a limited number of maneuvers that technically qualify as aerobatics, such as spins; thus, in any production airplane, you may fly only those aerobatic maneuvers that are specifically authorized in the aircraft operating manual.

For an insight into the differences between aircraft licensed in the normal category and the aerobatic category, consider the Cessna 150 and the Cessna Aerobat. Superficially the aircraft look alike, and the Aerobat was derived from the 150. Yet their operating manuals clearly reveal that from an aerobatic standpoint they are completely different aircraft. The Aerobat is designed to withstand considerably greater loads than the 150, allowing it to safely fly maneuvers that could easily overstress the 150.

Approved aerobic maneuvers

1975 Cessna 150

Flight load limits:

(Flaps up) +4.4G & -1.76G; (flaps down) +3.5G

Chandelles

Lazy eights (Continued on page 6.)

(Continued from page 5.)

Steep turns
Spins
Stalls

1977 Cessna Aerobat

Flight load limits:

(Flaps up) +6.0G & -3.0G; (flaps down) +3.5G

Chandelles
Lazy eights
Steep turns
Spins
Stalls
Loops
Cuban eights
Immelmanns
Aileron rolls
Barrel rolls
Snap rolls
Vertical reversements

Only an unthinking pilot would try anything but chandelles, lazy eights, stalls, and spins in a 150, and he would be breaking regulations.

While the question of doing aerobatics in a certified production aircraft is quite straightforward, in the case of experimental aircraft, more latitude is left to the designer and builder. For experimental aircraft, no regulatory requirements specifically authorize aerobatic maneuvers, let alone list them in the aircraft operating manual; however, many homebuilt aircraft are as good or better than factory models. Many homebuilt designers and builders take great pride in their work and know and document the capabilities of their aircraft in great detail. The threat of liability suits is another reason for the experimental builder to be thorough.

Let the buyer beware. Choose a tried design, and if you are buying a finished experimental aircraft rather than building your own, carefully check out the builder and the airplane's history, including its aerobatic activities.

SAFETY AND THE IMPORTANCE OF PROFESSIONAL INSTRUCTION

In aerobatic flight, you deliberately operate your aircraft closer to the extremes of its performance envelope, the limits of airspeed and load, than during any other form of flying. The closer you are to these limits, the easier it becomes to inadvertently exceed them. As you hover on the edge of a stall, an indelicate or misguided control movement can push you over the edge and perhaps even into an unintentional spin. Close to redline and accelerating, an excessively urgent pull on the stick can send the G loads

on your aircraft and your body soaring beyond tolerance. And misjudging the altitude required to complete a maneuver can really ruin your day. So you must take precautions and develop and adhere to sound safety habits.

The right attitude

In large measure safety is a matter of having the right attitude. All the regulations, policies and procedures, and credible advice in the world will not keep you safe if you don't intend to abide by them.

Get professional instruction

Aerobatics is a mature sport with decades of tradition borne of experience. Anything that the novice aerobatic pilot can try has been developed to perfection by others before and is safely made available to newcomers by qualified aerobatic instructors. Only an unthinking pilot would endanger body and soul and everyone else within reach by attempting self-taught aerobatics. Make it your business to learn aerobatics only from a properly qualified aerobatic instructor. Self-study is strewn with pitfalls that make it an unacceptable option.

Though they might think otherwise, the self-studying novices lack the skills to consistently stay within the aircraft's performance limits and to save themselves when they surely overstep those limits. Nor do they have any point of reference to know whether their antics have any resemblance to the precision aerobatic maneuvers they claim to be doing.

Self-study usually leads to one of two things: either the pilot gets scared sufficiently to stop further experiments, and maybe abandon aerobatics altogether, or becomes an NTSB statistic. Do yourself and the sport a big favor. Get a qualified aerobatic instructor.

Where to find aerobatic instruction

Having committed yourself to learning aerobatics from a qualified school or owner-operator, the next question is where to find one. Because there is no aerobatic rating requirement, or any special additional regulations of flight schools and instructors offering aerobatic instruction, how can you evaluate what you get? You need to do some homework, but the process is easier than it might seem.

A good place to start is the International Aerobatic Club (IAC), the Experimental Aircraft Association's aerobatic arm. The IAC maintains a list of aerobatic schools throughout the country (though it does not evaluate or endorse them), and can provide the names of schools offering aerobatic instruction in your area. The IAC's address is in appendix C. The IAC also has a large number of chapters nationwide, the grass roots support group of the sport. It is worth looking up the local chapter in your area if you plan to do aerobatics. You will find excellent advice, reliable leads regarding instruction, and great camaraderie.

Other sources of information are the advertising sections of aviation magazines and newspapers, and the local airport grapevine. Some nationally known aerobatic centers that can be easily reached through their advertising in the aviation media might also be able to get you in touch with a school in your area.

When you have located a school or owner-operator, check it out thoroughly. Ask for a description of the course, see what aircraft are used, and find out how long the establishment has been in business. Ask how many students it has, what the aerobatic experience of the instructors is, do they do any other form of aerobatic flying such as competition or display flying, and whatever else might come to your mind. Talk to some former students about their experience and if everything checks out, sign up for an introductory lesson.

Safety pointers

When you chose to seek qualified aerobatic instruction, you took an important step toward learning aerobatics safely. But as in all other forms of flying, it is important to maintain a safety conscious attitude throughout your aerobatic flying. Though by no means exhaustive, and intended to complement general safety practices, here are some safety pointers particularly apt for the aerobatic pilot.

Understand aerobatic theory. It is by understanding not only “how” and “what,” but also “why” that you will find it effortless to stay ahead of your aircraft during all phases of aerobatics. During flights to performance limits, your grasp of theory and your ability to apply it might mean the difference between being safe or overstepping your airplane’s capabilities.

Know your airplane. This is a basic requirement and it means knowing not only performance parameters, but all of the aircraft’s behavioral characteristics, the design features responsible for them, and the designer’s thinking behind them (again, think in terms of “why,” not only “what”).

Always have an out. Learn to think in terms of contingencies. Make it a point to study the ways out of trouble and be ready with your options if a maneuver goes wrong.

Wear a parachute. Some pilots claim that they would never jump, and under certain circumstances, such as during low-level airshow flying, the chance of a successful parachute jump might be slim. But most of your aerobatics will be at altitude, so why deny yourself an option if all it takes is strapping it on? Also, be sure to comply with the legal requirements of wearing parachutes.

Always have plenty of altitude. The FARs’ minimum altitude for aerobatics is just that: minimum. Based upon aircraft performance characteristics and contingencies for botched maneuvers, an extra altitude margin is always a good idea. As they say, one of the most useless things in aviation is the altitude above you. For some types of aircraft, such as high-performance warbirds, even as much as 5,000–6,000 feet might not be enough to safely recover from certain botched maneuvers.

Fly only in good visibility. Many aerobatic pilots consider the 3-mile minimum visibility requirement as insufficient for aerobatics because it leaves too little time to

notice and evade conflicting traffic while flying an aerobatic sequence. A commonly used personal standard is 7 miles visibility.

Always check maneuver entry speed and altitude. Make a habit of glancing at the airspeed indicator and altimeter prior to any aerobatic maneuver to verify that you have sufficient speed and altitude for the maneuver. This point might seem obvious, but it will prove helpful when you begin to string sequences together and will be tempted to zoom from one maneuver to the other without a quick check of airspeed and altitude.

Practice only what you know. As you make progress and gain confidence during your training, you might be tempted to try new maneuvers that you haven't yet learned on your own, which could get you in trouble. It is best to be conservative and check with your instructor before you try anything solo.

Be rested and in good health. Flying aerobatics when you are tired or ill is a sure way to lose your edge and compromise your safety.

Respect FARs. It seems fashionable to complain about regulations, but most of them make good sense, and in many respects the amount of regulations is actually quite minimal. Bear in mind that new regulations are frequently the result of someone not towing the line of unregulated common sense, prompting the Feds to regulate.

HEALTH AND PHYSICAL CONDITION

Basic aerobatics does not require the pilot to be in extraordinary physical shape. Any-one in basically good health who can pass the FAA Class III physical for the private pilot's certificate should feel quite comfortable doing basic aerobatics after a chance to get used to the new sensations; however, it is true that the better shape you are in, the less you will feel the effects of aerobatics, and to withstand the punishing maneuvers of high-G advanced aerobatics, good physical conditioning is essential.

To increase G tolerance, weightlifting is the best exercise—better than cardiovascular exercises that improve circulation, making it easier for the blood to flow through the body and collect in certain body areas to the detriment of others during high G maneuvers.

A concern of most novice aerobatic pilots is airsickness. Fortunately, in most cases nausea appears to be caused psychologically, usually from a fear of what is to come. As soon as the pilot ceases to tense up the instant that the aircraft commences an aerobatic maneuver and the pilot's body is conditioned to flow with the airplane instead of trying to fight it, nausea ceases to be a factor. Many people feel nauseous when someone else is doing the flying; as soon as they are given the controls, their condition improves. Tolerance can usually be developed over time. It also helps not to overeat before an aerobatic session. For a small minority of pilots, nausea has physical causes, in which case it is best to consult a flight surgeon.

An often overlooked, but common factor in flying aerobatics comfortably is the importance of being well rested before an aerobatic session. Doing any serious aerobatics with a hangover would be especially counterproductive, to put it mildly. For

some pilots, eating habits can also have an effect on their comfort level during aerobatics. It is usually best to avoid an empty or overstuffed stomach prior to an aerobatic session. Scrub the flight if you feel the least bit unwell, such as when you have flu symptoms. Be especially wary of any ear or sinus trouble. The aerobatic pilot should understand the effective G forces on the body. This topic is addressed separately, in chapter 2, following a general discussion of G forces.

SELECTING AN AEROBATIC TRAINING AIRCRAFT

Aerobatic aircraft come in a surprising number of configurations: high-wing, low-wing, monoplanes, biplanes, tandem seating, side-by-side seating, yokes, sticks, fixed-pitch propellers, constant-speed propellers, taildraggers, tricycle gear, and on and on. What to choose is a matter of personal preference, and your shortlist may also be determined by what is available in your area. Nevertheless, a few general observations are worth thinking about.

Pure aerobatic aircraft or derivatives? It is generally preferable to choose an aircraft that was designed specifically for aerobatics, rather than one designed for other purposes and certified in a modified version for aerobatics. Often the modifications strengthen the structure to withstand higher Gs, but otherwise leave the aircraft unchanged. Many of the modified aircraft will thus have airfoils and control systems designed without aerobatics in mind, which often results in uninspiring handling characteristics barely adequate for basic maneuvers. On the other hand, an aircraft specifically designed for aerobatics is always more likely to be light and crisp on the controls in comparison. For example, aerobatics in a Decathlon are far more pleasant and productive than in a Citabria. Another advantage of aircraft specifically designed for aerobatics is that they are more likely to have inverted oil and fuel systems.

High wing, low wing, monoplane, biplane? This question is entirely a matter of personal preference. Aerodynamically, there is little difference from the standpoint of basic aerobatics. For many people, the fact that they are doing aerobatics in a biplane such as a Pitts is an added thrill, evoking an earlier era of aviation. Others feel that the extra wing blocks too much visibility. All high-wing aircraft tend to have rather restricted visibility. It is probably fair to say that when you have been in a bubble-canopied low-wing monoplane, its stunning visibility will be hard to give up.

Tandem or side-by-side? Tandem seating allows you to sit on the aircraft's longitudinal axis, enabling you to get a more precise sense of your position and trends during a maneuver. On the other hand, side-by-side seating makes communications much easier between student and instructor, especially if hand gestures are called for. For the recreational pilot, either option is probably fine, while the student intent on competition aerobatics might opt for tandem seating from the outset.

Stick or yoke? Stick!

Fixed-pitch or constant-speed? Doing aerobatics in an airplane equipped with a constant-speed propeller is great because you don't have to worry about engine over-

speed, and in most maneuvers, even the throttle setting is not worrisome. To review, a constant-speed propeller adjusts its blade angle in changing flight conditions to maintain a constant RPM. In many cases, you can just set up the power at the beginning of the session and leave it untouched throughout, allowing you to fully concentrate on the maneuvers. A fixed-pitch propeller's RPM varies with changing flight conditions. With the fixed-pitch propeller, RPM increases with aircraft speed and, if not checked, might easily result in an engine overspeed. On airplanes with fixed-pitch propellers, you frequently find yourself having to make distracting power adjustments and casting worried glances at the tachometer; however, learning aerobatics with a fixed-pitch propeller is good training to sensitize you to monitoring and coping with the limits of an airplane.

Basic or high-performance trainer? It has become more and more the practice to bypass aerobatic trainers and jump directly into the dual version of a high-performance competition airplane. While this is not inherently undesirable, you will miss something if you leave the low-performance aerobatic trainer out of your curriculum. It is more difficult to fly aerobatics well in an airplane of lower performance. If at first you opt for the less-sexy trainer, you will be a better pilot. Perhaps the best approach is the progressive upgrade to machines of higher and higher performance. Say, start with a Decathlon, followed by a Pitts, and then a Staudacher, a Sukhoi, an Extra, or any other unlimited monoplane.

Regardless of your choice, after your initial training, when you go on to fly aerobatics in aircraft of either lower or higher performance, a thorough dual aerobatic checkout in each aircraft should be the first item of business; if it is a single-seater, get checked out in a two-seater of very similar flight characteristics.

AEROBATICS AND AVIATION INSURANCE

The law-abiding aerobatic pilot need not worry much about special insurance requirements for aerobatic flight because usually there are none. Insurance is generally written to cover whatever type of flight is authorized by the flight manual, and in the case of aerobatic aircraft, this includes aerobatic flight. To be fully informed of your specific situation, check your policy and consult your insurance provider.

The case of an experimental aircraft might be a bit more murky, especially if the aircraft operating manual does not specifically address aerobatics. The prudent pilot will carefully research the suitability of the experimental aircraft for aerobatics and will confirm coverage of aerobatic flight with the insurance provider.

An easy way to invalidate insurance coverage is to violate the FARs, including the terms of your airplane's airworthiness certificate. If you come to grief flying aerobatics in an aircraft not appropriately certified, your insurance coverage will most likely be invalid. An accident or incident during aerobatics below a legal minimum altitude might also compromise coverage.

It is also a good idea to make an extra effort to understand those regulations that affect aerobatic flight, but that you might not regularly encounter during your normal

GETTING STARTED

nonaerobatic flying. Examples are regulations covering the use and maintenance of parachutes, and the checkout and currency requirements for flying taildraggers. Bear in mind that any damage or injury caused to third parties will always open you to a hefty liability lawsuit and if your insurance coverage is inadequate or you caused the problem while busting FARs, you will place not only yourself but your family in grave financial jeopardy.

Aerobatic pilots who intend to participate in airshow displays or in competitions with or without compensation should consult their insurance provider to check what special insurance conditions might apply.