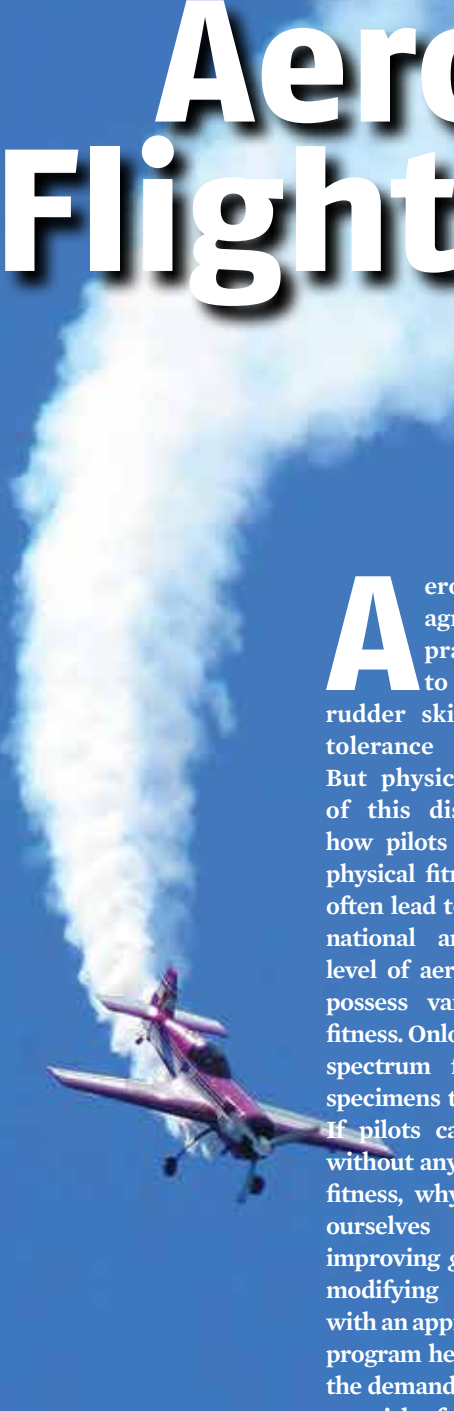


Maximizing Aerobatic Flight Fitness

by Rick Volker, IAC 23297



Aerobatic pilots unanimously agree on the importance of practicing flight maneuvers to build better stick and rudder skills and to improve the tolerance of increased g-loading. But physical fitness is rarely part of this discussion. Suggestions of how pilots can improve aerobatic physical fitness while on the ground often lead to eyes glazing over. At the national and world championship level of aerobatic competition, pilots possess varying levels of physical fitness. Onlookers can observe a broad spectrum from prime boot camp specimens to doughnut connoisseurs. If pilots can compete at this level without any correlation with physical fitness, why do we need to concern ourselves with earthly ways of improving g-tolerance? Quite simply, modifying our physical condition with an appropriately designed fitness program helps us to better withstand the demands of aerobatic flight, lower our risk of G-LOC, and become more alert and precise pilots in the process.

Aerobatic flying fitness responds to training frequency. Due to the body's own automatic physiologic adaptations, a pilot will see huge

improvements in g-tolerance by increasing aerobatic flight frequency. World-class pilots often train two or three times a day to maximize these adaptations. With a job, a family, financial constraints, and other competing interests, we cannot all fly with enough frequency to maximize our g-tolerance.

Aerobic and anaerobic (strength based) fitness programs also affect g-tolerance and are easier to fit into busy schedules. Resources are available to enable the pilot to develop an individual plan to optimize aerobatic flight fitness.

A pilot's first consideration should be to maintain a healthy body weight and good aerobic and muscular fitness to help the body sustain adequate cerebral blood pressure, stabilize posture during extremes, and permit one to strain with less effort during high g-forces. Think of the body as a column of blood with the heart at the center functioning as a pump that is designed to work effectively at 1g of gravity.

Increased g-forces cause blood to pool in the legs, decrease the blood return to the heart, and challenge the heart's ability to maintain adequate



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blood pressure to the brain.

The body possesses several different systems that help regulate blood pressure. G-LOC results when a pilot defeats these systems. An overweight pilot burdens the system with extra tissue to regulate.

Excess mass places additional demands on muscles during extreme g-forces, which distort posture and cause early fatigue. Aerobatic pilots should be aware that excess caffeine or alcohol, overheating, and dehydration decrease g-tolerance by 0.5g to 1g. Large blood sugar variations decrease g-tolerance. Aerobatic pilots benefit from eating prior to aerobatic flight, as an empty stomach allows sagging of the heart during positive g, thereby increasing the heart-to-brain distance to further decrease g-tolerance.

Aerobic Fitness

We all benefit from aerobic fitness.

It lessens fatigue, stabilizes blood sugar, spares muscle mass, and keeps body fat levels in check. Aerobic fitness improves cardiac health, lowers cholesterol, helps prevent many diseases, optimizes brain health, and keeps us flying later in life. Aerobic fitness is not, however, directly correlated with increased g-tolerance. Ideal aerobic fitness requires an additional caloric expenditure of 2,000 to 3,500 kcal (150-300 minutes) per week through aerobic exercise spread over three to five days of activity. This can be steady-paced for longer duration or can incorporate higher intensity intervals in much shorter sessions. Exceeding these time and calorie recommendations work against the aerobatic pilot, as heart rate and blood pressure may decline to lower than desired levels. Several air forces suggest that their pilots restrict participation in extreme

aerobic practices that cause the resting heart rate to decline to below 55 beats per minute (bpm). Marathon runners and long distance bicyclists commonly have resting heart rates as low as 40 bpm and low blood pressure to match. Many get hypotensive (lightheaded) after standing up too quickly from a supine position, a sign that it will be more difficult to maintain cerebral blood pressure during high g-load.

Anaerobic Fitness

Effective strength training (anaerobic exercise) has been proven to provide pilots with the equivalent benefit of wearing a G-suit. In fact, several countries' fighter pilots are required to lift weights. Building a better strength-to-weight ratio is the aim. Strength training improves the ability to contract muscles more strongly during positive g with less effort and fatigue, and can improve g-tolerance by 1g.

It is a myth that strength training will result in the need for a new

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wardrobe. Changes in overall body mass or body weight can only be supported by changes in diet or calories burned. Bulky muscles are the result of a runaway appetite, not heavy weights.

Develop Core Strength First

Strengthening the core muscles directly affects the efficacy of *g*-straining and has shown the highest correlation with improved *g*-tolerance. As with any exercise, opposing muscles must be kept in balance. Strength training of the abdominals should be done with equal effort expended on the muscles of the lower back to create a solid base of support for the actions of other muscle groups of the body.

Improving leg muscle strength has the next highest correlation with increasing *g*-tolerance. Strong leg muscles increase venous blood return to the heart and decrease blood pooling to improve blood pressure regulation. Upper body exercises have shown much lower correlation with *g*-tolerance, but they are important to stabilize the torso and provide better fine motor control of the arms under *g*-load.

Strength Versus Size

Strength-training principles fall into one of two camps: strength or size. The size, or bodybuilding, camp uses comparatively lighter weights with enough repetitions per set to achieve total muscle exhaustion to induce hypertrophy (increased muscle size) as the prime goal. Rest is limited between sets to accentuate the exhaustion/hypertrophy response. Many isolated exercises are added to change muscle shapes and symmetry, with little regard for strength. A bodybuilding workout results in muscles too exhausted to be in top form for another strenuous activity done later in the same day. Strength is increased, but is secondary to the goal of building muscle size.

The strength camp focuses primarily on building a better strength to weight ratio. Increased muscle size is merely a necessary evil. Strength-based athletes such as weightlifters,

wrestlers, running sprinters, cycling sprinters, and, yes, aerobatic pilots want to get the most strength with the least associated gain of mass. Strength trainers use higher weight loads and a faster speed of movement than bodybuilders do to increase central nervous system synchronization and increase recruitment of fast-twitch muscle fibers. This results in larger increases in strength than in muscle size. Strength workouts are not done to exhaustion and as a result can be structured to leave enough energy for other physically challenging activities in the same day.

Free Weights Are King

Strength training with free weights is superior to any other option, both in the amount of strength that can be gained and in the time in which one can gain results. Free weights train natural movements and avoid individual muscle isolation. Large compound movements such as the barbell squat and dead lift integrate more muscles to provide the best strength results. In contrast, machines isolate muscles to build strength that the neuromuscular pathways cannot efficiently coordinate into real-world movements.

If injury or motivation precludes the use of free weights, limited strength increases can be accomplished with callisthenic exercises. Core exercises, body weight squats, pushups, pullups, and TRX workouts are all options for increasing the power-to-weight ratio to better control the body with less effort and fatigue during high-*g* flight.

Adapt Your Program to You

As with any new pursuit, go to recognized industry experts and absorb their knowledge and experience to guarantee the best results.

Thankfully, the latest and greatest information is readily available. As a start, the following books provide an introduction to strength training. Pick one and embark on a path to maximizing *g*-tolerance and minimizing risk. The health benefits will affect everything else in your life.

- *Starting Strength* by Mark

Rippetoe is universally respected at the top of the strength-training world. *Starting Strength* teaches perfect exercise form to prevent injury. It simplifies the strength workout to what has proven to work the best.

- *Practical Programming for Strength Training* by Mark Rippetoe is a part two to *Starting Strength* and helps the reader devise a training plan varying workout volume and intensity throughout the year for maximum results.

- *The Barbell Prescription: Strength Training for Life After 40* by Jonathon M. Sullivan and Andy Baker incorporates the information found in *Starting Strength* and *Practical Programming*, and focuses on the demands and limitations of those who are over 40 years of age. It is the best all-in-one book choice if you are a pilot over 40.

- *Periodization Training for Sports* by Tudor Bompa offers simple and concise planning to lay out a personalized workout schedule throughout the year. If you already know the correct form for the exercises, this book will help you modify your present strength training for best results. It also shows the reader how to structure strength training to excel in many different sports. It is life changing for high school athletes through Olympic athletes.

- *Science and Practice of Strength Training* by Vladimir Zatsiorsky and William Kraemer is essentially a bible of theory and proof for the skeptics. **IAC**

Rick Volker is a practicing dentist and former Unlimited category competitor, now in his 14th year of flying air shows in a Sukhoi (+12g/-10g), a Harvard, or one of several Battle of Britain fighters. With a history of competitive bodybuilding, swimming, speed skating, and bicycle racing, Rick is experienced in maximizing the benefits of strength training and sport. He now competes at the world championship level in bicycle track sprint events, using strength training as the foundation.