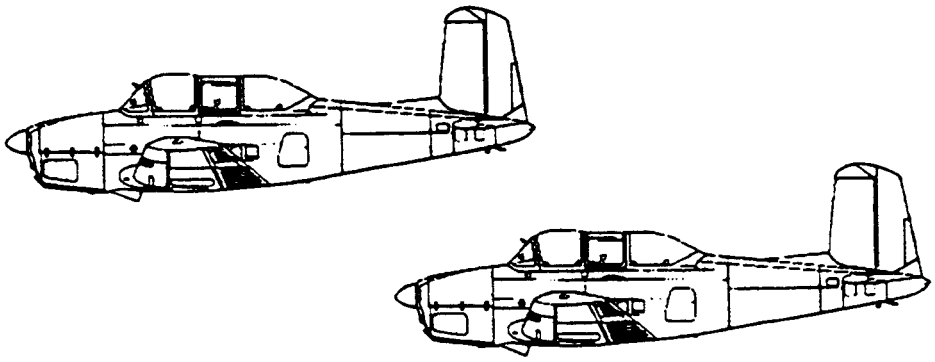
# SKY WARRIORS

## AIR COMBAT MANEUVERING

# PHASE I - IV

SKY WARRIORS
AERIAL LASER COMBAT
TM



# CHAPTER 4

## Flight Physiology

Flight physiology describes how your body reacts to the flying environment. Fighter pilots are particularly concerned with how flight physiology affects their ability to fight an opponent. One of the primary rules of air combat is: "Never give up fighting as long as you have the means to fight." It ruins a fighter pilot's whole day when he/she has to disengage from a fight because of physical exhaustion or disorientation. The price a pilot may have to pay for giving up is getting shot down by the enemy. Therefore, a fighter pilot wants to know what his/her physical limitations are during a fight. With that knowledge, a pilot may compensate for these limitations with physical training, specialized equipment, and proper diet.

### G-Forces

"G" is the fighter pilot's lingo for gravity force. In a fighter, G refers to the centrifigal force generated by turning the fighter. As a fighter wraps around a turn, the aircraft, and everything in it, is pressed to the outside of the turn. Within the cockpit, the pilot feels this G as an apparent increase in weight. In 1 G unaccelerated flight, the fighter and its contents weigh what they would normally weigh sitting still on earth. In a 2 G turn, the fighter and its contents double in apparent weight. At 3 Gs, this weight triples, and so on. At 3 Gs, for example, your 150-pound body would feel as though it weighs 450 pounds (3 x 150 pounds). Your 15-pound head would feel like it weighs 45 pounds. The pilot controls Gs by varying the amount of back pressure applied to the aircraft control stick. The harder you pull back on the stick, the tighter the aircraft turns and the more G-force you feel.

Most individuals tolerate 4 to 5 Gs with no noticeable physiological effects. This tolerance level is called "resting G tolerance," or, your ability to withstand Gs without any physical effort. *(Sky Warriors plans missions for a 3 to 4 G range.)* At 4 to 5 Gs, you simply feel heavier and it takes more effort to raise your limbs from a resting position. While this feeling may be surprising at first, it is not uncomfortable. Most pilots enjoy light to moderate Gs, since the force presses you into your seat, creating a secure, "strapped down" feeling. Above 4 to 5 Gs, you may experience some unusual sensations. As the G-forces increase above your resting tolerance level, you may notice a dimming of your vision. This is because under G, blood drains from your head and pools in your lower extremities. Your optic nerve is very sensitive to any decrease in local blood pressure. You may lose color vision. Some pilots report seeing a scattering of white dots in their field of view. If G force is increased further, your peripheral vision may decrease until you only have a clear view through a narrow field, called "tunnel vision." If G force is increased further still, your vision may fail completely, though you remain completely conscious. From this point, any increase in G force will most likely result in loss of consciousness. The good news is, as soon as you stop pulling back on the control stick, returning to a lighter G force, any physiological effects you were feeling at higher Gs will instantly disappear, with no after-effects. The only exception to this rule is loss of consciousness. If you pull back on the control stick hard enough to produce G-induced loss of consciousness (G-LOC), it will take anywhere from 20 seconds to a minute and a half to return to a state at which you can effectively fight your opponent. Tolerance for G forces varies from individual to individual. Each person's resting G tolerance varies slightly from day to day. Factors which affect resting G tolerance are:

Physical stature

In general, shorter, muscular individuals have a slightly higher resting G tolerance than tall, lanky individuals.

General health

Any illness reduces your resting G tolerance to some degree.
Fatigue reduces G tolerance.

Level of hydration

The more dehydrated your body, the less G force you can tolerate without physiological effects. In fact, if you are thirsty, in general, you are about 3% dehydrated. *At 3% dehydration, you have lost 50% of your normal G tolerance.*
Causes of dehydration include:

Not drinking enough water on a daily basis
Alcohol consumption
Intake of diuretics such as caffeinated tea, coffee and cola
Illness

Flight frequency

The more often you fly, the better your G tolerance.

The rules for ensuring your resting G tolerance will be at its optimum are simple:

Drink plenty of water.
Get sufficient sleep.
Keep caffeinated drinks to a minimum.
Avoid overindulging in alcohol the night before and the day of a flight.
Do not fly if you are ill.

Pilots may increase their G tolerance by a level of 3 to 4 Gs above their resting level by practicing an anti-G straining technique, called an "L-1 maneuver." Your safety pilot will demonstrate the L-1 maneuver during your preflight briefing, but an L-1 should not be necessary at the lower G levels of a Sky Warrior mission. The L-1 maneuver increases the blood pressure in your head, staving off loss of vision and G-LOC under high G forces. If your resting G tolerance is 5 Gs, using the L-1, you should be able to sustain 8 to 9 Gs without loss of vision or other physiological effects. (However, the T-34 is designed for a maximum of 6 Gs, so a 9 G turn will not be possible during your mission.)

Contrary to popular belief, wearing a G-suit does little to increase your G tolerance by itself. A G-suit is a modified pressure cuff which is worn about the legs and abdomen like a pair of pants. The G-suit has a hose extending from the hip which connects to a port in a fighter cockpit. When the pilot applies Gs to his fighter, a valve opens up inside the cockpit port. High pressure air flows into the hose, inflating the G-suit. The G-suit presses on the legs and abdomen of the pilot. The fallacy is that an inflated G-suit squeezes the legs and abdomen, preventing blood from draining into the lower extremities. This is absolutely untrue. The truth is, a G-suit will only increase a pilot's resting G tolerance by 1 G; and there is still some question as to whether the G-suit even needs to be inflated in order to provide the 1 G of extra tolerance. The G-suit works its magic by making it easier for the pilot to perform an anti-G strain. When the G-suit inflates, it pushes against the pilot's stomach and leg muscles. The pilot can constrict his muscles and "push" against the inflated suit. It is muscle constriction against the suit, not the suit itself, which chokes off a pilot's blood capillaries, preventing the blood from flowing to the feet. With good physical conditioning, and proper training, a pilot can achieve nearly the same G resistance without a G-suit.

Now that we have your attention, and have probably raised your anxiety level, you can relax. **Your mission at Sky Warriors will never require you to fly at an uncomfortable G level.** Again, we plan to fly in the 3 to 4 G range. At this level, you should not notice any physiological effects and you should not have to strain. However, if you do not like 3 to 4 Gs, simply ease up and reduce your pull back on the control stick. We want you to have fun and stay comfortable, which is why *you* are flying the aircraft.

## Orientation

Flying a fighter in a dogfight involves turning and accelerating in 3 dimensions. All of that movement can be disorienting. Fighter pilots always say, "Maneuver in relation to the bandit." They mean, watch your opponent,

# CHAPTER 5

# AIR COMBAT OVERVIEW

The following material is intended to provide you with enough information to maximize your enjoyment during your visit to Sky Warriors. It takes years of training and practice to produce a combat-ready fighter pilot. This manual will concentrate on the essential elements of dogfighting.

For our non-pilots, please remember that we are here to please. We will demonstrate and allow you to perform as much or as little as you desire. For our aggressive pilots, this can be a wonderful learning experience. We do our best to match up participants of equal ability and desires.

The material presented is all-encompassing in order to accommodate all four phases. Please read the information pertaining to your particular phase. Also, please keep in mind that your instructor/safety pilot will be able to modify the mission to your personal goals and skill level to achieve maximum enjoyment for you.

## PHASE I
## ACM OVERVIEW

1. Tracking Gunshot Exercise
2. Defensive Hard Turn
3. High Yo-Yo
4. Dogfight from Merge Setup
5. Optional GCI Intercepts
6. Aerobatics (Optional)

## PHASE II
## ENERGY MANAGEMENT

1. Tracking Gunshot Exercise
2. Maximum Performance Turn
3. Rudder Control Exercise
4. Closure Control Exercise
5. Lo Yo-Yo
6. Lag Roll
7. Nose Counters
8. Dogfight from Merge Setup with Limited Bandit

## PHASE III
## FIGHT PROJECTION

1. Tactical Formation: In-Place Turns; Check Turns; Delay Turns
2. Tracking Gunshot Exercise
3. No Sight Defense
4. Reversal to a Flat Scissors
5. Pitchback Fight Entry
6. Sliceback Fight Entry
7. Dogfight from Merge Setup with Altitude Splits

## PHASE IV
## REFINEMENTS

1. Tactical Formation: Fluid Turns; Delay Turns; Check Turns; In-Place Turns; Shackle
2. Discuss Last Ditch Maneuvers
3. Immelman Turn
4. Slow Speed Fight
5. Dogfight from Merge Setups with Optional Safety Pilot Demo Fight

canopy bow surrounding the front windscreen, begin the maneuver. (See Figure 27.) Roll initially into approximately 125-145 degrees of bank (using outside references), and rapidly but smoothly increase back stick pressure to achieve light buffet or maximum allowable G, whichever occurs first. If maximum allowable G is reached first, maintain that G loading until airspeed bleed off allows you to maintain the light buffet within G limits. At high energy levels airspeed may not bleed off enough to allow light buffet to be achieved.

***CAUTION: An overly aggressive pull at high energy levels could result in an over-G.***

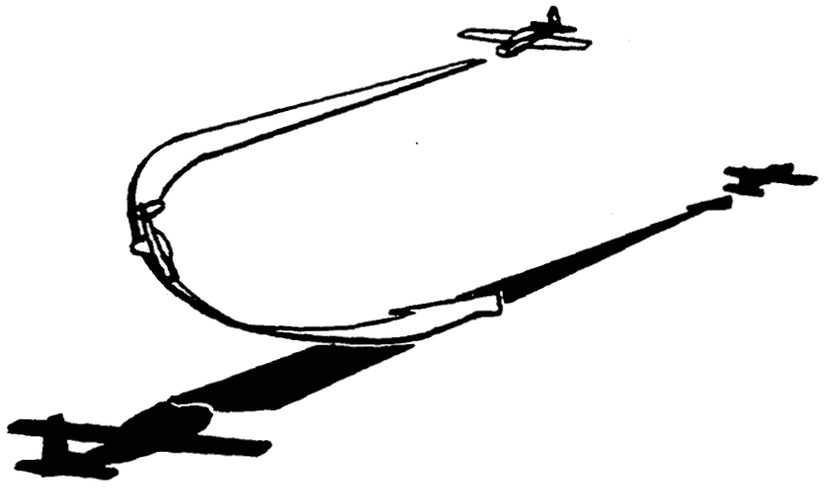


Figure 27. The Sliceback

Pull through toward the bandit maintaining the plane of turn using the rudder. As the nose comes through the horizon after turning approximately 180 degrees, roll-out and relax back pressure as necessary. A properly executed sliceback will place you 500-1000' behind the bandit, co-airspeed.

**Merge Setup with Offsetting Altitude and Airspeed Splits**

These merge setups dogfights will be entered using the same techniques as the pitchback and sliceback exercise. The opponent entering the fight from above will maintain a power setting to hold 120 knots. The opponent entering the fight from below will maintain 150 knots. If the fight progresses beyond 720 degrees of turn, both fighters may power up to combat power. By entering the fight with offsetting altitudes and airspeeds, you will have to fight your fight using entirely different techniques than your opponent uses. Fight projection will become critical to formulating your own game plan.

**Summary**

This concludes your Phase III mission. This phase demonstrates that a dogfight is a dynamic event in which both opponents must continuously re-evaluate the situation. How you fight your fight may be entirely different from your opponent's game plan. As you execute your maneuvers, you have to analyze the bandit's reaction and change your strategy. When you return for Phase IV, you will develop a flying style best suited to your abilities.

## Pitchback

A pitchback is an optimum to maximum performance turn performed **above** the horizon in order to reverse the aircraft's flight path direction. The pitchback allows you to use the G of gravity during the last half of the turn when your energy is lowest, without sacrificing the high loss of energy associated with an Immelmann turn. The pitchback has a much smaller turn diameter in the horizontal plane than a level turn because it is tilted to the horizon. Because the pitchback is performed above the horizon, you must have relatively high energy, a minimum of 150 knots, in order to come out of the maneuver with maneuvering potential.

To set up the pitchback, you will take separation from your opponent using the same techniques described for a merge setup. The target aircraft will maintain 120 knots and an altitude 1000' above your aircraft during the setup and exercise. You will maintain a minimum of 150 knots until entering the pitchback. As in the merge setup, both aircraft will turn towards each other to pass winglines with 500' of lateral separation.

Begin the pitchback about the time the target aircraft passes the canopy bow surrounding the front windscreen. (See Figure 26.) Roll the aircraft into approximately 40-50 degrees of bank (using outside references) and simultaneously apply back stick pressure to achieve an optimum to maximum performance turn. Pull toward the bandit in an approximately oblique half-loop. Use rudder to control the direction of the pull. The maneuver is completed upon roll-out after approximately 180 degrees of turn. If properly projected, you should arrive 500-1000' behind the target, co-airspeed.

***CAUTION: When starting a pitchback at high energy levels, an overly aggressive pull could result in an over-G.***

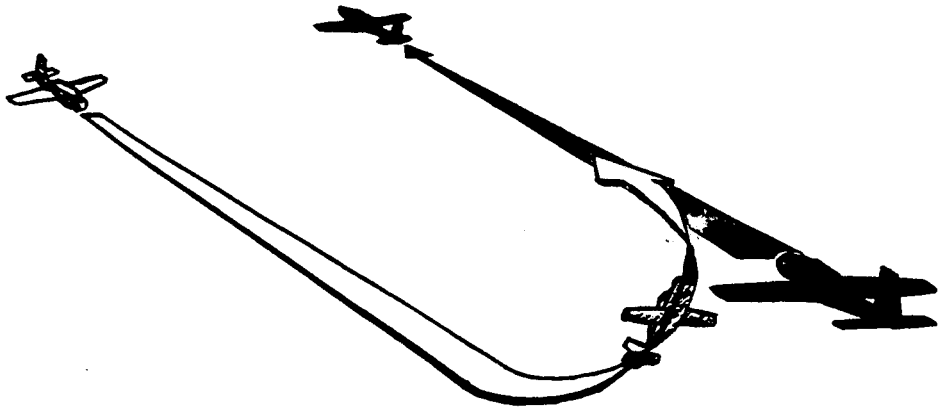


Figure 26. The Pitchback

## Sliceback

A sliceback is an optimum to maximum performance turn performed **below** the horizon in order to reverse the aircraft's flight path direction. The sliceback can be entered at relatively low energy states because the nose is low during the entire maneuver. Energy can be maintained or, in some cases, even increased. The sliceback allows you to turn 180 degrees while minimizing turn time and optimizing energy state by using the G of gravity, without sacrificing the large altitude loss associated with a Split-S.

The setup is exactly as described for the pitchback, except the target aircraft will maintain 150 knots and an altitude 1000' below you, offset 1000' laterally. You will enter the merge at 120 knots. As the target passes the