

# Airplane trim

Or.....

when "hands off" means something different than what you tell your daughter's date before they go to the prom

Plus how to impress the public during an air show

# Topics

- ✓ First steps
- ✓ Basic flight trim
- ✓ Flying for the public (air show)
- ✓ Basic aerobatic maneuvers
- ✓ Flight plan for a show
  - Aerobatic
  - Warbirds

# First steps

- ✓ Before you fly
  - CG
  - Lateral balance
  - Control surfaces
    - Travel volume
    - Direction
    - Interference
    - Wing and stab incidence
    - Engine thrust line
- ✓ Type of plane
  - Trainers
  - Sport low wing
  - Aerobatic planes
  - Scale
- ✓ What we want
  - Trainer
    - Stability
    - Slow flight
    - Hands off recovery
  - Sport low wing
    - Maneuverability
    - Wide speed range
    - Predictable
  - Aerobatic
    - High power to weight ratio
    - No recovery tendencies
    - No linkage between the 3 axis
  - Scale
    - Depends on the prototype

# Initial trim maneuvers

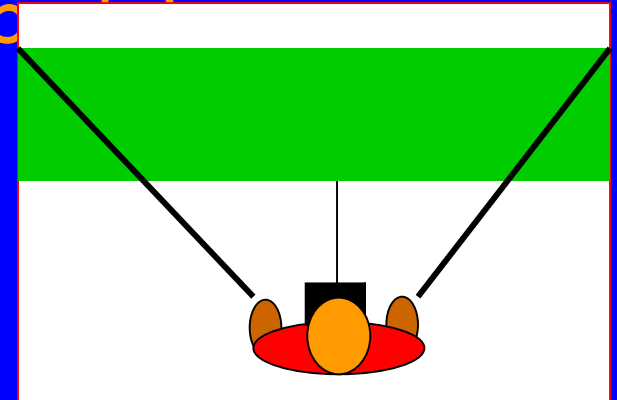
- ✓ Check for possible danger of aft CG
- ✓ Trim elevator, ailerons, and rudder
  - Land and reset clevises or use sub-trim
  - Repeat until trim tabs are centered
- ✓ Check thrust line
  - Fly straight and level at full throttle
  - Cut the throttle
  - The plane should continue straight and level for a few feet then start to lose altitude without changing direction
  - If it changes direction, change the thrust line in the direction of the change
- ✓ Fine tuning CG
  - Fly inverted and determine the amount of down elevator
    - Too much down elevator means nose heavy
    - What is too much?
- ✓ Fine tune roll rate
  - 3 rolls in 8 to 10 seconds but no more than 12

# Flying for the public or yourself

Do maneuvers in front of yourself  
Use turnaround maneuvers  
Stay in the "box"

## Before the fun starts

- ✓ Stance (turn your head not your body)
- ✓ Consistent flight path
  - Heading
  - Distance
- ✓ Practice straight and level flight
- ✓ Remember your left hand
- ✓ The throttle and the rudder can be used in flight



# The 3 basic maneuvers and a bit more

✓ LOOPS

✓ ROLLS

✓ STALL TURNS

✓ What is next?

# Loops

- ✓ Must be round NO EGGS
- ✓ Elevator setting changes continuously
- ✓ Do several IN FRONT OF YOU
- ✓ Errors
  - Not concentric
  - Cork screw
  - Not a constant diameter
  - Uneven entry and exit (heading and altitude)
- ✓ After you master them use the throttle on the backside

# Rolls

- ✓ Start with one roll
  - Start in level flight
  - Finish in level flight
    - Same altitude
    - Same heading
- ✓ Multiple rolls in straight line
  - Same as above
  - **MUST USE THE ELEVATOR** to maintain altitude and heading
  - Start by using the elevator while inverted

# Stall turns

- ✓ Using elevator, throttle, and rudder
- ✓ You will need lots of rudder
- ✓ Steps
  1. Enter from straight and level
  2. Start a Loop
  3. Establish a short vertical after a  $\frac{1}{4}$  Loop
  4. Reduce throttle to  $\frac{1}{4}$  or  $\frac{1}{2}$
  5. Just before the plane stops apply full rudder
  6. Fly straight down and pull out with a  $\frac{1}{4}$  loop
  7. Exit must be at the same altitude and  $180^\circ$  from the entry

# Next steps

- ✓ Immelman
- ✓ Split "S"
- ✓ Cuban 8
- ✓ Inverted flight
- ✓ Outside Loops
- ✓ Knife edge

# Now let's SHOW OFF

- ✓ Create a flight plan
  - Write it down
  - Use center maneuvers and turn around maneuvers
  - Have a caller
- ✓ Provide the list to the announcer
- ✓ Practice
- ✓ Practice
- ✓ Practice

# Sample flight plan

- ✓ The idea is to have a continuous flow
  - Take off (mandatory)
  - Climb at 45 degrees T.A. Half Cuban 8
  - Low high speed pass
  - Stall turn T.A.
  - Loop (s)
  - Half loop T.A.
  - Fly inverted
  - Split "S" T.A.
  - Low pass inverted or knife edge or high speed
  - Immelman (T.A.)
  - Spin
  - Climbing rolls
  - Split "S" T.A.
  - Cuban 8
  - Landing (optional)

# Showing Scale Planes

- ✓ Same as aerobatic planes but they are overpowered so remember...
  - P51s are not supersonic
  - Cubs seldom do more than 80 mph
  - Eindeckers do not have unlimited vertical
- ✓ Use realistic speed and maneuvers
- ✓ Fly closer (show the features)
- ✓ Show mechanisms (retracts, flaps, etc)

If you want to impress them

**PLAN YOUR FLIGHT**

**PRACTICE YOUR PLAN**



That is all folks

# Test your skills (Level A)

- ✓ Take off (U)
- ✓ Straight and level flight (D)
- ✓ Straight and level flight (U)
- ✓ 1 Roll (D)
- ✓ 2 Loops (U)
- ✓ Immelman (D)
- ✓ 2 Loops (U)
- ✓ Landing (U)

D= Down Wind      U= Upwind

# Test your skills (Level B)

- ✓ Take off (U)
- ✓ Straight and level flight (D)
- ✓ Straight and level flight (U)
- ✓ 3 Rolls (D)
- ✓ 3 Loops (U)
- ✓ Immelman (D)
- ✓ Split "S"
- ✓ Stall Turn (U)
- ✓ Landing (U)

D= Down Wind      U= Upwind

# Rules

- ✓ Two judges
  - Following the guidelines of the AMA rule book
  - The two scores will be averaged
  - Those that complain about the score will be prosecuted to the fullest extent of the law (my law)
- ✓ One or two flight lines
- ✓ Minimum 3 rounds (will do as many as possible)
- ✓ Final score will be the average of all the rounds
- ✓ Any changes or additions to the rules will be published in the newsletter well in advance

# Low wing sport plane

- ✓ When inverted no more than  $\frac{1}{2}$  down elevator
- ✓ Partially stable (slow recovery)
- ✓ Gentle stall
- ✓ 45° Rudder travel
- ✓ 3 rolls in 6 to 8 seconds
- ✓ Use dual rate for snaps and fast rolls
- ✓ May need mixing to do knife edge

# Aerobatic plane

- ✓ Maximum travel volume
  - Shorter servo arms and longer control horns
- ✓ No axis linkage
  - Adverse or pro-verse roll with rudder
  - Pitch change with rudder
- ✓ When inverted minimum down elevator
- ✓ Check vertical lines to find tendencies
  - Lateral balance
  - Thrust line
- ✓ Consecutive loops
  - Cork screws
  - Wing warp
- ✓ Aileron differential. Is it needed?
  - Check multiple axial rolls
  - Barrel rolling?
- ✓ 3 rolls in 6 to 7 seconds