

773rd Test Squadron



Flight Test at Edwards AFB

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Outline

- About Edwards AFB and AFTC
- Why We Structures Test
- Types of Structures Tests
- What is P&FQ?
- Why We Test P&FQ
- Types of P&FQ Testing
- Career Paths
- Questions



Edwards Air Force Base

- Edwards, CA
- Appx 70 Miles North of LA
- Home of:
 - Air Force Test Center
 - USAF Test Pilot School
 - Air Force Research Lab
 - NASA Armstrong Flight Research Center
- Mixed Workforce
 - 25% Military
 - 75% Civilian



AFTC Mission

- Purpose of the Air Force Test Center
 - Provide USAF with an evaluation of a weapon system
 - Test a few before thousands are built
- Why we Test
 - Verify the design
 - Verify that system specifications are met
 - Ensure the system can perform required missions
 - Characterize the system
 - Reduce risk
 - Provide the warfighter a system they can count on



Aircraft We Test

Bombers



Fighters



Cargos



Unmanned



Tankers



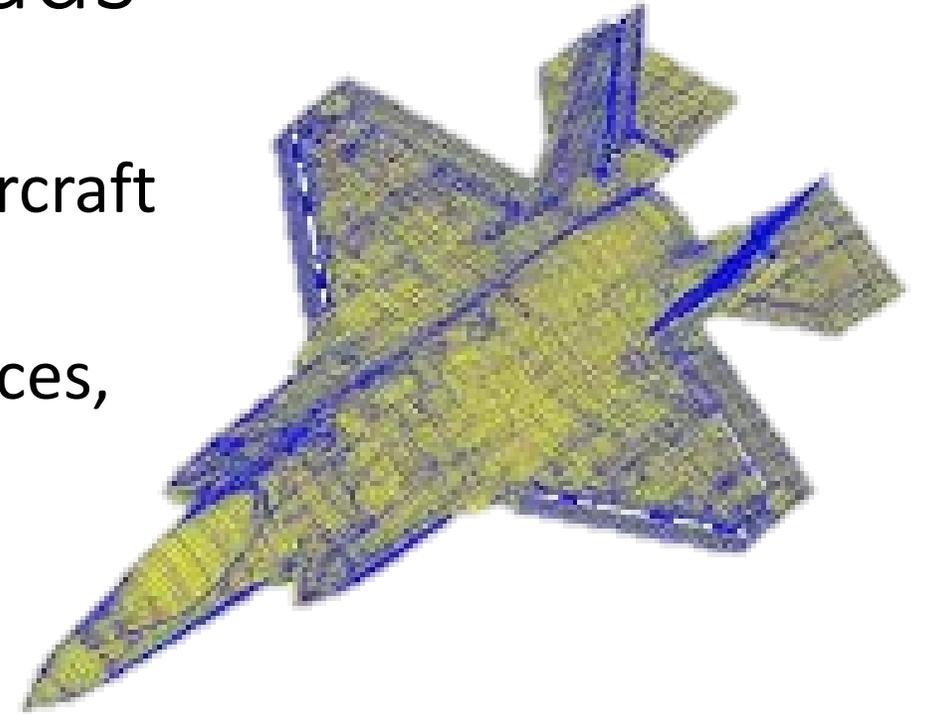
Why We Structures Test

- 1954 B-47 Cracking Mishaps: [Boeing B-47 Stratojet \(Low Altitude Bombing System\) LABS Maneuver - YouTube](#)
- 1997 F-117 Flutter Failure: [F117 Stealth Fighter Crash - Martin's Airshow \(youtube.com\)](#)
- 2001 C-130 Wing Separation
- 2007 F-15C Fuselage Fatigue



Types of Structures Tests: Loads

- Static and dynamic stresses to which the aircraft structure is exposed to
- Induced by inertial forces, aerodynamic forces, and thermal stresses



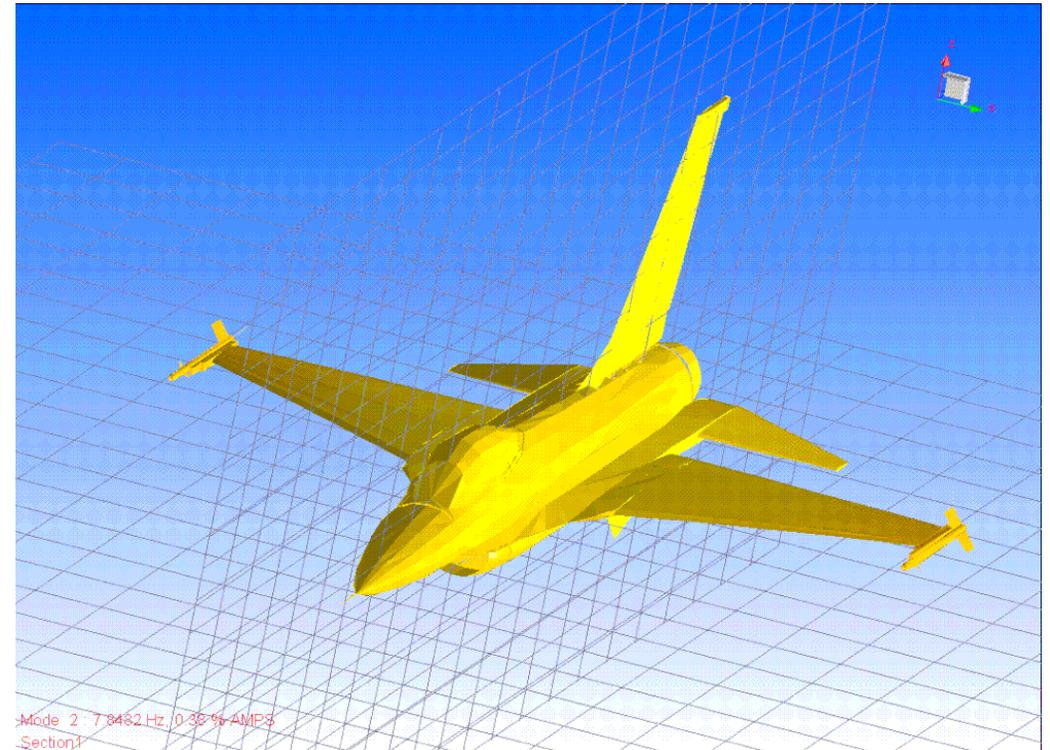
Types of Structures Tests: Loads

- Ground Test (contractor)
- Flight Test Maneuvers
 - Wings Level Side Slips
 - 1g Rolls
 - Symmetric Wind-Up-Turns
 - Pushover Pull-Ups
 - Elevated g Rolls
 - PYR Doublets
 - Rudder Kicks
 - Constant AoA Decelerations



Types of Structures Tests: Flutter

- Dynamic oscillating stresses to which the aircraft structure is exposed
- Induced aeroelastic coupling of first bending and first torsion mode
- Subsets include:
 - Body Freedom Flutter
 - B-2 Example:
<https://youtu.be/GUMowPZ-NWw?si=EpeymUPJLAy3DxHT>
 - Limit Cycle Oscillation



Types of Structures Tests: Flutter

- Flight Test Maneuvers
 - Bursts/Dwells
 - Sweeps
 - 1g Trim
 - Slow Accelerations
 - Flutter Excitations
 - Natural Turbulence
 - Control Surface
 - Shaker Mass
 - Pyrotechnic
 - Doublets/Stick Raps
 - Wind-Up-Turns

- Ground Vibration Test (GVT)
 - Shakers
 - Soft Support or Deflated Tires



<https://youtu.be/qwylNMeJHp4?si=zUqs8wHyH5evrKxT>

Types of Structures Tests: Noise & Vibration

- High frequency oscillations and buzz exposing the aircraft's structure to high fatigue loads
- Induced by aerodynamic flow phenomena and sympathetic vibrations from the engines and other mechanical systems

Types of Structures Tests: Noise & Vibration

- Flight Test Maneuvers
 - Wings Level Side Slips
 - 1g Rolls
 - Symmetric Wind-Up-Turns
 - Pushover Pull-Ups
 - Elevated g Rolls
 - Constant AoA Decelerations
 - Rapid Acceleration/Deceleration
 - Throttle Chops
 - Speed Soaks



What is Performance & Flying Qualities?

Performance



- How far? (Range)
- How fast? (Top Speed)
- How high? (Service Ceiling)
- How long? (Endurance)

Flying Qualities/Handling Qualities



- How does the aircraft (A/C) move?
- How does the A/C plus pilot move?

Why We Test P&FQ?

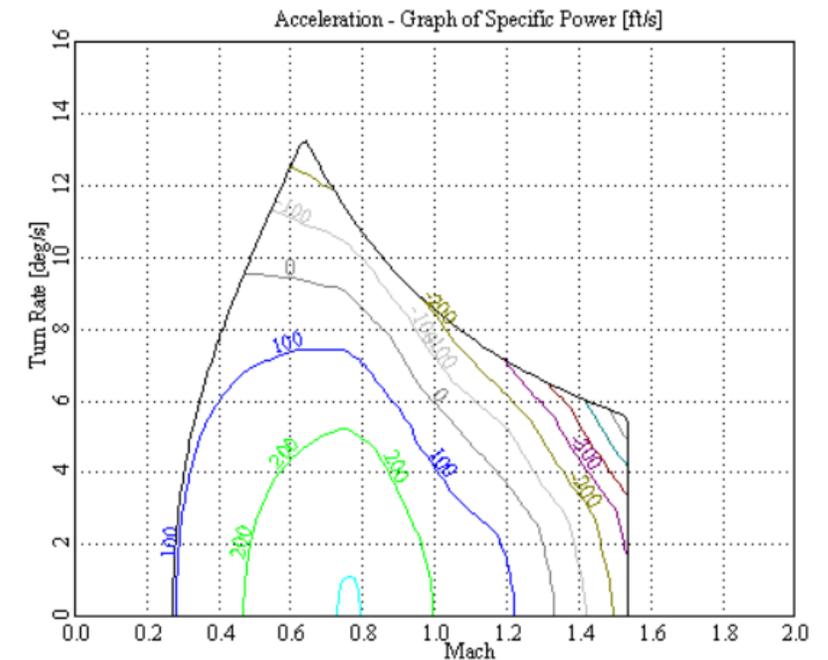
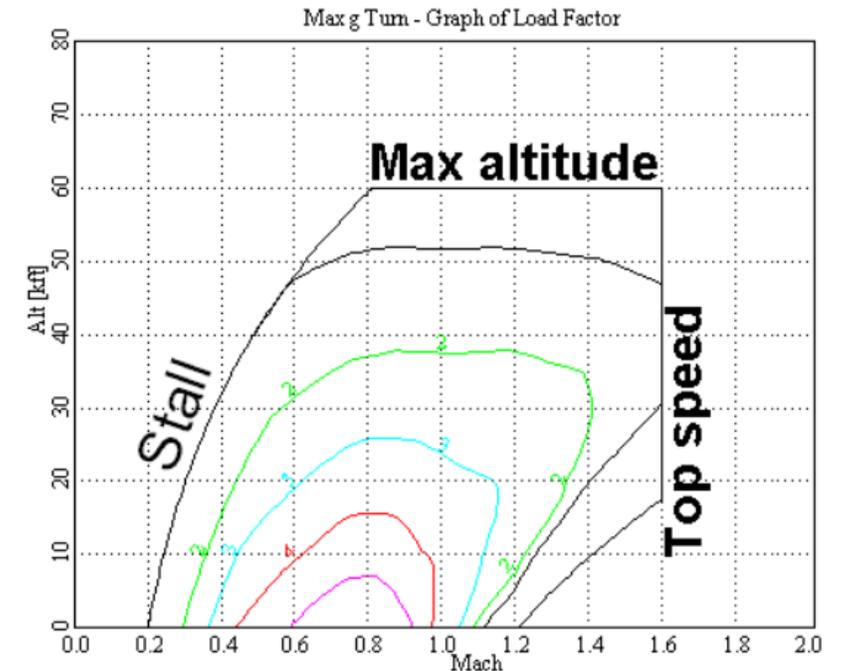
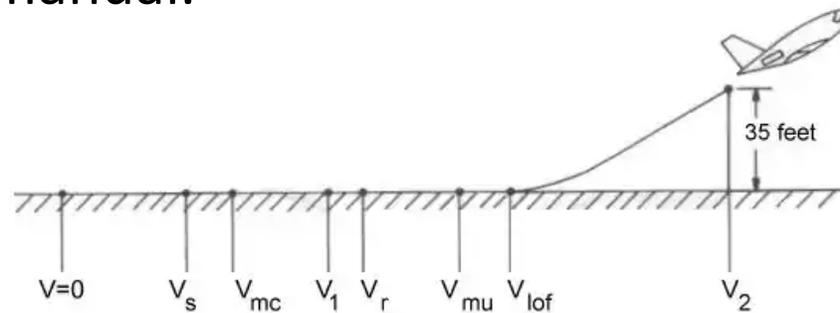
- [YF-22 Pilot Induced Oscillation \(PIO\)](#)
- [Chuck Yeager F-104 Sustained Flatspin](#)
- F-16 Automatic Ground Collision Avoidance System (AGCAS)

Types of Test: Performance

Objective: Obtain sufficient performance data to generate takeoff/landing distance, turn rate, and performance envelope of the A/C for the flight manual.

Maneuvers:

- Takeoff
- Climb
- Level Acceleration
- Sustained Turn
- Landing



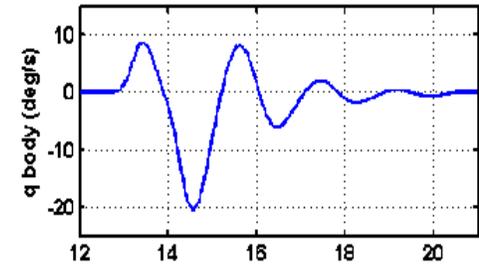
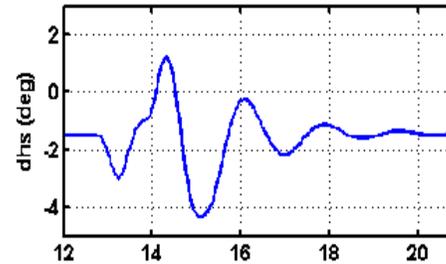
Types of Test: Flying Qualities

Objective: Collect sufficient data to clear the operational envelope of the A/C for various configurations.

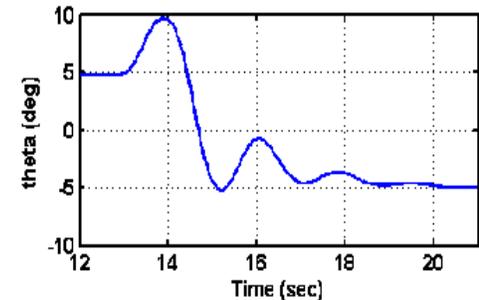
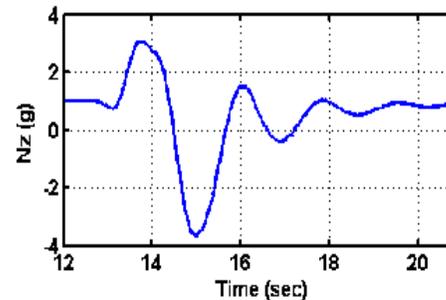
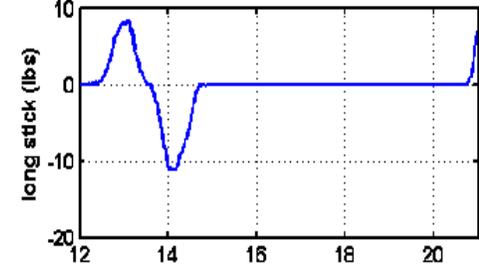
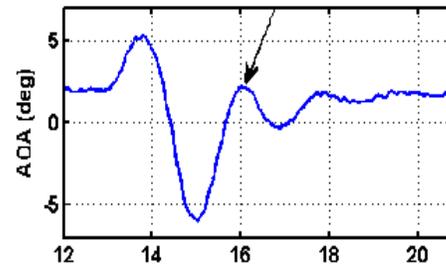
Maneuvers:

- Trim
- Doublet
- Wind-Up-Turn (WUT)
- Wings-Level Sideslip (WLSS)
- Steady-Heading Sideslip (SHSS)
- Full-Stick Full-Check (FSFC) Roll
- Full-Stick Release Roll

Example Pitch Doublet



AoA response lightly damped in short period frequency range



Types of Test: Handling Qualities

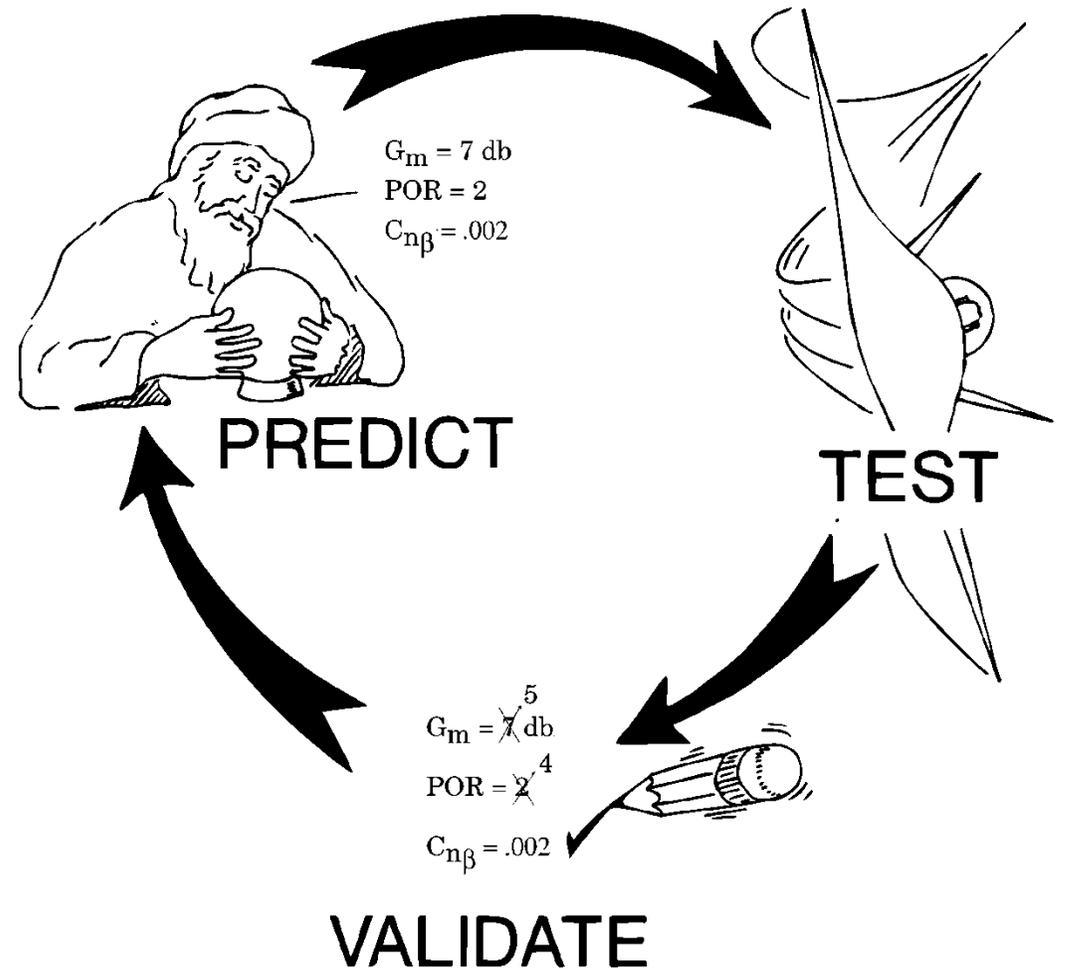
Objective: Record pilot comments during Basic Fighter Maneuvers (BFM) and Air Combat Maneuvering (ACM) before delivering asset to Operational Test (OT).

Maneuvers:

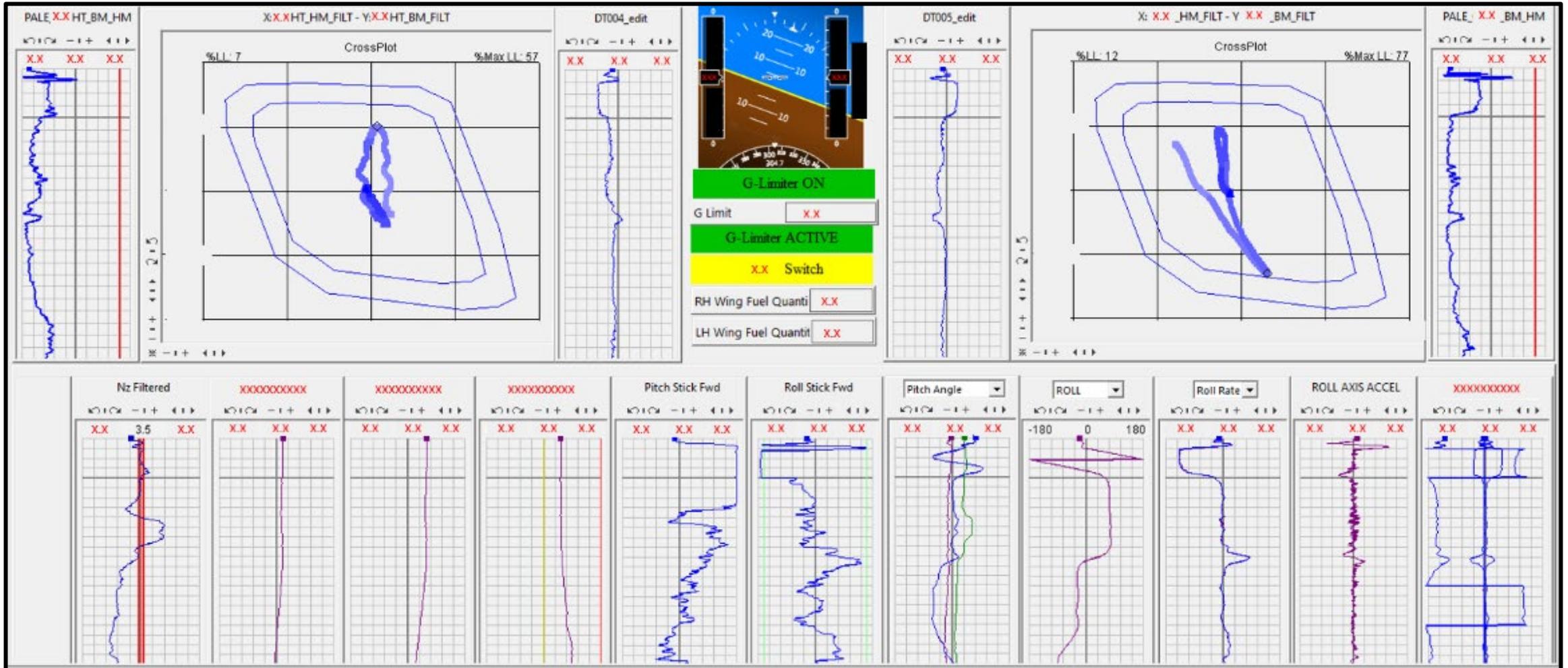
- Takeoff/Landing (TOLD)
- Aerial Refueling
- Military Utility Testing (MUT) a.k.a. Dogfighting
 - [Example](#)

Day to Day

- Write test plans
- Write safety plans
- Monitor missions in control room
- Post mission data analysis
- Report writing



Example Control Room Screens



Other Types of Testing Under the 773rd

- Subsystems
 - Brake Testing
 - HVAC
 - Fire Suppression Systems
 - Landing Gear
 - Fuel
 - Etc.
- Propulsion
- Human System Integration
- Reliability and Maintainability



Dryden Flight Research Center EC92-1284 Photographed 1992
SR-71B take-off with "shock diamonds" in the exhaust. NASA photo



Testing at 775th Test Squadron

- 775th Test Squadron – Mission Systems
 - C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance)
 - Radar Integration
 - Weapons Integration
 - EOIR (Electro-optical Infrared)
 - Guidance, Navigation, Identification



Testing at 771st Test Squadrons

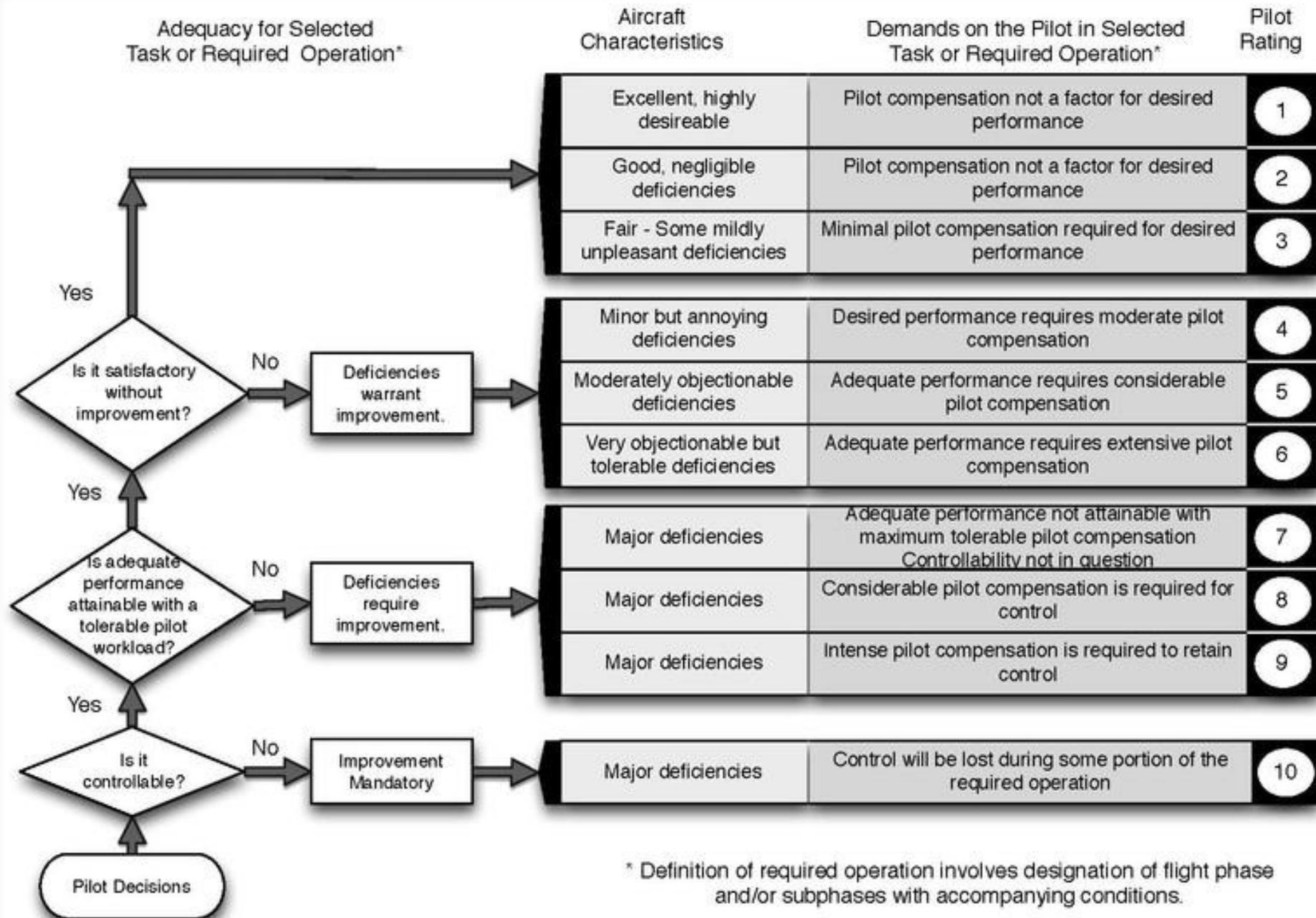
- 771st Test Squadron – Electronic Warfare
 - Google it



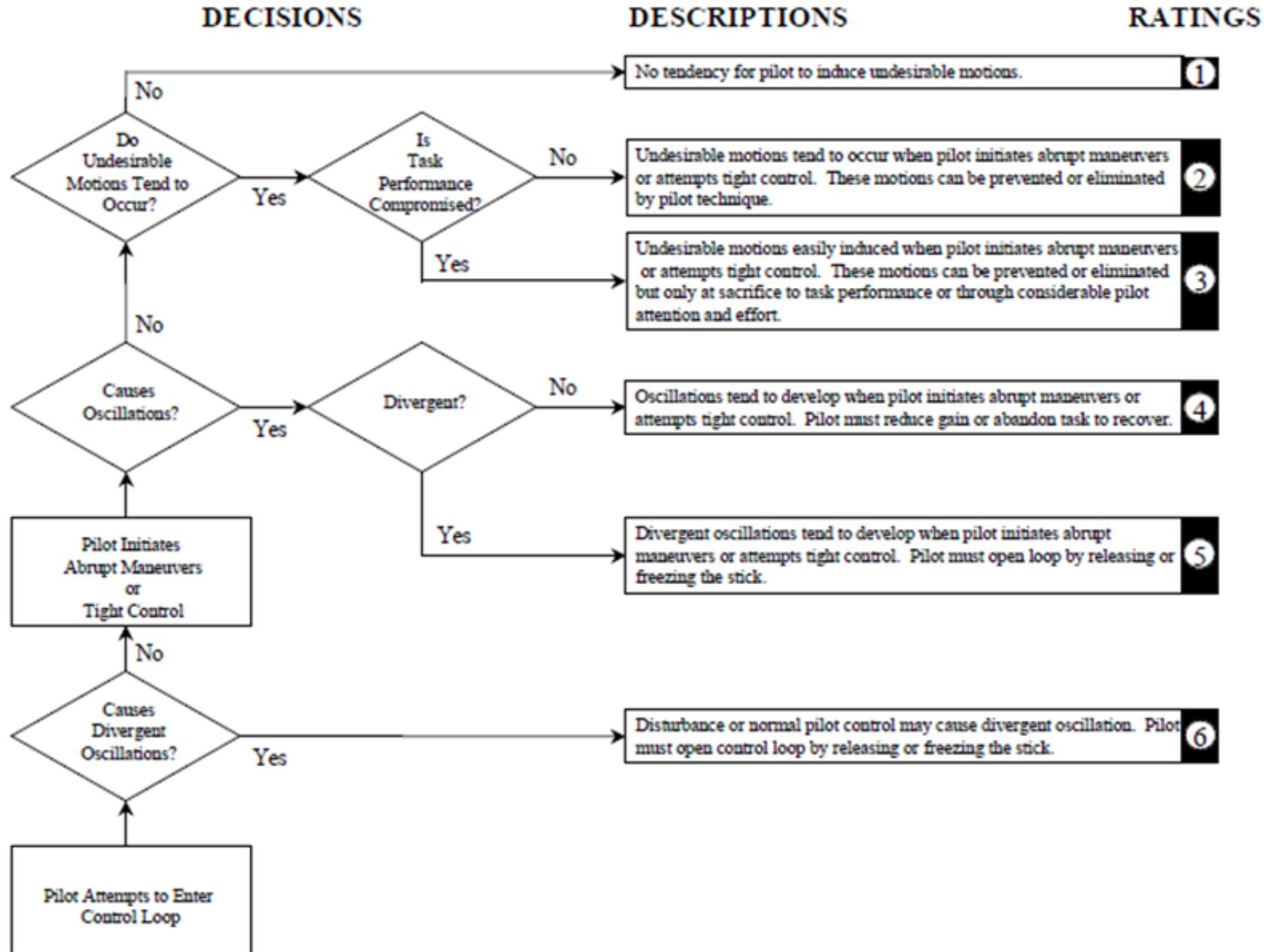
Questions?



Cooper-Harper Rating (CHR) Scale



Pilot Induced Oscillation Rating (PIOR)



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