PROJECT HAVE DOUGHNUT - EXPLOITATION OF THE MIG-21

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The Mystery MiG
Project Background

- The U.S. borrowed a Soviet-built MiG-21F-13 FISHBED E from 23 January 1968 to 8 April 1968
  - The Foreign Technology Division of AFSC led the exploitation utilizing expertise from AFFTC, ASD, TAC, NWC
  - The purpose was to substantiate and supplement existing threat data
  - Included ground and flight testing
  - 102 flights (77 flying hours) in 40 days of flying
  - The U.S. gave the jet back when they were done with it
USAF MiG-21F-13 80965
What did we have?

- HAVE DOUGHNUT was an export MiG-21F-13 (Article 74)
  - The aircraft manufacture date was last quarter, 1963
  - The aircraft had approximately 135 hours on it – the engine had 165 hours
  - No ATOLL missiles included in the deal – substituted AIM-9B Sidewinders (which were almost identical anyway)
HAVE DOUGHNUT Cockpit
On-site Modifications
Performance Sorties 17
Stability & Control Sorties 9
Site-installed instrumentation
- Oscillograph 12 channels - nav light switch/cannon switch
- Gyros Pitch, Roll, Yaw ...plus rates – vertical tail
- Fuel Flow Meters Total and Normal
- Photo Panel Airspeed, Altitude, Mach, Free Air Temp, &
  (in nose) Clock
- Instrument panel A-13 clock, airspeed, altimeter, Mach,
  accelerometer, stop watch, engine fuel temp
- Cockpit two Triad 16mm cameras, voice recording system
- Battery
- UHF radio
Missile configuration

- Non-firing AIM-9B used to replace ATOLLS
- AIM-9 rail with laminated plywood/fiberglass and steel fittings
- No performance change except slight improvement at low speed
Operational Data

- Days Available: 52
- Days Flown: 40
- Days Cancelled Due to Weather: 8
- Days Cancelled Due to Maintenance: 4
- Sorties Scheduled: 134
- Sorties Flown: 102
- Sorties Cancelled Due to Weather: 21
- Sorties Cancelled Due to Maintenance: 11
MiG-21 Flight Test
## Sortie Breakdown

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>USAF Tactical</td>
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<tr>
<td>USN Tactical</td>
<td>25</td>
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<tr>
<td>USAF Performance, Stability &amp; Control</td>
<td>26</td>
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<td>Air Defense Command</td>
<td>4</td>
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<tr>
<td>Strategic Air Command</td>
<td>2</td>
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<tr>
<td>Infra Red</td>
<td>9</td>
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<tr>
<td>Radar Cross Section</td>
<td>1</td>
</tr>
<tr>
<td>Photo</td>
<td>1</td>
</tr>
<tr>
<td>Acceptance Flight</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Sorties</strong></td>
<td><strong>102</strong></td>
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</tbody>
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AFFTC Lessons Learned

- Power checked at Mil power prior to brake release..brakes would not hold in afterburner
- Rudder effectiveness occurred at 45 kt
- Nosewheel liftoff at 114 KIAS (with full aft stick)
- At 15,400 lbs, with 30 degree (full) flaps, takeoff speed was 165 KIAS
- Afterburner would not light when selected until after military thrust was achieved
- Stabilator was the only trimmable control surface
- The engine did not ever stall
Maintenance

- MiG-21 Aircraft at Test Site: 75 days
- Reassembly: 15 days
- Bell Mouth Ground Run: 3 days
- Disassembly: 5 days
- Aircraft Available to Fly: 52 days
- Scheduled Maintenance (50 hr insp): 2 days
- Unscheduled Maintenance (susp engine prob): 2 days

Six men serviced and maintained the MiG-21
Maintenance Discrepancies

- 12 Feb 68  #1 Boost pump inoperative
- 24 Feb 68  EGT Malfunction (harness frayed)
- 28 Feb 68  Frayed brake cable
- 5 March 68 Oil System (6 sorties lost)
- 11 Mar 68  EGT Malfunction
- 27 March  EGT malfunction

The oil system did not malfunction...unfamiliarity with the aircraft made a clogged oil filter seem like a major problem

Still, only 11 sorties lost. The U.S. jets didn’t come close to that
Findings: the bottom line
MiG-21 Good Features

- Simplicity; Ease of Flying – It’s a good, honest aircraft!
- Reliability and Maintainability (20 minute turn around)
- Cross-Sectional Area
- Engine Exhaust Smoke
- 3-wheel brake concept
MiG-21 Shortcomings

- Visibility
- Engine Response
- Low Altitude Transonic Vibration
- Formation Flying
- Flying in Turbulence
- Night Flying
MiG-21 “Unique Design Features”

- Very Low Wing Loading (50-55 psf)
- Lacquer Coating for Corrosion Prevention
- Ejection System (SK-1 seat and canopy)
- Air Intake (3-position, normal, Mach 1.5, Mach 1.9)
- Seat Position
- Low Maintenance Requirements
- No roll, pitch, yaw stability augmentation
- Cooled Navigation Lights
- Optimized Cross Section
- Smooth only where it needed to be
U.S.A.F. and U.S. Navy
Responses to the Project
What did we do?

- The Navy created TOP GUN in 1969 and experienced strong results against the MiG-21 when they encountered it in 1972.
- The Air Force did not create a dissimilar air combat program until 1972/73.
- In June/July 1972, the Vietnamese MiG-21 held a 9:1 air-to-air kill ratio over the USAF.
- The Air Force created Red Flag to give its pilots a better edge in the fight.
What we learned

- **G-load factor**: 8gs without stores, 6 with stores
- **Max indicated airspeed**: 595 kt below 15,000 ft, 640 kt above 15,000 ft
- **Maximum indicated Mach**: 2.05 without stores, 1.6 with stores
- **Strike radius**: 370 NM with external fuel
- **Poor forward and rearward visibility**: F-4 acquired at 3-5 miles range
- **Low Q limit**: Below 15,000 limited to .98 Mach or 595kt – severe buffet
- **Afterburner puff**: Above 15,000 FISHBED E produces a puff in/out of AB
- **Engine response**: Extremely slow
- **Cockpit noise**: Extremely low
- **Gunsight capabilities**: 3.7NM, missile mode; 1.6NM, gun. Gun/missile target tracking impossible over 3gs
- **Slow speed**: The MiG-21 could maneuver at 115 KIAS
- **Easy to kill**: Non-sealing tanks, unprotected engine, light metal structure, high pressure O2 bottles – 85% kill probability
Comparisons with US aircraft