

Foreign Technology Division

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





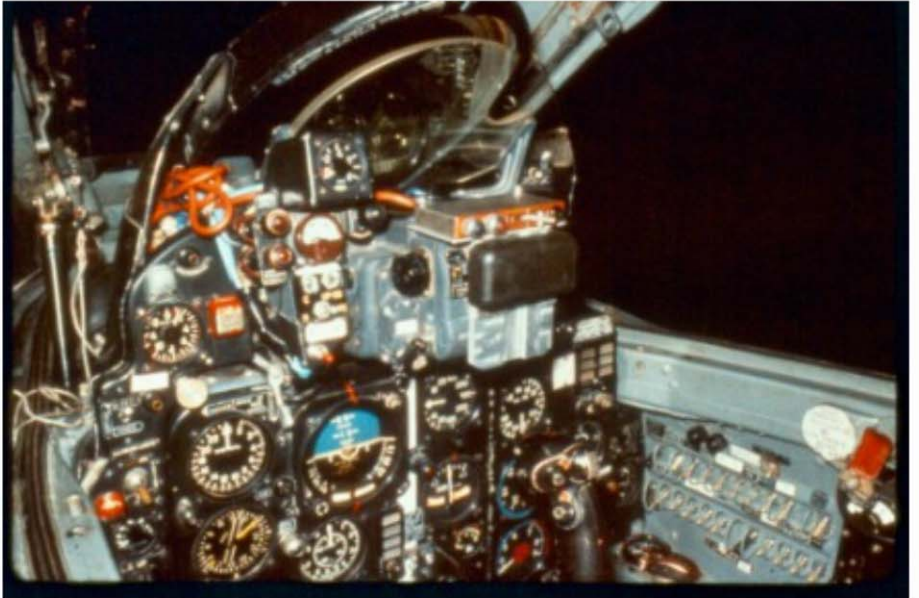
What did we have?

- **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)



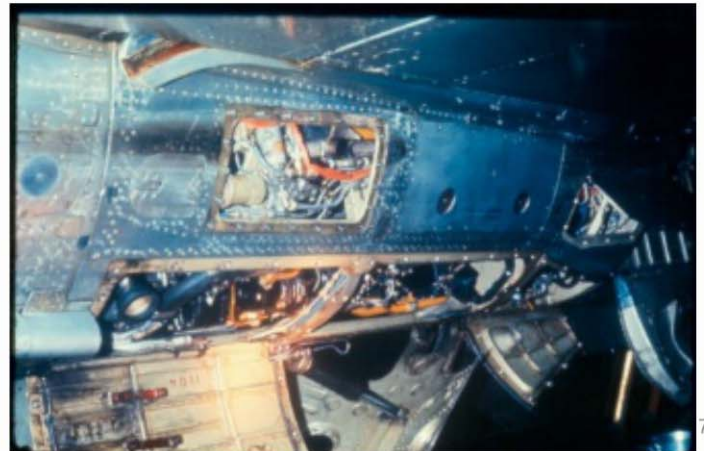


HAVE DOUGHNUT Cockpit





On-site Modifications





AFFTC Performance Evaluation

- **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, &**
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

| | |
|---|-----|
| ■ USAF Tactical | 33 |
| ■ USN Tactical | 25 |
| ■ USAF Performance, Stability & Control | 26 |
| ■ Air Defense Command | 4 |
| ■ Strategic Air Command | 2 |
| ■ Infra Red | 9 |
| ■ Radar Cross Section | 1 |
| ■ Photo | 1 |
| ■ Acceptance Flight | 1 |
| ■ Total Sorties | 102 |



AFTC 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
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- 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

