U-2 and SR-71
A COMPARISON

Stormy Boudreaux
U-2 Pilot #373
SR-71 Pilot #51
**U-2**

- High Performance Powered glider
  - 26:1 glide ratio,
    - the glide range from +70’K is beyond the visual horizon (+225 nm)
    - taking 2 hours to descend at trimmed spd
  - Extreme light construction
  - High power to weight ratio,
    - R and later S models ~14,000lb empty with 19,000lb thrust
    - “C” was ~11,000lb empty with same 19,000lb thrust
    - Coffin Corner “C”
    - ±3kts from mach buffet to stall buffet
  - Landing difficulties
    - Even Greater Taxiing difficulties (189’ turn radius)
  - Myths
U-2A
U-2 First Article
U-2C and U-2R
U-2 “C” and “R”
Very different aircraft

• U-2C
  – 80’ wingspan
  – Partial Pressure suit
  – 11,000 empty wt
  – 500 lb payload
  – Coffin Corner ±3kts
  – Drag chute
  – Porsche
  – Won fly-off to 20,000’ the F-4

• U-2R
  – 105’ wingspan
  – Full pressure suit
  – 14,000 empty wt
  – 5,000 payload
  – Expanded flt envelope
  – Spoilers
  – Cadillac
  – Too much fuel for comfort, even better with “S” J-118-101
MODULAR PAYLOAD CAPABILITY

E-BAY PAYLOAD
- LN-33 PIII INS
- NAS-21A ANS
- EWS

NOSE PAYLOAD
- CAMERAS
  - E/O
  - IR
- ASARS-2
- SPAN
- DDL

Q-BAY PAYLOAD
- IRIS III
  24 IN PANORAMIC CAMERA
- "H" CONFIG.
  66 IN FRAMING CAMERA
- OBC
  30 IN PANORAMIC CAMERA
- AIR SAMPLER
- UHF CTT RADIO RELAY
- MISSION RECORDER

SUPERPOD PAYLOAD
- SENIOR SPEAR
- SENIOR RUBY
- INTEROPERABLE DATA LINK
- DUAL DATA LINK
- SPUR LINK
- INTEROPERABLE DATA LINK
- DUAL DATA LINK

UNCLASSIFIED
U-2S Steam Gages
U-2S Block 20 (RAMP)
U-2D (one of only two)
U-2C (Larger intakes, J-75 Engine)
Loading camera in Q-Bay
U-2C Landing on Carrier
US Ranger
US America CVA-66
U-2R Wing Fold
DIRTY BIRD
DIRTY BIRD
Last U-2C 56-6701 in USAF Offutt AFB Museum in 1982
SR-71

- Glide – like a log curve
  - 70,000’ @ Mach3, if both engines flamed out
    - 3.0m = ~3100ft/sec (That’s 0.5nm in ONE second)
    - 77 NM surface impact!

- Easy Landing
- Ti presented problems
- Max Attention at Cruise
  - Unstarts
  - Pitch up at 3.2m
- Environment - Mach Hold, Turbulence
Sinister
SR-71 Development Problems

- No hydraulic fluid to meet specs
- Fuel
  - vapor pressure/relight
  - Ignition System - (TEB) Triethyl Borne (pyrophoric)
- Cooling for Crew/Avionics/Hydro/Oil
- Unstarts – highly reduced inlet airflow
  - Instant chop of ~50+% of thrust on one side
- Continuous AB for supersonic cruise
- Tires - white walls
- DAFICS (Digital Auto Flight and Inlet Control System)
Conical Camber
Canted Spikes
Delta Wing - Fore-body Chines
Pre-1981 White Letters
13 Fireballs - RAF Mildenhall Airshow 1985
Glowing
SR-71 Uniqueness

- Inlets – turbo-ramjet propulsion system (Hybrid)
- Ti Structure
- Stealth:
  - Chines, canting v-tails inward (initially tails were all composite later replaced with Ti)
  - RAM were incorporated into sawtooth shaped sections of the skin of the aircraft
  - RCS was much greater than the F-117, but about 1/13th that of the U-2.
  - IR was Big issue
- Fuel
- Astro-Inertial Navigation System (ANS)
- Sensors
FORE BODY CONSTRUCTION
Wing Raised to Access J-58
A Letter to Kelly
History

- Cold War – Need for accurate intelligence on Soviet capabilities
- U-2 becoming vulnerable to Soviet SAMs
- CIA and Air Force issued requirement for new reconnaissance aircraft
- Lockheed won competition over General Dynamics
- Development started in 1958
Lockheed’s Oxcart Configuration Evolution

- **Jul 1958**: Archangel 1
- **Sep 1958**: Archangel 2
- **Nov 1958**: Archangel 3
- **Dec 1958**: Archangel 4
- **Dec 1958**: Archangel 5
- **Jan 1959**: Archangel 6
- **Jan 1959**: Archangel 7
- **Feb 1959**: Archangel 10
- **Mar 1959**: Archangel 11
- **Jul 1959**: Archangel 12

- **(2) Turbojets**
Oxcart Flight-line
Blackbird Concept to Reality Timeline

Records 1965:

- 500 KM Closed Course: 1643
- 1000 KM Closed Course: 1689
- Height @ Sustained Level Flight: 80,258
- World Absolute Speed Record: 2070 MPH (1966)

10,000NM in 6 Hours (1966)
Problems Overcome

- HEAT!
  - Temperature increase dramatic above Mach 2.5
  - Titanium structure chosen for strength and heat resistance
  - Special fuel, engine oil, hydraulic fluid required
  - Cooling of cockpit and sensitive equipment by fuel-air heat exchanger
  - Pre-heating of camera ports required
  - Landing gear buried in tubs surrounded by fuel to insulate wheels and tires
SR-71 BLACKBIRDS

SURFACE TEMPERATURES

CRUISE CONDITIONS
AVERAGE SKIN TEMP 550°F

DOEARCH CONDITIONS
AVERAGE SKIN TEMP 550°F

578°
938°
531°
630°
593°
582°L
622°

NOTE:
L DENOTES LOWER SURFACES

DEGREES FAHRENHEIT

400 600 800 1000 1200

UNCLASSIFIED
THRUST AND DRAG DISTRIBUTION VS $M_o$

% PROPELLIVE THRUST
($F_N - D_{INLET}$)

MAX A/B

0-1

2-3

3-4

0-1

SUBSONIC LOITER

CLIMB SPEED

HIGH SPEED

09-17-04
SR71-48
First Real Stealth Aircraft

SR-71 Graphite Airframe Material

Figure 4-5. Composite-Honeycomb Areas of the SR-71
ASTRO-INERTIAL NAVIGATION

• ASTRO-INERTIAL (ANS) developed from system originally intended for Skybolt missile.
• Major technological breakthrough was 64K memory board.
• Almost as accurate as current GPS, but not dependent on vulnerable satellites.
• Constantly updates inertial platform by sequentially tracking pre-programmed stars, **day or night**.
Sensors

- Radar/ASARS – capable of submarine ID at 100 miles range, or ID aircraft in open hangar
- Cameras:
  - TROC – 6” focal length, 9” wide film
  - OOC (2) - 13” focal length, 70mm film
  - TEOC (2) – 48” focal length, 9” film, 6” resolution
  - OBC – Horizon to horizon coverage – 100,000 sq mi per hour (OBC nose interchanges with radar nose)
- ELINT – coordinated missions with RC-135
100,000 Sq Miles
The OFFICE
Crew Selection Process

• Application
• Interview at Beale with squadron and wing leaders
  – *Flights in T-38 (instruments and formation)*
  – *SR-71 simulator flight*
• Intensive physical exam (same exam given to astronaut candidates)
• Final approval and class assignment
GETTING STRAPPED IN
ENGINE IGNITION w/ TEB – BUICKS for STARTER
RUDDERS and MODULAR NOSE
PRE-TAKEOFF CHECKS
KADENA AB
ENGINE RUN-UP
CLEARED For TAKE-OFF
200 Kts, 70,000 lbs Thrust and 90,000 Lb/Hr FF
NIGHT TAKEOFFS - SPECTACTURAL
210kt NOSEWHEEL LIFT OFF
250kts AIRBORNE - RETRACT GEAR
GEAR - On the WAY UP!
450kt CLIMB
OUT OF SIGHT in a HURRY!
FUEL LEAKED WHILE AIRCRAFT COLD
OFF TANKER – LIGHT THE BURNERS and ACCERATE
BLACK ABOVE Stars in daytime
Major Theaters of Operation
YOU COULD ALWAYS TELL WHEN CHUTE POPPED
SR-71 Records

- April 1971 – 15,000NM in 10.5 hours
- Sep 1974 – New York to London in 1 Hr and 55 Min
- Sep 1974 – London to Los Angeles in 3 Hrs and 45 Min
- July 1976:
  - 1000KM Closed Course – 2092 MPH
  - Sustained Altitude in Level Flight – 85,069 Ft
  - World Absolute Speed – 2193 MPH
- Mar 1990 - Los Angeles to Washington in 67 Min, 54 Secs
World Absolute Speed Record
Lockheed SR-71A 64-17958
2193.167 mph
28 July 1976
SR-71 Into Sunset