Honeywell INS

The untold story

Above: A-12 and YF-12 aircraft lined up at the Nevada test site in late 1963. Aircraft are lined up in numerical order by tail number, with the third YF-12 and last three A-12s still yet to join the fleet. Also missing are airframe 06925 (on RCS test range) and 06926 (lost in an accident earlier that year).

Courtesy RR!

Background

Most people's perception of the Blackbird, aka the A-12, project Oxcart, is of the unique delta wing airframe, the large engines, the inlet system and its phenomenal speed and altitude.

However, little thought is given to other systems that allowed this magnificent, revolutionary aircraft to perform its mission. One of the most important systems was the Honeywell Inertial Navigation System (INS), project H-330.

The INS allowed the pilot to fly his mission at Mach 3.1 on auto pilot and without his intervention, something that was not feasible at the time.

The author spent four years at Area 51, from February of 1964 to the end of the Oxcart project, in June of 1968, working for Honeywell on the INS.

I would like to thank Honeywell's Stan Moeschl and Russ Buyse for their contributions to this article.

History of the A-12's Inertial Navigation System (INS)

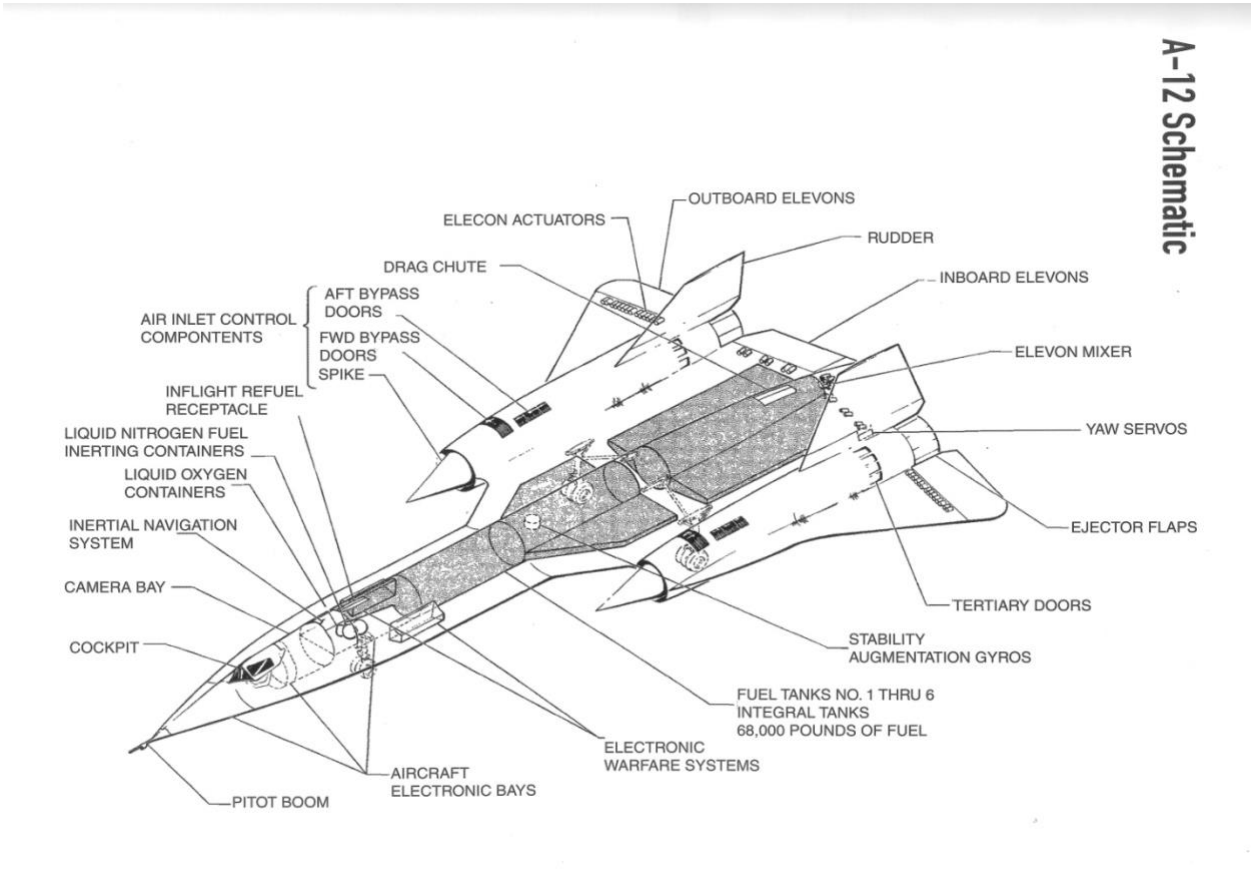
Inertial Navigation Systems started to find limited applications in the late 1950s. The applications were normally highly classified and had some form of military use. The systems were also very expensive and large. The uniqueness of the INS is that it uses no external navigation aids, nor does it transmit any external signal. The A-12 was a spy plane, whose purpose was to go completely undetected during flight, so it had to be nearly invisible to all forms of detection. Transmitting any electronic signals would have made the aircraft vulnerable.

Honeywell's A-12 Oxcart adventure began in late 1959. Two engineers from Lockheed (in reality one of the engineers was not a Lockheed engineer, but a rep of the CIA!) visited our facility in St. Petersburg, Florida and were very interested in Honeywell's digital inertial navigation system, which we were developing with our internal development funds. They wanted to know the weight, volume, accuracy, and cost of the system. They also asked when it would be ready to fly. We provided them with all the data they requested.

About a month later we had a call from Washington, D.C. asking if we could meet with some engineers and managers at a fish market on the Potomac River. We met with four individuals from the CIA for an afternoon. At the end of the meeting they asked if we could be ready to fly by 1962 and could we meet a navigation error rate of one nautical mile per hour. Our answer was yes to both. They instructed us to open a post office box in Largo, Florida, in the name of Midwest Engineering and we would receive further instructions.

In early 1962, Honeywell's INS was ready to fly, but the A12 wasn't quite ready. We were to begin flight testing in a Lockheed Jet Star, but before we could get the INS installed in the Jet Star it crashed. Our next flight test vehicle was a U-2 piloted by Francis Gary Powers. Powers was a workaholic, taxiing up and down the runway at Burbank and flying Burbank to Seattle and back twice a week. We discovered a major problem with the system which was confirmed at the Honeywell facility in Florida. After a fix was developed and installed in the INS, we continued our flight testing in the U-2. At the completion of flight testing at Burbank, four Honeywell engineers went to Area 51 to set up the INS lab and start flight testing there. The rest is history. *

**Stan Moeschl, RRI bio*

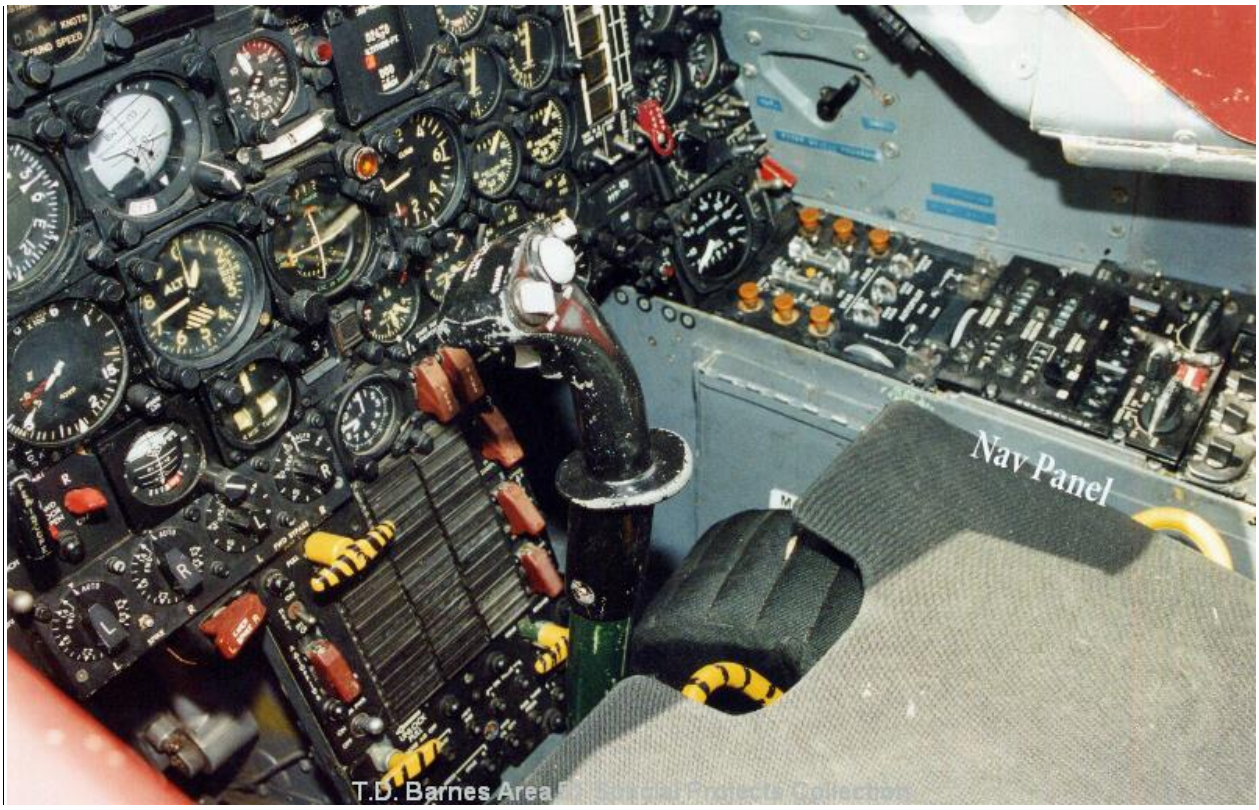


Details of the A-12's INS

The INS was located in the E-bay of the A-12 directly above the front landing gear. The INS consisted of six boxes along with the cabling that interfaced the boxes with each other and the instrumentation located in the cockpit. The boxes were fastened in a cage assembly, which was approximately a cubic meter in volume and weighed close to 200 pounds. To replace the INS, a crane was used to lift the cage assembly out of the E-bay.

The INS interfaced with the pilot through four different pieces of equipment:

1. The Navigation Panel, located on the right console of the cockpit, (see picture), which portrayed the aircraft's destination and present position in latitude and longitude coordinates and controlled the various operating modes of the INS.
2. The Distance-to-Go indicator, which was on the front instrumentation panel, and gave the pilot continuous ground speed and distance-to-go to the next way point (intermediate destination) or to the A-12's final destination;
3. The Attitude/Heading indicator, also located in the front instrumentation panel, which gave the pilot the aircraft's attitude in three dimensions and the true heading to the next waypoint.
4. The Destination Select Panel, also located on the front instrumentation panel, which allowed the pilot to select waypoints out of the normal preplanned flight path.


Nav Panel
T.D. Barnes Area


DTG Indicator
Dest Select Ind
Attitude/Heading Ind.
T.D. Barnes Area 51 Special Projects Collection

How the INS Guided the A-12

During preflight, the present position was loaded in the INS computer, along with the waypoints and final destination of the mission. Before engines were started the pilot placed the INS in the 'Nav Mode' and the 'Stored Auto' mode, which allowed the INS to automatically select destinations in the sequence determined by the mission planners.

After the pilot completed his preflight checklist, he taxied the A-12 to the end of the runway. After clearance for takeoff was obtained and all systems were go, the pilot advanced the throttle, which activated the afterburners and the A-12 was airborne.

One of the initial destinations was the location where the A-12 was to be refueled by a tanker. After the required fuel was transferred, the pilot again activated his afterburners, placed the autopilot in the Auto Nav mode, and ascended to cruising altitude (normally approximately 80,000 feet) to start the designated flight path as loaded during preflight in the INS computer.

The INS commanded the auto pilot to steer the A-12 to the next selected destination. As the aircraft approached the destination, at the calculated point, the next destination was automatically selected and the INS commanded a 30 degree bank to turn the A-12 to that new destination. With the aircraft at cruising speed, the next destination was selected well before the destination was reached as the turn radius of the A-12 was approximately 75 miles at cruising speeds. The destinations defined the flight path, not the desired locations where the A-12 flew. This process continued until all previously stored destinations were automatically selected with the last destination being the location of the landing position. Normally, the final destination was the same as the takeoff point, as the aircraft was highly classified and required specialized ground equipment.

My Personal Contribution

In the fall of 1965 and early 1966, preparations were being made to make the A-12 operational, but many problems remained and Lockheed and its sub-contractors, began feeling increased pressure from the "customer" (CIA), to correct these problems…or else!

The INS was one of the major aircraft systems, and when it failed, it was an automatic mission abort. Most of our failures were due to our Navigation Panel, located in the right hand console of the cockpit (see picture). The failure consisted of the Present Position and Destination counters for latitude and longitude, freezing up and causing an abort of the mission. Imagine the pilot not knowing where he was, while flying at Mach 3 and 80 thousand feet of altitude.

We took a lot of heat from the "customer" on this issue and since the Navigation Panel was my responsibility, I took on the challenge of correcting the problem. What made the problem difficult to correct, was that once the defective panel was removed from the aircraft and brought to the shop, it would work perfectly every time.

My investigation of the testing procedure at the plant in Florida, revealed that the panel was tested while blowing cold air on it. This was just the opposite of its operational environment in the cockpit's right hand console, where I suspected the temperature was around 90-120 degrees F. Of course, I had no proof of any of this, but I felt very confident of my theory that the electromechanical stepper motors used to drive the Present Position and Destination counters were heat sensitive and causing the failure.

I set about changing the test procedure at the plant, something that normally would take an act of congress, but with the pressure being exerted by the 'customer", my boss, Palmer Hanson, told me to write a new test procedure, and he would make sure it was implemented. My name was already known back at the plant because of the many long memos I had written over time regarding different problems. Of course, people back at the plant had no idea how or where, the INS components were being used.

I flew back to the plant in Clearwater. Florida, and wrote a new test procedure which used a "Rube Goldberg" oven made of cardboard and lined on the inside with aluminum foil. One end of the box had a hole for a hair dryer to blow hot air in and an exhaust hole in the other end. The Navigation Panel was placed inside this "oven" and tested for about 20 minutes. I crossed my fingers and prayed that this would solve the problem.

The new test procedure solved the problem with the Navigation Panel, something that to this day I am very proud of. However, looking back now, I am amazed at how crude the tools were that I used to solve a very critical problem in a very important and classified program.

Honeywell

Ode to the A12

Back in the days of the cold war, the bird,

Looked like something from another planet.

Area 51 was home to its secrets.

Call it a triumph of cutting edge technology.

Kept under wraps except for the chosen few,

Buck Rogers would be envious.

Impossible to shoot down,

Reconnaissance brought back unchallenged.

Daring though it was… it died a premature death

Erik M. Faraldo
Area 51, 1964-1968