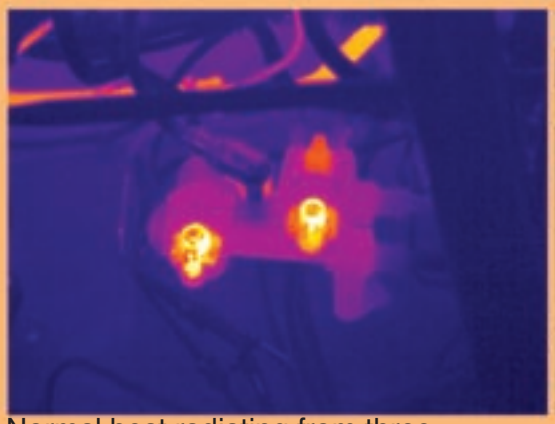
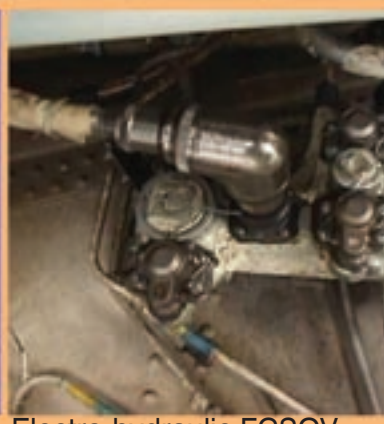
Troubleshooting Aircraft Systems With Infrared Thermography



Normal heat radiating from three solenoids



Electro-hydraulic FCSOV tested under identical flight operations.

By Jed Figg

S-3B technical representatives from Naval Air Technical Data and Engineering Service Command (NATEC) 3.7 Detachment North Island, Calif. and Detachment Jacksonville, Fla., are using infrared (IR) thermography to detect and predict component failures on aircraft systems. NATEC Detachment North Island formed an infrared team three years ago and targeted the T-56 engine, S-3B, and FA-18 aircraft components. Although the primary focus has been on electrical circuits, environmental-control systems, and engine performance, the concept has expanded to the H-60 and E-2C aircraft. However, future applications are envisioned for every area of naval aviation

The primary objective for the NATEC IR team is to establish procedures that will benefit the Navy's entire inventory of aging aircraft, expand the process to include non-destructive inspections (NDI), and push to make IR technology a fleetwide troubleshooting tool. The IR team is collecting baseline data from all platforms to archive and use for comparative studies.

How does it work?

Every object around us releases thermal energy to the environment in the form of invisible, radiant energy. As an object heats up, it will radiate progressively more energy from its surface. We are able to feel infrared radiation, although it cannot be seen in the visible spectrum without an infrared device. The technique for making radiation visible is called thermal imaging or infrared thermography (IRT).

Thermal images are pictures of heat, rather than light. The measurement principle is based on the fact that any physical object radiates energy at infrared wavelengths—within the IR portion of the electromagnetic spectrum. Thermal cameras can measure and see emitted infrared radiation in electrical devices that have been energized. Surface temperature distribution is recorded in the form of a high-resolution thermogram. The ability to radiate heat is a property called emissivity, and some materials like aluminum or polished metals may radiate little energy, despite their high surface temperature, because their emissivity is low.

Advantages

Commercial aerospace companies widely use IRT to inspect composites for cracks or corrosion and electrical anomalies. NATEC 3.7 has adapted many of these same principles and applied them for troubleshooting in naval-aviation maintenance. Thermography, regardless of the name, is a type of non-destructive inspection that has proven very effective. Using this high-tech, non-intrusive and non-invasive camera to evaluate electrical circuits, pneumatics, hydraulics, engine performance, and aircraft structural defects gives us several advantages. It is a simple, advanced method of analysis: you just stand back, point and click. The high-resolution thermal camera is about

Photos by Jed Figg/NATEC Det North Island

Only two operating solenoids are seen here.

the size and weight of a modern camcorder that can videotape, photograph and store thermal images on an onboard digital storage device. With IRT software, the technician can analyze and study the images on a PC or laptop computer.

Preventive or predictive maintenance?

IRT can be classified as both types of maintenance since it is hard to evaluate accurately the potential savings. For years, surface-Navy engineers have used IRT, enabling maintainers to remove and replace components identified as potential failures. This process is identified as predictive maintenance (PdM).It saves moneybecause you can calculate what the unit replacement cost would be if it failed completely. The IRT maintenance theory is designed to detect possible defects before the problem becomes a major discrepancy or catastrophic failure. Archived data now can become an essential part of the existing maintenance record and can be prioritized as to the repair.

This process has made systems more reliable and minimized downtime spent repairing the systems. Naval-aviation maintenance departments have not experienced the true state-of-the-art benefits of IRT. This partly is due to the "we've always done it this way" mentality. The reality is that most technicians are unaware of the technology. As operational tempos increase and technicians become scarce, we constantly are reminded and tasked to do more with less. It is

The Naval Safety Center is dedicated to reducing mishaps by 50 percent in two years.

Flight, Flight-Related, and Ground Class A Mishaps 08/22/2003 to 12/12/2003

Aircraft	Command	Date
S-3B	VS-31	08/24/2003

Aircraft struck ground shortly after rotation with landing gear retracted.

FA-18C	VFA-25	09/05/2003

Aircraft had a stuck throttle in flight, and pilot ejected as aircraft departed runway upon landing.

EA-6B	VAQ-141	09/06/2003

Aircraft out-of-control flight at runway threshold after flying through another aircraft's wake turbulence.

E-2C	VAW-120	09/11/2003
F-14D	VF-101	09/11/2003
FA-18D	VFA-106	09/11/2003

Hornet lost at sea following failed carrier arrested landing. Pilot ejected. Other aircraft damaged.

FA-18A	VMFA-115	10/15/2003

During BFM, two aircraft struck water. Both aircraft destroyed.

UH-1N	HMLA-367	10/22/2003

Aircraft struck ground on waveoff during a simulated troop insert.

S-3B	VS-31	11/21/2003

While repositioning an aircraft towing dolly, Sailor crushed between store and dolly.

AV-8B	VMA-211	12/03/2003

Pilot ejected on final due to controllability problems. Minor injury.

AV-8B	VMA-211	12/08/2003

During flight, pilot ejected. No injuries.

Class B Mishaps 08/22/2003 to 12/12/2003

Aircraft	Command	Date
F-14B	VF-32	08/22/2003

Aircraft sustained hail damage during return to base.

AV-8B	HMM-264	08/29/2003

Bird damaged LITENING II targeting pod during flight.

UH-3H	PMRF HAWAII	09/04/2003

Captive BQM-74 departed aircraft in flight. No injuries.

Continued on page 29