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Three sides of the cargo door aperture are intact

United 747: cargo door suspected

US accident investigators are
concentrating on the forward
cargo door as the possible
source of the cabin structural
failure suffered by a United
Airlines Boeing 747-100. A
bomb, fatigue failure, and
corrosion have all been
discounted.
Nine people died in the
rapid cabin decompression at
23,000ft caused when a 10ft
by 20ft hole appeared in the
starboard side.
The National Trans-
portation Safety Board is not
sure whether the cargo door
failed first, or followed the
fuselage panels. Last summer
the Federal Aviation Admini-
stration issued an Airworthi-
ness Directive (AD) ordering
airlines to inspect cargo-door
lock systems on early 747s
after one partial inflight fail-
ure. The United aircraft,
N4713U, had apparently
undergone inspection of its
cargo-door locking systems,
but modifications ordered in
the AD had not yet been
carried out.

United Flight 811 from
Honolulu to Auckland, New
Zealand, carried 336
passengers and 18 crew.
According to the crew, about
20min after take-off and 70
miles out the captain heard a
thump passing through
22,000ft and the aircraft
yawed to port, followed by
number three engine failure.
There was a fire in number
four engine, and, after jetti-

soning fuel, the crew landed
back at Honolulu just over an
hour after take-off.
United immediately
announced a programme of
detailed technical inspections
of 747 door mechanisms.
Additionally, the airline
directed that a mechanic
should inspect every 747
cargo door on arrival at
destination and personally
oversee the door closing for
departure. The NTSB does
not expect to recover the door
involved, which is in 16,000ft
of water.
The 747 was the 89th built
by Boeing and the sixth deliv-
ered to United in November
1970. It had accumulated
58,815hr and just over 15,020
cycles. Boeing says that a
"high-time" aircraft of similar
age to the United 747 would
typically have registerd
79,000hr and 26,000 cycles.
The United aircraft was
built using the cold-bonding
process which has been widely
questioned following the
massive Aloha Airlines 737
roof failure last year. The pro-
cess uses a cold-temperature
adhesive to fasten over-
lapping panels of fuselage
skin. Later experience indi-
cated that cold bonds tended
to separate slightly and to
suffer corrosion. Cold bond-
ing was replaced by hot bond-
ing for all Boeing aircraft after
1971, but the accident aircraft
was one of 169 cold-bonded
747-100s.

USA and UK

reveal advanced

STOVL plan

by Julian Moxon
in Washington D.C.
The USA and UK have agreed
the future direction of their
advanced short take-off and
vertical landing (ASTOVL)
research. It is the first major
result of the January 1986
agreement between the two
countries to co-operate on
future ASTOVL research.
A bilateral government team
studied four different
propulsion systems proposed by
industry teams in both countries
(advanced vectored thrust,
remote augmented lift, ejector
augmented lift, and hybrid
tandem fan). Its conclusions do
not specifically favour any one
concept, although the hybrid
tandem fan was eventually
rejected because it had
"significantly higher risks"
without offering enough
performance gain.
The team finds the best solu-
tion comes with a "mixed flow"
engine (with core and bypass
airflows mixed before exit at the
nozzle) located in the traditional
position for a supersonic fighter
aircraft—at the rear of the fuse-
lage. One or more remote
nozzles ducted off the engine
would be used to balance the
aircraft during vertical flight.
"We were not striving for an
unconventional concept," says
Jack Levine, NASA's flight
projects director, and co-
chairman of the US/UK joint
working group. "This is a super-
sonic fighter that has vertical
landing capability. We have
agreed on a simple, elegant
solution arising from the need
to balance the aircraft in
jetborne flight."
One concept, however, was
selected for separate devel-
opment by Harrier II prime
contractor McDonnell Douglas
because it had "special merit".
This is a version of the
"four-poster" system used on
the Harrier, in which fan and
core flows are exhausted sepa-
rately through front and rear
nozzles. McDonnell Douglas'
proposed mixed-flow vectored-
thrust idea combines both flows
in a common plenum chamber
before discharge.
The next step will be to

develop a joint US/UK
programme to look at seven
critical technology elements of
the mixed-flow /remote-lift
concept. The plan should be
complete by the end of this year,
and may, says Levine, include
definition of an- experimental
research aircraft. "There are
very preliminary discussions in
both countries" on a flying test
vehicle, he says.
The technology programme
should culminate in 1995 with a
technology base that would
support a service requirement
for an ASTOVL supersonic
fighter. The US Air Force
(which took part in the recent
study) is developing its own
research programme for a
STOVL fighter to complement
the Advanced Tactical Fighter
early in the next century. The
service had no comment on
whether it would take advan-
tage of the UK/US research.
The seven main elements are:
• diverter valves and transfer
ducts;
• aircraft and ground environ-
ment;
• hot gas ingestion;
• aircraft controls and
handling qualities;
• propulsion controls;
• nozzles;
• STOVL augmentors.
In assessing the various
ASTOVL systems, the team
noted that Harrier-type short-
coupled propulsion systems
located astride the aircraft
e.g. "significantly compromise
design flexibility from many
points of view, particularly
supersonic performance,
manoeuvrability, and stores
carriage". The great advantage
offered by a remote-lift system,
says Levine, is that it provides
flexibility in engine location to
allow for balance and volume
distribution.

A mixed engine flow for
cruise flight was considered
important because separate core
and bypass nozzles are, accord-
ing to the study, "likely to lead
to higher afterbody drag, and
the core nozzle may subject
parts of the rear of the aircraft
to very hot, high-energy jets".
Non-reheated mixed-flow

supersonic fighter engines are

2 FLIGHT INTERNATIONAL, 4 March 1989