

Booster burnthrough caused Shuttle explosion

HOUSTON

Nasa believes that burnthrough of a solid rocket booster caused the catastrophic explosion which destroyed *Challenger*, killing its crew of seven little more than a minute into the 25th Space Shuttle mission.

The external tank containing liquid hydrogen and liquid oxygen exploded with such force that, for an hour after, recovery ships and aircraft were prevented from entering the impact area by debris falling from high altitude.

Mission 51L lifted off at 1138hr local time on January 28. The day was clear, but cold, and the first 70sec of flight appeared normal. About 50sec after launch *Challenger's* three main engines were throttled back to 60 per cent thrust as the Shuttle experienced maximum air pressure.

Some 15sec later the engines were throttled up to maximum 104 per cent power as air pressure diminished. Shortly before the explosion the crew received the standard call from mission control, "*Challenger*, go at throttle up," indicating that telemetry reported engine performance as normal.

At 72sec after lift-off, just after commander Dick Scobee made the standard reply and the last words from *Challenger*, "Roger, go at throttle up", the base of the external tank appeared to catch fire. The fire spread rapidly, and the forward liquid oxygen tank exploded, engulfing the Shuttle in flames.

Film released by Nasa reveals that more than 10sec before the explosion a plume of flame appeared near the base of the righthand booster, playing like a blowtorch over the external tank. Nasa believes that this flame burned through the tank, causing a liquid hydrogen leak, the resulting fire spreading forward to ignite the highly explosive liquid oxygen tank.

Initially the boosters appeared to emerge unscathed from the fireball that engulfed *Challenger*, only to be deliberately destroyed 30sec later by the range safety officer, a standard procedure which

may have robbed Nasa of valuable evidence.

Nasa at first discounted a possible booster failure, saying that telemetry had indicated "reasonably nominal" thrust. Later analysis showed that combustion pressure in the righthand booster had dropped by about 10 per cent before the explosion. The burnthrough is thought to have occurred at the bolted joint between two booster segments.

Attention is now focussed on possible ice damage to the booster while still on the launch pad. Nasa had earlier discouraged speculation that ice was to blame, saying that ice teams had inspected the pad twice on the morning of the launch, including just 20min before lift off, and had reported that low risk was involved. Shuttle was launched without problem in similar icing conditions in January 1984, Nasa said.

The boosters are designed to be recovered, refurbished, refilled, and reused ten times. The boosters for this mission are reported to have been assembled from elements which had flown no more than

three times.

Shuttle was travelling at 2,900ft/sec, 47,000ft altitude, seven miles downrange when the explosion occurred. Nasa immediately formed an interim board of inquiry. Teams were formed to impound and protect data on telemetry, trajectory, launch pad, beach area, debris, Shuttle processing, astronaut corps, main propulsion, solid rocket boosters, and external tank.

The seven-strong crew comprised commander, pilot, three mission specialists, and two payload specialists, one of whom was Nasa's first "citizen astronaut", a US teacher.

Commander Dick Scobee, 46, was pilot on *Challenger* mission 41C in April 1984 when the Solar Max satellite was repaired in space. Pilot Mike Smith, 40, was on his first Shuttle mission. Mission specialist Judy Resnik, 36, became America's second woman in space on *Discovery* mission 41D in August 1984. Ron McNair, 35, was on his second Shuttle flight, having flown on *Challenger* mission 41B in February 1984. Scobee, Smith, Resnik, and McNair

were in the Orbiter cockpit.

In the mid-deck beneath the cockpit was mission specialist Ellison Onizuka, 39, veteran of *Discovery* mission 51C in January 1985. Beside him were Shuttle newcomers Hughes Communications payload specialist Greg Jarvis, 39, and US teacher Christa McAuliffe, 37, selected from 10,000 applicants to become Nasa's first Spaceflight Participant.

Challenger's crew were the first US astronauts to be lost in flight. Nineteen years earlier, on January 27, 1967, the three-man crew of Apollo 1 was killed when the spacecraft caught fire during a test on the launch pad at Cape Canaveral. The deaths of Gus Grissom, Ed White, and Roger Chaffee delayed the Apollo programme for almost two years.

Also in 1967, on April 24, the Soviet Soyuz 1 plummeted to Earth when its parachute failed and cosmonaut Vladimir Komarov became the first space casualty. On June 29, 1971, cosmonauts Georgi Dobrovolsky, Viktor Patsayev, and Vladislav Volkov died before re-entry after a 20-day stay aboard the Salyut 1 space station when their Soyuz 11 descent module depressurised.

On April 5, 1975, during the launch of Soyuz 18, the second stage of the Soviet A-2 launch vehicle failed to separate completely from the core stage, and the two-man Soyuz capsule was hauled clear by escape rockets to land near the border with China. On September 27, 1983, an A-2 booster carrying Soyuz T10 exploded on the launch pad. Again the two-man crew was saved when their capsule was hauled to safety by the rocket escape system.

Shuttle has come close to disaster before. *Discovery* mission 41D aborted on the launch pad on June 26, 1984, as did *Challenger* itself on mission 51F on July 12 last year. When mission 51F was finally launched, on July 29, *Challenger* lost one main engine during ascent, but safely reached orbit. These incidents have only served to underline the reliability and safety of Shuttle's demanding fail-safe systems.

