

Fuel explosion downed Landsat 6 satellite

How might police detectives unravel the cause of a death when they can't find the body or any eyewitnesses? That's the problem investigators faced in the case of Landsat 6, a satellite that disappeared during its launch on Oct. 5, 1993.

Now, after sifting through dozens of potential answers, two review boards have concluded that a fuel line exploded 7 minutes after takeoff, preventing the craft from reaching orbit. The \$220 million Earth-sensing satellite burned up as it plunged back into the atmosphere.

The joint report, released last week, came out of investigations conducted by the craft's builder, Martin Marietta Corp., and by the National Oceanic and Atmospheric Administration (NOAA), which oversaw Landsat 6's development. Although they did not determine culpability, the review boards concluded that propulsion systems like Landsat 6's require more extensive testing than the satellite had received.

The loss of Landsat 6 has hampered a broad community of researchers who rely on satellite images of Earth's surface. They must wait until 1998 for Landsat 7 to replace the partially disabled, 11-year-old Landsat 5.

In their investigations, the review boards focused on the propulsion system for Landsat 6, which used a fuel called hydrazine. For safety reasons, engineers had designed the system to keep pressurized hydrazine within storage tanks during takeoff. Onboard computers would later open a set of valves, allowing the fuel to reach four motors. The motors would separate Landsat 6 from the Titan 2 launch rocket and then control the satellite's orientation as its main engine propelled the craft to its final orbit.

The valves in the propulsion system are called pyrovalves. They work by firing a metal ram toward a plug in the fuel line. The ram knocks the plug out of the way, opening up the line.

The joint report concluded that the firing of one pyrovalve somehow ignited hydrazine in the fuel line. The explosion burst the half-inch-wide tube, preventing fuel from reaching the four orientation motors. As a result, the satellite tumbled out of control when its main engine fired.

The investigators reached that verdict because engineers witnessed an explosion during pyrovalve testing following the Landsat 6 loss. The scenario also

explains why Landsat 6 pulled away from the Titan 2 much too slowly — a fact gleaned from radar observations.

Although common components of spacecraft, pyrovalves have been implicated in a number of failures, including the loss of the \$200 million AT&T Telstar 402 communications satellite on Sept. 8, 1994, and the disappearance of the \$487 million Mars Observer on Aug. 21, 1993. Martin Marietta's Astro Space division constructed both of these satellites, as well as Landsat 6.

The review boards recommended that "any newly designed hydrazine fuel-feed system should be tested extensively." Manufacturers should pay particular attention to the use of pyrovalves in these systems, they warn.

Michael Mignogno, chief of NOAA's Landsat Commercialization Division in Suitland, Md., said engineers did not conduct these kinds of tests on the pyrovalves and hydrazine system prior to launch of Landsat 6.

Because pyrovalve problems have surfaced only recently, some aerospace experts say they, too, would not have performed extensive pyrovalve tests. "I find it very difficult to be critical," says review board member Michael Griffin of Space Industries International in Washington, D.C. — R. Monastersky

Nice guys look better in women's eyes

Researchers studying what women want in a date or mate have often underestimated decent, respectful guys. Many studies have emphasized the importance to women of a man's physical attractiveness and "dominant" behavior, such as assertiveness and talkativeness.

But according to a new study, a man perceived by women as kind and cooperative also tends to get rated more physically attractive and more desirable as a partner than an otherwise comparable fellow seen as selfish and unhelpful.

Dominant behaviors further enhance the attractiveness of nice guys for women but don't improve the allure of unkind men, contend Lauri A. Jensen-Campbell, a psychologist at Texas A & M University in College Station, and her colleagues.

"Past attraction research may not have been designed adequately to examine the complexity of women's interpretation of men's 'personality,'" the researchers conclude in the March *JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY*.

The inspiration for their work comes from evolutionary biology. Charles Darwin argued in 1871 that females of many species evaluate prospective mates far more carefully than males do and look for certain attributes that, over time, get accentuated in males.

Refinements to Darwinian theory have emphasized that, since females usually take primary responsibility for raising offspring, they look for male partners who have both access to key resources and the willingness to devote some of their wealth to child support.

Across cultures, women typically report that they seek mates displaying ambition, industriousness, and good financial prospects — all prime dominance behaviors (SN: 10/12/91, p.232).

Jensen-Campbell's group conducted three related investigations. In the first, 115 female college students viewed videos of prearranged interactions between one of two male college students (one physically attractive, the other physically unattractive) and an experimenter.

The men received higher ratings of physical and sexual attractiveness after behaving altruistically (actively volunteering to watch a boring documentary so that the woman viewing the interaction could watch a popular comedy). Women also rated altruistic men as more desirable dates and friends than nonaltruistic men.

In the second study, 159 female college students viewed scripted encounters between either two men or a man and a woman deliberating a hypotheti-

cal criminal case.

Women rated a designated man as more physically and sexually attractive if he solicited his partner's opinions, showed sensitivity to his partner's perspective, and displayed warmth (a pattern termed "agreeableness"). A man's attractiveness rating dropped if his approach to a partner was critical and insensitive.

In the last study, 27 men and 47 women formed mental images of a person of the opposite sex described in a written passage only as high or low in various features of agreeableness and dominance. Women cited dominant men as more physically attractive than nondominant men. However, a man's agreeableness had a greater impact on these ratings. For highly agreeable men, dominance enhanced their desirability as dates and as long-term partners; dominance made no impact on ratings of men who lacked agreeable characteristics.

Men rated highly agreeable women as most attractive and desirable as a date. A woman's degree of dominance did not alter these opinions.

Further work is needed to specify particular situations that evoke greater reliance by men and women on signs of dominance and altruism in a potential romantic partner, the researchers say.

— B. Bower