Roger Boisjoly

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Roger Mark Boisjoly (*вон-zhu-lay*; April 25, 1938 – January 6, 2012) was an American mechanical engineer, fluid, and an aerodynamicist. He is best known for having raised strenuous objections to the launch of the Space Shuttle *Challenger* the day before the loss of the spacecraft and its crew in January 1986. Boisjoly correctly predicted, based on earlier flight data, that the O-rings on the rocket boosters would fail if the shuttle launched in cold weather.

Roger Boisjoly

Roger Boisjoly testifies before Congress on the Shuttle disaster, 1986

Born	Roger Mark Boisjoly April 25, 1938 Lowell, Massachusetts
Died	January 6, 2012 (aged 73) Nephi, Utah
Nationality	American
Fields	Mechanical Engineering
Institutions	Morton Thiokol
Alma mater	University of Massachusetts Lowell
Known for	*Challenger* Disaster
Notable awards	AAAS Award for Scientific Freedom and Responsibility (1988)[1]

Notes

Project manager of the solid fuel boosters of the Shuttle Program System

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Early life

Boisjoly studied mechanical engineering at the University of Massachusetts Lowell. He worked for companies in California on lunar module life-support systems and the moon vehicle.[2] He later worked for Morton Thiokol, the manufacturer of the solid rocket boosters (SRBs) for the Space Shuttle program.

O-ring safety concerns

Boisjoly wrote a memo in July 1985 to his superiors concerning the faulty design of the solid rocket boosters that, if left unaddressed, could lead to a catastrophic event during launch of a Space Shuttle. Such a catastrophic event did occur less than a year later resulting in the Space Shuttle *Challenger* disaster.

This memo followed his investigation of a solid rocket booster (SRB) from a shuttle flight in January 1985. During his investigation, he discovered that the first of a system of two O-rings had failed completely, and that some damage had been caused to the second O-ring.

The O-rings were two rubber rings that formed a seal between two sections of the SRBs. The sections of the boosters were joined using tang and clevis joints and the rings were intended to seal the joint, while allowing for the inevitable movement between the sections under flight conditions. By design, pressure from within the booster was to push a fillet of putty into the joint, forcing the O-ring into its seat. The system never functioned as designed. The rings were supposed to sit in a groove and seal the joint between the sections of the booster. It was found, however, that flight dynamics caused the joints in the SRBs to flex during launch, opening a gap through which rocket exhaust could escape. As the joints flexed, the rings would come out of their grooves and move to a new position in the joint, a process called extrusion. The extruded ring would form a seal in this new position, but during the time it took for the ring to shift, the joint was unsealed and hot gases could escape, a process called blow-by. These hot gases would cause damage to the rings until the seal was achieved.

Boisjoly's investigation showed that the amount of damage to the O-ring depended on the length of time it took for the ring to move out of its groove and make the seal, and that the amount of time depended on the temperature of the rings. Cold weather made the rubber hard and less flexible, meaning that extrusion took more time and more blow-by took place. He determined that if the O-rings were damaged enough they could fail.

If the second O-ring had failed, Boisjoly realized, the results would almost certainly have been catastrophic with the complete loss of the shuttle and crew seemingly the only outcome. His investigation found that the first O-ring failed because the low temperatures on the night before the flight had compromised the flexibility of the O-ring, reducing its ability to form a seal. The temperature at launch had been only 10 °C (50 °F), the coldest on record (until January 28, 1986). The first rubber O-ring had formed a partial seal, but not a complete one, but the second O-ring had held.

Boisjoly sent a memo describing the problem to his managers, but was apparently ignored.[3] Following several further memos, a task force was set up—including Boisjoly—to investigate the matter, but after a month Boisjoly realized that the task force had no power, no resources and no management support. In late 1985 Boisjoly advised his managers that if the problem was not fixed, there was a distinct chance that a shuttle mission would end in disaster. No action was taken.

Challenger disaster

Following the announcement that the *Challenger* mission was confirmed for January 28, 1986, Boisjoly and his colleagues tried to stop the flight. Temperatures were due to be down to −1 °C (30 °F) overnight. Boisjoly felt that this would severely compromise the safety of the O-ring, and potentially lose the flight.

The matter was discussed with Morton Thiokol managers, who agreed that the issue was serious enough to recommend delaying the flight. They arranged a telephone conference with NASA management and gave their findings. However, after a while, the Morton Thiokol managers asked for a few minutes off the phone to discuss their final position again. Despite the efforts of Boisjoly and others, such as Bob Ebeling, in this off-line briefing, the Morton Thiokol managers decided to advise NASA that their data was inconclusive. NASA asked if there were objections. Hearing none, the decision to fly the ill-fated STS-51L *Challenger* mission was made.

Boisjoly's concerns proved correct. In the first moments after ignition, the O-rings failed completely and were burned away, resulting in the black puff of smoke visible on films of the launch. An aluminum oxide seal plugged the hole at the last second, preventing the loss of the orbiter at liftoff. At 58 seconds after launch, buffeted by high-altitude winds, the oxide seal gave way. Hot gases streamed out of the joint in a visible blowtorch-like plume that burned into the external hydrogen tank. At about 73 seconds, the adjacent SRB strut gave way and the vehicle quickly disintegrated.

Initially, Boisjoly was relieved when the flight lifted off, as his investigations had predicted that the SRB would explode during take-off. However, seventy-three seconds later, he witnessed the shuttle disaster on television.

Later career

After President Ronald Reagan ordered a presidential commission to review the disaster, Boisjoly was one of the witnesses called. He gave accounts of how and why he felt the O-rings had failed. After the commission gave its findings, Boisjoly found himself shunned by colleagues and managers[4] and he resigned from the company.

Boisjoly became a speaker on workplace ethics.[5] He argued that the caucus called by Morton Thiokol managers, which resulted in a recommendation to launch, "constituted the unethical decision-making forum resulting from intense customer intimidation."[4]

For his honesty and integrity leading up to and directly following the shuttle disaster, Boisjoly was awarded the Award for Scientific Freedom and Responsibility by the American Association for the Advancement of Science in 1988.[1][5]

When Boisjoly left Morton Thiokol, he took 14 boxes containing every note and paper he received or sent in seven years. On May 13, 2010, he donated his personal memoranda—six boxes of personal papers, including memos and notes from congressional testimony—to Chapman University in Orange, California. Rand Boyd, the special-collections and archival librarian at Chapman's Leatherby Libraries, said the materials will be catalogued and archived. It was to be about six months to a year before library visitors would be able to view the materials.[6]

Boisjoly died on January 6, 2012, of cancer of the colon, kidneys, and liver.[2]

References

1. Roger M. Boisjoly (http://archives.aaas.org/people.php?p_id=331), American Association for the Advancement of Science webpage. Full text: "For his exemplary and repeated efforts to fulfill his professional responsibilities as an engineer by alerting others to life-threatening design problems of the Challenger space shuttle and for steadfastly recommending against the tragic launch of January 1986." Retrieved 2012-02-07.
2. Martin, Douglas (February 3, 2012). "Roger Boisjoly, 73, Dies; Warned of Shuttle Danger". *The New York Times*. www.nytimes.com. Retrieved February 4, 2012.
3. "The result would be a catastrophe". www.lettersofnote.com. October 27, 2009. Archived from the original on January 28, 2012. Retrieved January 28, 2012.
4. Boisjoly, Roger. "Ethical Decisions - Morton Thiokol and the Space Shuttle *Challenger* Disaster". onlineethics.org. Retrieved August 5, 2008.

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6. Fields, Eugene W., "Chapman receives papers from Challenger disaster" (http://www.ocregister.com/news/boisjoly-248703-boyd-chapman.html), *The Orange County Register*, May 13, 2010 9:37 p.m.

External links

- Boisjoly, Roger (May 15, 2006) "Ethical Decisions - Morton Thiokol and the Space Shuttle *Challenger* Disaster - Index" (http://www.onlineethics.org/CMS/profpractice/ppessays/thiokolshuttle.aspx) Online Ethics Center for Engineering, National Academy of Engineering
- Roger and Roberta Boisjoly Challenger Disaster Collection (http://www1.chapman.edu/library/archives/boisjoly.html) at Chapman University Leatherby Libraries
- History of the *Challenger* accident (http://history.msfc.nasa.gov/book/chptnine.pdf) from the NASA Marshall Spaceflight Center, discussing the O-ring and Boisjoly's objections to flight
- Robison, Wade, Boisjoly, David Hoeker and Stefan Young, "Representation and Misrepresentation: Tufte and the Morton Thiokol Engineers on the *Challenger*" (http://www.onlineethics.org/CMS/profpractice/exempindex/RB-intro/RepMisrep.aspx) (*Science and Engineering Ethics* (2002) 8, 59-81) sharply criticizes Edward Tufte's analysis of pre-disaster non-employment of graphics in Tufte's *Visual Explanations*. Robison was a Rochester Institute of Technology professor; Hoeker and Young freshman RIT students. Alternative link. (http://people.rit.edu/wlrgsh/FINRobison.pdf)

Categories: 1938 births | 2012 deaths | American mechanical engineers | American aerospace engineers | American Latter Day Saints | American whistleblowers | Cancer deaths in Utah | People from Lowell, Massachusetts | People from St. George, Utah | University of Massachusetts Lowell alumni | Space Shuttle Challenger disaster

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