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AN AUTONOMOUS INSTITUTION



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CASE STUDY

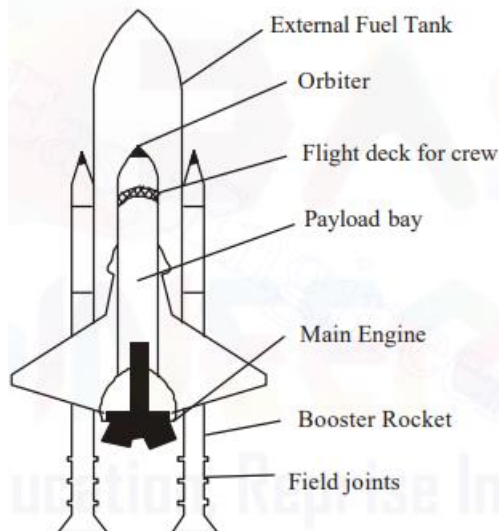
CASE STUDY: THE CHALLENGER

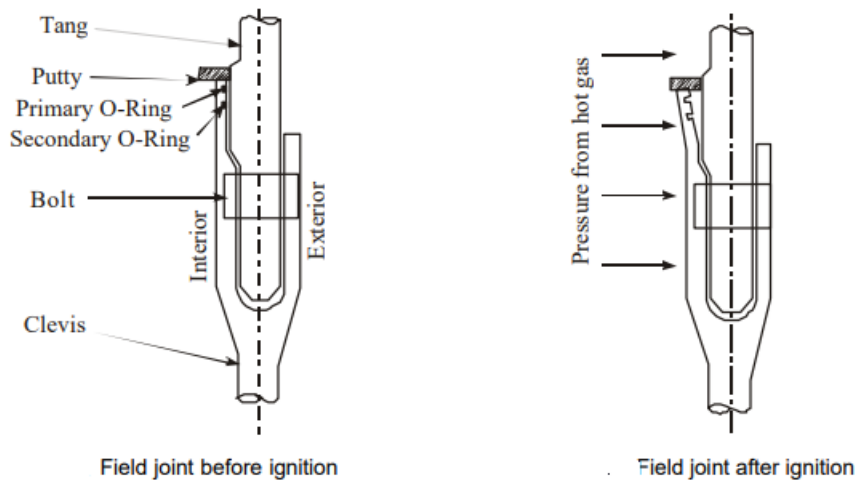
The orbiter of the Challenger had three main engines fuelled by liquid hydrogen. The fuel was carried in an external fuel tank which was jettisoned when empty. During lift-off, the main engines fire for about nine minutes, although initially the thrust was provided by the two booster rockets. These booster rockets are of the solid fuel type, each burning a million pound load of aluminum, potassium chloride, and iron oxide.

The casing of each booster rocket is about 150 feet long and 12 feet in diameter. This consists of consisting of pairs of O-rings made of vulcanized rubber. The O-rings work with a putty barrier made of zinc chromate.

The engineers were employed with Rockwell International (manufacturers for the orbiter and main rocket), Morton-Thiokol (maker of booster rockets), and they worked for NASA. After many postponements, the launch of Challenger was set for morning of Jan 28, 1986. Allan J. McDonald was an engineer from Morton-Thiokol and the director of the Solid Rocket Booster Project. He was skeptic about the freezing temperature conditions forecast for that morning, which was lower than the previous launch conditions. A teleconference between NASA engineers and MT engineers was arranged by Allan.

Arnold Thompson and Roger Boisjoly, the seal experts at MT explained to the other engineers how the booster rocket walls would bulge upon launch and combustion gases can blow past the O-rings of the field joints segments that are assembled at the launch site. There are four-field joints and they use seals.





On many of the previous flights the rings have been found to have charred and eroded. In freezing temperature, the rings and the putty packing are less pliable. From the past data gathered, at temperature less than 65 °F the O-rings failure was certain. But these data were not deliberated at that conference as the launch time was fast approaching.

The engineering managers Bob Lund and Joe Kilminster agreed that there was a safety problem. Boisjoly testified and recommended that no launch should be attempted with temperature less than 53 °F. These managers were annoyed to postpone the launch yet again. The top management of MT was planning for the renewal of contract with NASA, for making booster rocket. The managers told Bob Lund “to take-off the engineering hat and put on your management hat”. The judgment of the engineers was not given weightage. The inability of these engineers to substantiate that the launch would be unsafe was taken by NASA as an approval by Rockwell to launch.

At 11.38 a.m. the rockets along with Challenger rose up the sky. The cameras recorded smoke coming out of one of the filed joints on the right booster rocket. Soon there was a flame that hit the external fuel tank. At 76 seconds into the flight, the Challenger at a height of 10 miles was totally engulfed in a fireball. The crew cabin fell into the ocean killing all the seven aboard.

Some of the factual issues, conceptual issues and moral/normative issues in the space shuttle challenger incident, are highlighted hereunder for further study.

Moral/Normative Issues:

1. The crew had no escape mechanism. Douglas, the engineer, designed an abort module to allow the separation of the orbiter, triggered by a field-joint leak. But such a ‘safe exit’ was rejected as too expensive, and because of an accompanying reduction in payload.
2. The crew were not informed of the problems existing in the field joints. The principle of informed consent was not followed.
3. Engineers gave warning signals on safety. But the management group prevailed over and ignored the warning.

Conceptual Issues :

1. NASA counted that the probability of failure of the craft was one in one lakh launches. But it was expected that only the 100000th launch will fail.
2. There were 700 criticality-1 items, which included the field joints. A failure in any one of them would have caused the tragedy. No back-up or stand-bye had been provided for these criticality-1 components.

Factual/Descriptive Issues:

1. Field joints gave way in earlier flights. But the authorities felt the risk is not high.
2. NASA has disregarded warnings about the bad weather, at the time of launch, because they wanted to complete the project, prove their supremacy, get the funding from Government continued and get an applaud from the President of USA.
3. The inability of the Rockwell Engineers (manufacturer) to prove that the lift-off was unsafe. This was interpreted by the NASA, as an approval by Rockwell to launch.