



# WHAT DESTROYED SPACE SHUTTLE CHALLENGER

**MTI ASSESSMENT OF TEMPERATURE CONCERN ON SRB-25 (SRL) LAUNCH**

- CALCULATIONS SHOW THAT SRB-25 O-RINGS WILL BE 20° COLDER THAN SRB-15 O-RINGS
- TEMPERATURE DATA NOT CONCLUSIVE ON PREDICTING PRIMARY O-RING SLOW-LEAK
- ENGINEERING ASSESSMENT IS THAT:
  - COLDER O-RINGS WILL HAVE INCREASED EFFECTIVE PERMEABILITY ("LEAKAGE")
  - "LEAKAGE" O-RINGS WILL TAKE LONGER TO "SEAT"
  - COLDER O-RINGS WILL TAKE LONGER TO "SEAT"
  - SECONDARY O-RINGS WILL TAKE LONGER TO "SEAT"
  - IF THE PRIMARY SEAL DOES NOT SEAT, THE SECONDARY SEAL WILL SEAT
  - PRESSURE WILL SET THE SECONDARY SEAL BEFORE THE METAL PARTS ROTATE
  - POINT-TO-POINT LEAKAGE IS 3 TIMES GREATER THAN O-RING
- MTI RECOMMENDS SRB-25 LAUNCH PROCEED ON 28 JANUARY 1986
- SRB-25 WILL NOT BE SIGNIFICANTLY DIFFERENT FROM SRB-15

*Morton Thiokol, Inc. President*  
**MORTON THIOKOL, INC.**  
 Wausau Division

## POOR DECISION-MAKING

NASA had no experience launching the shuttle in temperatures as cold as on the morning of Jan. 28, 1986. The coldest temperature of a previous launch was 20 degrees warmer.

Morton Thiokol, the builder of the solid-rocket boosters, advised NASA that they believed the O-ring seals in the solid-rocket boosters would perform adequately in the cold.

## WHAT HAPPENED?

### RUBBER O-RINGS

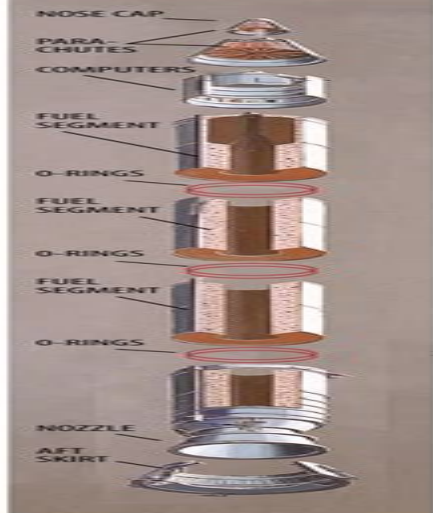
To make each solid-rocket booster, the Morton Thiokol factory built four hull segments filled with powdered aluminum (fuel) and ammonium perchlorate (oxidizer).

At the launch site, the fuel segments were assembled vertically. Field joints containing rubber O-ring seals were installed between each fuel segment.

The O-rings were never tested in extreme cold. On the morning of the launch, the cold rubber became stiff, failing to fully seal the joint.



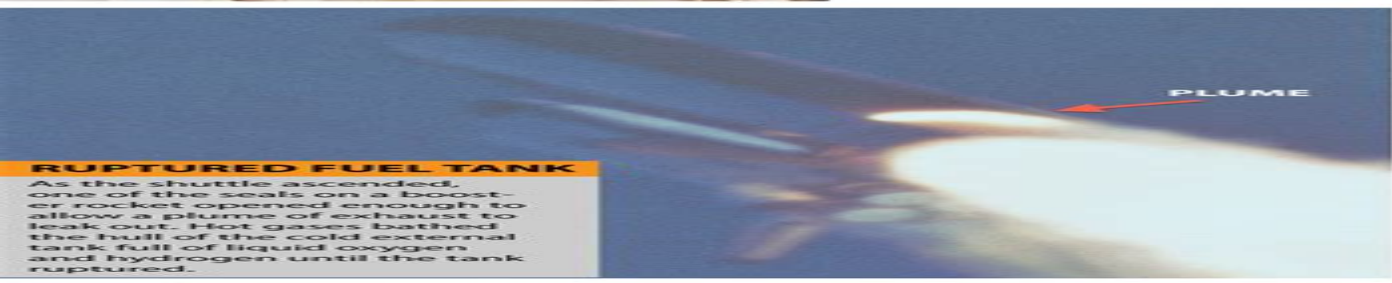
### SOLID ROCKET BOOSTER



### LEAKING SRB

### RUPTURED FUEL TANK

As the shuttle ascended, one of the seals on a booster rocket opened enough to allow a plume of exhaust to leak out. Hot gases bathed the hull of the cold external tank full of liquid oxygen and hydrogen until the tank ruptured.



## DISASTER

At 73 seconds after liftoff, at an altitude of 9 miles (14.5 kilometers), the shuttle was torn apart by aerodynamic forces.

The two solid-rocket boosters continued flying until the NASA range safety officer destroyed them by remote control.

The crew compartment ascended to an altitude of 12.3 miles (19.8 km) before free-falling into the Atlantic Ocean.



# Report Of The Challenger Accident

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