SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME: 19GET201-Professional Ethics And Human Values

IV YEAR / VII SEMESTER

Unit 2– Engineering as Social Experimentation

Topic 6: Case studies

What We'll Discuss

TOPIC OUTLINE

The Incident

Design of Shuttle

The Investigation

Role of Communication

The Incident

January 28, 1986

Launch

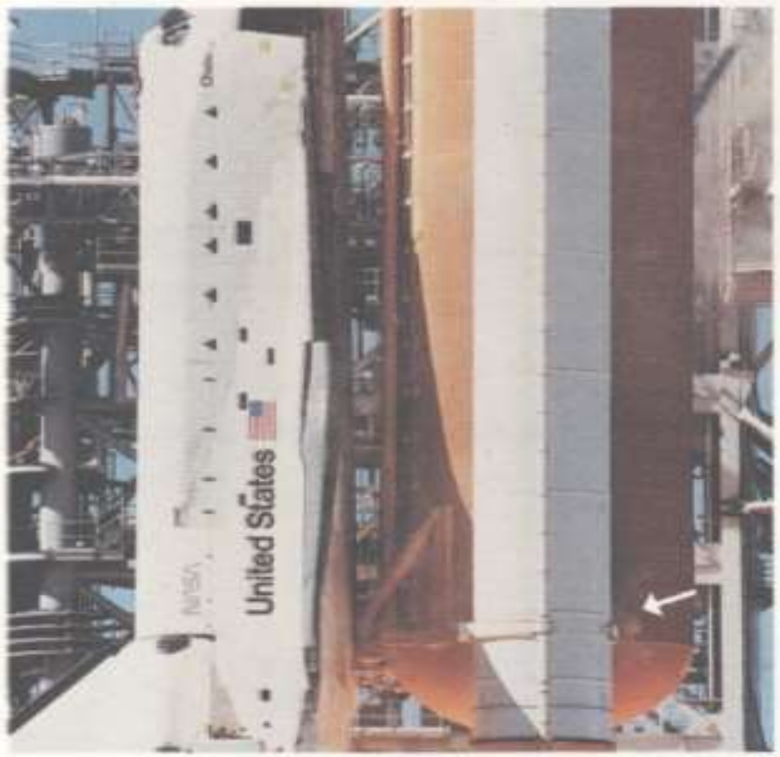
About 80 seconds after Launch
(shuttle broke down)

WHEN

- Tuesday, January 27th 1976
- The shuttle broke down 73 seconds into it’s flight

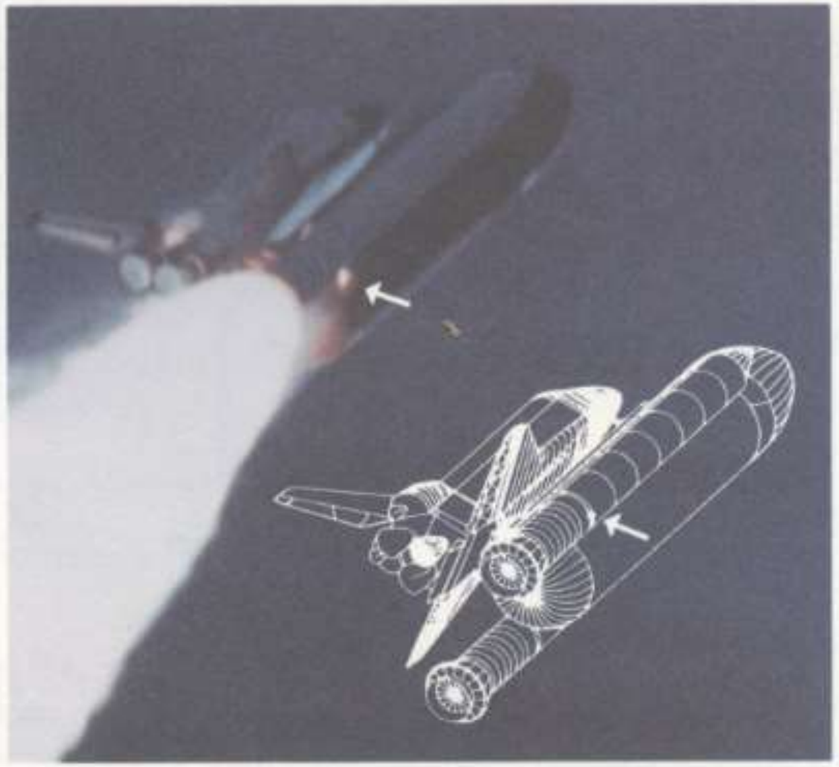
How

- Began after a seal on one of it's booster failed to hold off pressurized gas from reaching the fuel tank. This led to the shuttle disassembling and breaking apart.



Less than 1 second after ignition, a puff of smoke appeared at the aft joint of the right booster, indicating that the O-rings burned through and failed to seal. At this point, all was lost.

HOW

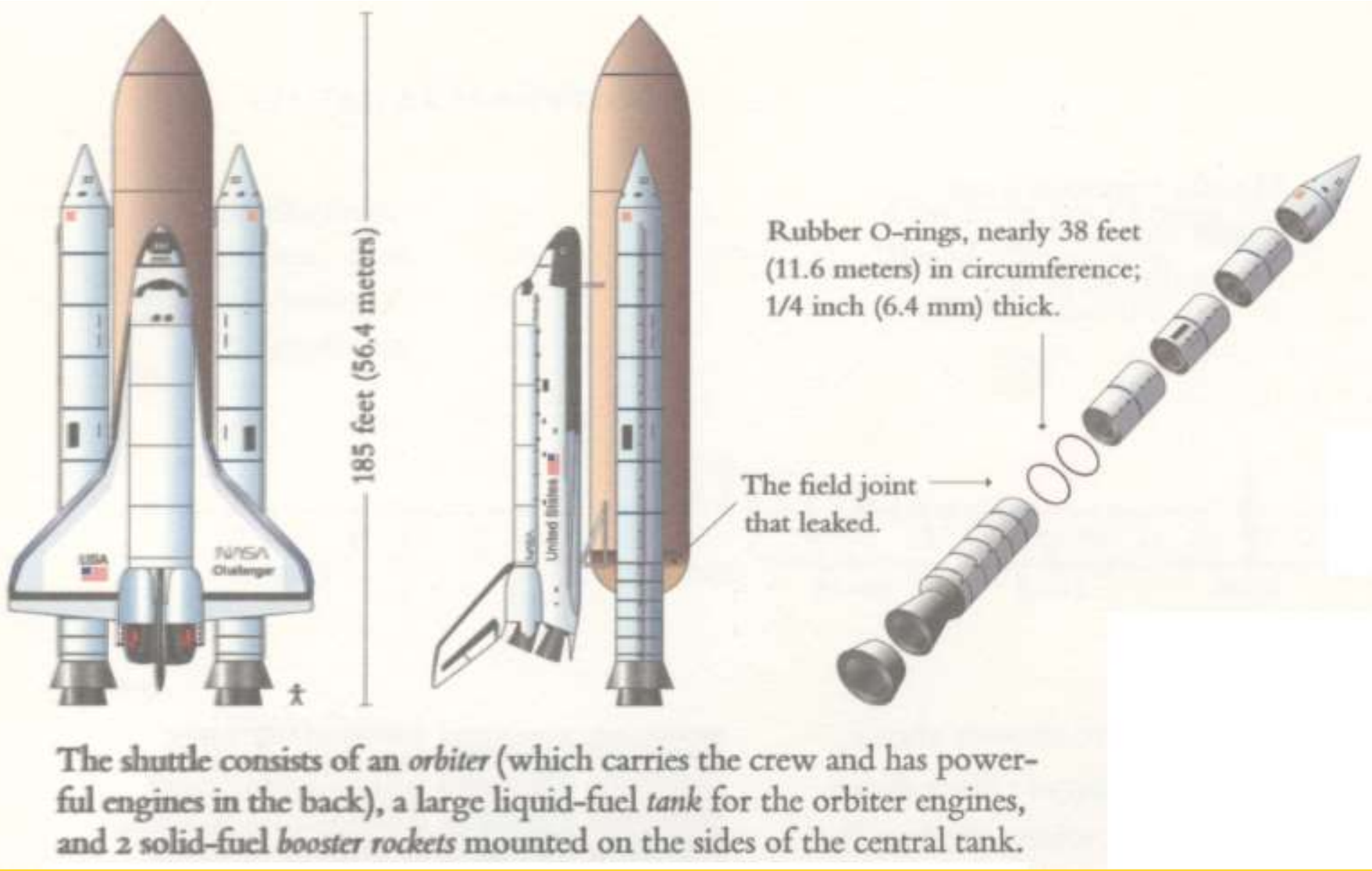


On the launch pad, the leak lasted only about 2 seconds and then apparently was plugged by putty and insulation as the shuttle rose, flying through rather strong cross-winds. Then 58.788 seconds after ignition, when the Challenger was 6 miles up, a flicker of flame emerged from the leaky joint. Within seconds, the flame grew and engulfed the fuel tank (containing liquid hydrogen and liquid oxygen). That tank ruptured and exploded, destroying the shuttle.

HOW

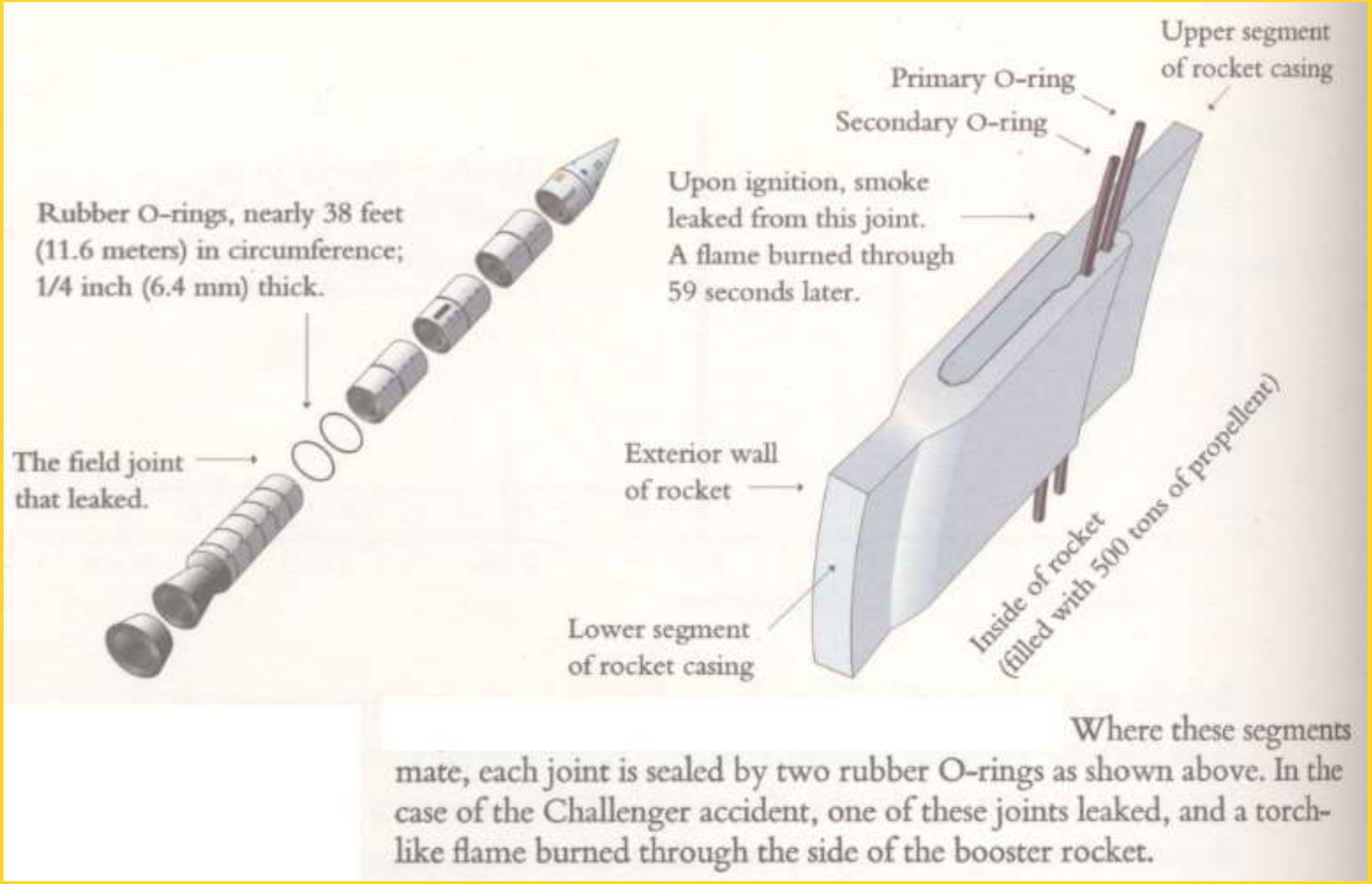
As the shuttle exploded and broke up at approximately 73 seconds after launch, the two booster rockets crisscrossed and continued flying wildly. The right booster, identifiable by its failure plume, is now to the left of its non-defective counterpart.

Design of Shuttle



The shuttle consists of an *orbiter* (which carries the crew and has powerful engines in the back), a large liquid-fuel *tank* for the orbiter engines, and 2 solid-fuel *booster rockets* mounted on the sides of the central tank.

Design of Shuttle



Where these segments mate, each joint is sealed by two rubber O-rings as shown above. In the case of the Challenger accident, one of these joints leaked, and a torch-like flame burned through the side of the booster rocket.

Here's that crew!

The flight crew of Challenger 51-L. Front row, left to right: Michael J. Smith, pilot; Francis R. (Dick) Scobee, commander; Ronald E. McNair. Back row: Ellison S. Onizuka, S. Christa McAuliffe, Gregory B. Jarvis, Judith A. Resnik.

Why

NASA did not address the issue even though they were aware of it.

The Investigation

1970's: less safe than more expensive alternative

1985: scorching becomes noticeable

- Thiokol analysis shows worse on colder days
- Launch constraint by NASA (waived every launch)
- Thiokol Engineer Roger Boisjoly warns superiors "we could lose a flight"

August '85: NASA Meeting, no changes

Later, Feynman calls this strategy "Russian Roulette"

The Investigation

Boisjoly and others: "too cold, delay launch!"

- Until 53ºF

Management: how come some warmer launches show scorching?

- (crucial fact ignored--every single launch in cold temperatures showed damage)

Thiokol management gets the engineers to accept a launch recommendation.

Role of Communication

Chart used by Thiokol Engineers on Jan 27 before launch

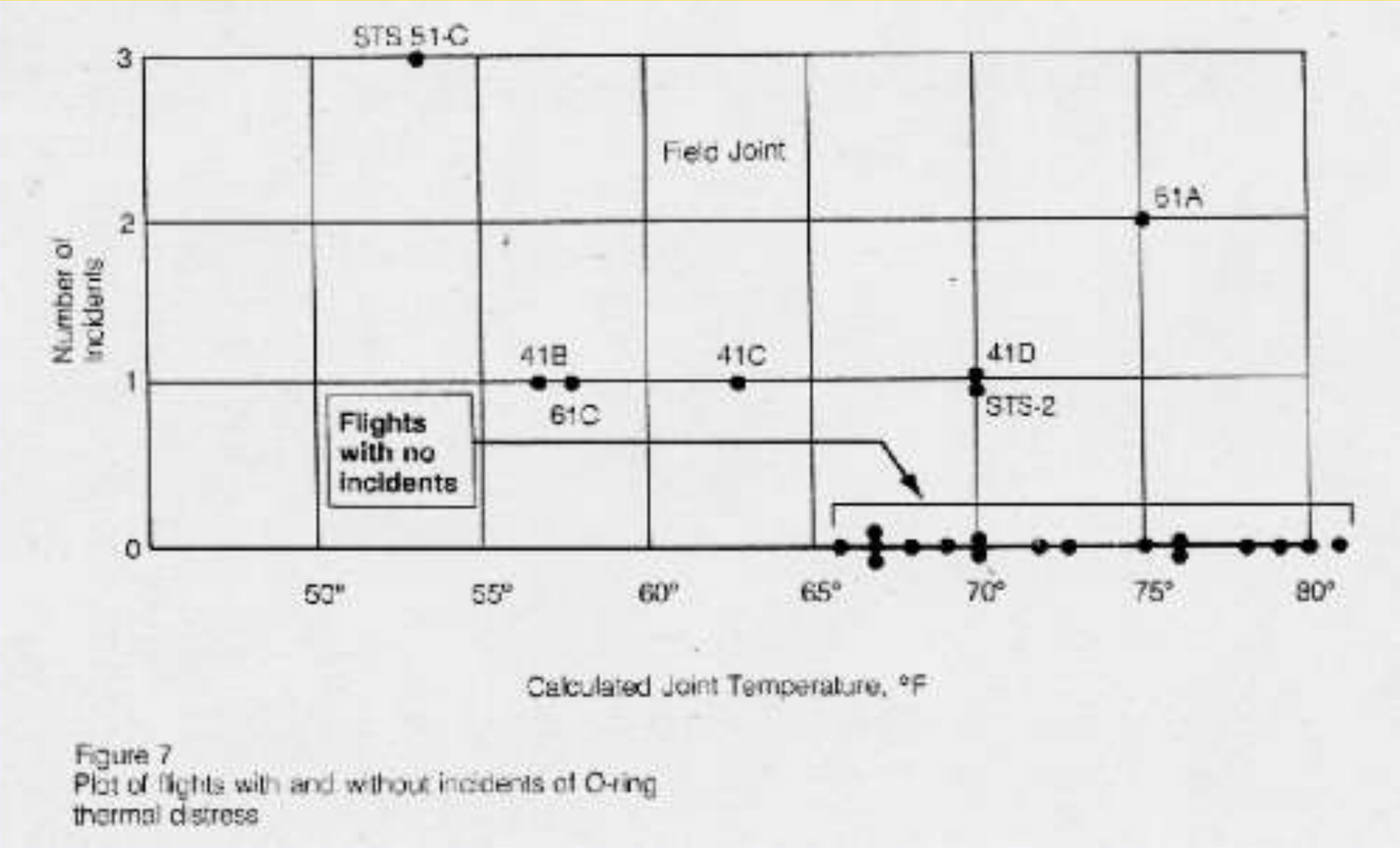


Figure 7
Plot of flights with and without incidents of O-ring thermal distress

Role of Communication

A Revised Chart by Rogers Commission Showing all launches

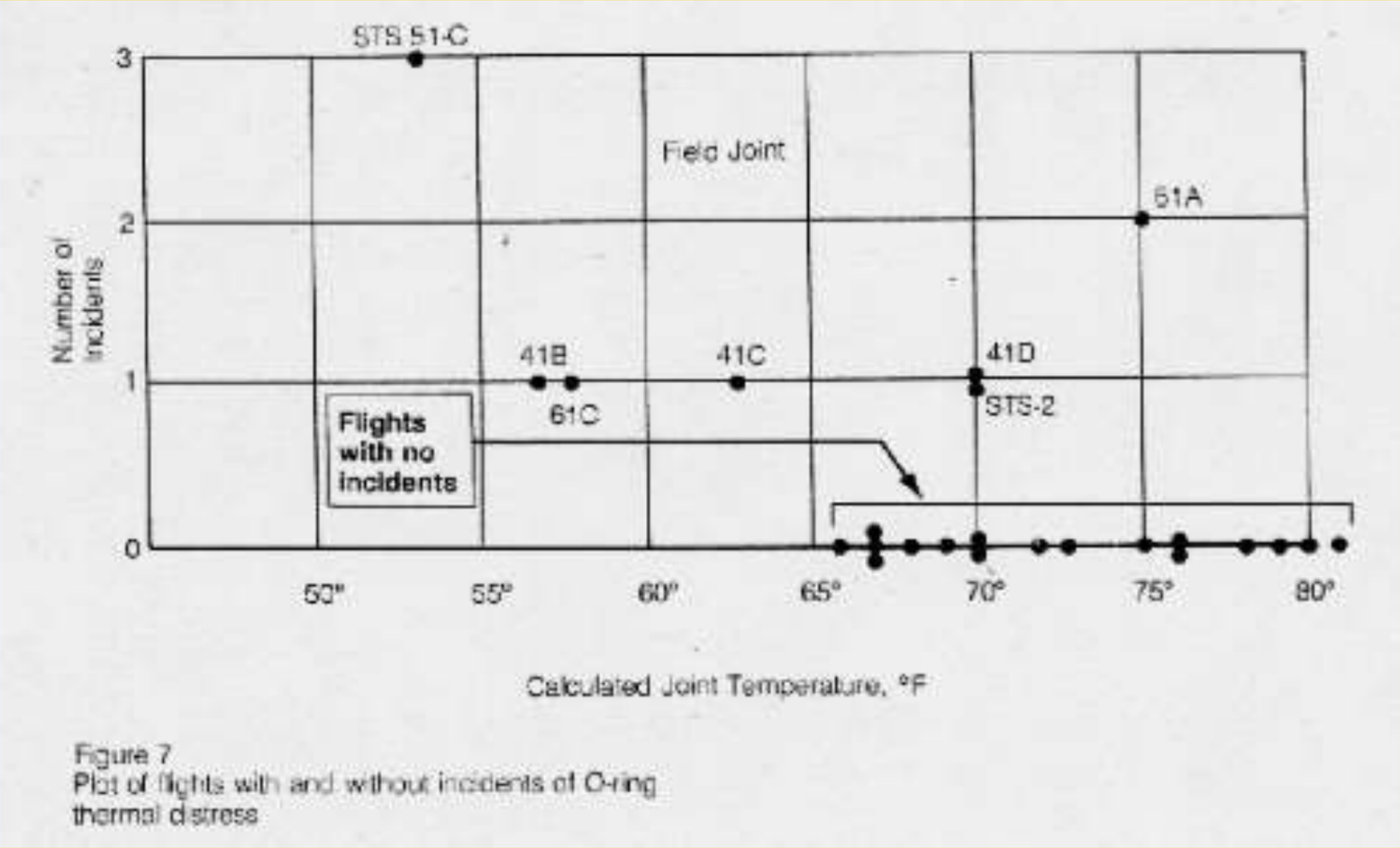


Figure 7
Plot of flights with and without incidents of O-ring thermal distress

Obfuscation during investigation

Famous physicist Richard Feynman performs experiment on television

- Dips o-ring in ice-water
- Shows greater stiffness
- also complains about slides, bullets

Edward Tufte, designer

- Provides further damning analysis of charts
- Condemns PowerPoint

RECALL TIME

ASSESSMENT TIME

THANK YOU