Safety Fundamentals:

Guard yourself against ‘normalization of deviance’.

Embrace responsibility and accountability.
Normalization of Deviance

Diane Vaughan, ‘The Challenger Launch Decision’

Getting away with short-cutting safety best-practices until that ‘deviance’ becomes your ‘norm’.
PRESSURES:

JOB PRESSURES
FAMILY WORRIES
RELATIONSHIP ISSUES
FINANCIAL CONCERNS
HEALTH CONCERNS
FATIGUE
Normalizing deviance leads to…

...your worst nightmare.

Injuries and Fatalities
Challenger was a predictable surprise precipitated by a four year normalization of deviance.
The Story of Challenger

January 28, 1986
Solid Rocket Boosters
46m length; 3.7m diameter; 590 metric tons
.64cm thick x 3.7m diameter O-ring
Redundant O-rings
Predictable Surprise

Diane Vaughan, "The Challenger Launch Decision"
Burned O-rings found on 12 of 24 pre-Challenger missions.

STS-2 Four years prior to Challenger
It is my honest and very real fear...we stand in jeopardy of losing a flight, (a crew) and all the launch pad facilities.”
Predictable Surprise
Diane Vaughan, “The Challenger Launch Decision”
Hazard Recognition and Mitigation

Criticality Category: 1

Failure Effects Summary: Loss of mission, vehicle, and crew...

NOTE: Leakage of the primary O-ring seal is classified as a single failure point due to possibility of loss of sealing at the secondary O-ring because of joint rotation after superpressurization.

Failure Effect Summary: Actual Loss - Loss of mission, vehicle, and crew due to metal erosion, burnthrough, and probable case burst resulting in fire and deflagration.

RATIONALE FOR RETENTION

Case, P/N 1U50129, 1U50131, 1U50130, 1U50185, 1U50179, 1U50171, 1U50176, 1U50177

A. DESIGN

The SRM case joint design is common in the lightweight and regular weight cases having identical dimensions. The SRM joint uses centering clips which are installed in the gap between the tang O.D. and the outside of the case. This is designed to gather and to reduce the total case gap.
Implied best-practice: Any O-ring damage is a GROUNDING deviance.
LAUNCH SCHEDULE PRESSURE

The Grand Plan for the Shuttle Program
Aircraft-like qualities of safety, maintainability, reliability, etc.
30,000 kg of payload
Share Costs with DoD

Sell launch services to:

Communication Satellite Market
24 missions per year flight rate
1981 – 2
1982 – 3
1983 – 4
1984 – 5
1985 – 9
1986 – 14 planned
Roger’s Commission Contractor Testimony:

“The problem was the increasing launch rate. We were just getting buried under all this stuff...The system was about to come down under its own weight...”
The Apollo era created an exceptional ‘can-do’ culture marked by tenacity in the face of seemingly impossible challenges.
“...NASA’s drive to achieve a launch schedule of 24-flights per year created pressure throughout the agency that directly contributed to unsafe launch operations.”

House Committee on the Challenger Disaster
Schedule Pressure
Creeping Risk Tolerance
.13cm O-ring burn erosion found after STS-2
.25cm intentional cut holds 20,000 kPa pressure
Test results expanded the acceptable limits of O-ring performance.
The Challenger Launch Decision

“Between 1981 and 1984...Four times, an incident that first was seen as a deviant event, was reinterpreted as non-deviant...”

Normalization of Deviance
What do we learn from the Challenger disaster?
LESSON 1:
You are vulnerable.
LESSON 2:

Procedural compliance should be a religion.

“It only takes a moment.”
T.O. 1T-36A-1CL-1

TAKEOFF.
2. Throttles — MAX.
3. Instruments — Check.

AFTER TAKEOFF.
1. Landing Gear Lever — LG UP, when definitely airborne.
2. Wing Flap Lever — UP.

CLIMB.
*1. Zero Delay Lanyard (if applicable) — Disconnect above 2000 feet AGL.
*2. Oxygen System — Check.
3. Cabin Pressure — Check.

LEVEL-OFF AND CRUISE.
*1. Oxygen System — Check.
2. Cabin Pressure — Check.
3. Fuel Quantity — Check.
*4. Altimeter — Reset as required, check STBY and return to RESET.

GO-AROUND.
1. Throttles — MIL (MAX if necessary).
2. Landing Gear Lever — LG UP, when definitely airborne.
3. Wing Flap Lever — UP.

AFTER LANDING.
1. Pitot Heat — OFF.
*2. Cockpit Loose Items — Check Secured (before opening canopy).
*4. HBU Interim Anchor Hook (if applicable) — Detached.

BEFORE LANDING.
*1. Pattern Airspeeds — Compute.
*2. Gear — Down & Check Down.
*3. Hydraulic Pressures — Check.
*4. Flaps — As Required.

6*1. Armament Safety Check — Completed.
6*2. Reticle Intensity Knob — OFF.
6*3. Helmet Visors — As Required.
6*4. Canopy Defog, Cabin Temp — As Required.
6*5. Pilot Heat, Engine Anti-Ice — As Required.
6*6. Altimeter — Reset as required, check STBY, and return to RESET.
6*8. Crossfeed — OFF.
6*10. Zero-Delay Lanyard (if applicable) — Attach above 2000 feet AGL.
LESSON 3:

Risk has no memory.

Risk is not diminished as a function of your success in taking the risk.
LESSON 4:

There are no inconsequential shortcuts from safety best practice compliance.

False feedback: The risk isn’t ‘absolute’ as previously learned, but rather it’s ‘manageable’.
LESSON 5:

Set challenging but attainable goals.
Responsibility & Accountability
LESSON 1:
The responsibilities of your job are non-transferable. OWN them!

See something…Say something…Do something.
LESSON 2:

“One person with courage forms a majority.”

author unknown

You count!
LESSON 3:

Value each other.

Take each others’ backs.

“It only takes a moment.”
Leaders: Empower your teams!
No crew escape system.
Cockpit
LESSON 5:

Pre-brief hazardous operations.

Maintain situational awareness.

“It only takes a moment.”
LESSON 6:

With responsibility comes accountability.

You own it. Own it to the good.
With responsibility comes accountability.
In hazardous work environments, you don’t get ‘Do-Overs’.
Safety Fundamentals:

Guard yourself against ‘normalization of deviance’.

Embrace responsibility and accountability.

“It only takes a moment.”
Countdown to Safety

www.MikeMullane.com
Riding Rockets, a memoir by Mike Mullane
MY LIFE STORY
Courageous Self-Leadership

Aggressive goal setting.

Tenacity in the pursuit of goal achievement.
Sputnik I
First earth satellite launched
October 4, 1957.
1960 Science Fair
Rocket Project
Preliminary Report
1960 Science Project
Development of Biological Rocketsonde

Michael Mullane
St. Pius X High School

FORWARD

Today, this country and many others throughout the world are steadily working towards the conquest of space. Someday, I also plan to participate in this great undertaking. At present, I am trying to familiarize myself with the basic principles of rocketry and to gain as much knowledge and practical "know-how" in this field as possible. To do this, I have been working on a series of scientific projects. The first of these was the development of a capsule and a reliable recovery system. This project, "Instrument Recovery From High Altitude" was entered in the 1959 Science Fair. With the data collected from this project it is now possible for me to expand my 1960 project into the development of a monitoring and telemetry system.
Today (1960), this country and many others throughout the world, are steadily working toward the conquest of space.

Someday, I also plan to participate in this great undertaking.

Mike Mullane, age 14
Attend Air Force Academy.
THIRD ALTERNATE

<table>
<thead>
<tr>
<th>ACADEMIC</th>
<th>PHYSICAL APTITUDE</th>
<th>MEDICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUALIFIED</td>
<td>QUALIFIED</td>
<td>QUALIFIED</td>
</tr>
</tbody>
</table>

2. **DISQUALIFIED FOR ADMISSION.** As shown above. (See Note 1 on Reverse Side).

3. **QUALIFIED - NO VACANCY.** You are fully qualified but there is no vacancy for your admission under the terms of your nomination. If your status changes for any reason, **YOU WILL BE NOTIFIED PROMPTLY.**

4. **QUALIFIED - STATUS PENDING.** You are fully qualified but your right to admission under the terms of your appointment depends upon the outcome of the presently undetermined status of the candidate, or candidates, ahead of you. **YOU WILL BE NOTIFIED AS SOON AS FINAL DETERMINATION IS MADE.**

5. **MEDICAL RE-EXAMINATION AUTHORIZED.** (Read Note 2 on Reverse Side) Should you desire a medical re-examination you are authorized to report as early as possible, **AND NOT LATER THAN**

Please fill out and return the attached form. Prior to reporting for re-examination, it is suggested you communicate with the hospital for an early appointment. Present indications in par. above.
You missed Korea, but here’s hoping you make Vietnam.
I was wildly curious about all things aviation & space related.

I was a passionate goal-setter.

I had an abundance of tenacity.
Courageous Self-Leader.
West Point 1967
Flight Training
1968
Vietnam 1969
Graduate School
1971
Test Pilot School (back-seater course) 1976
Astronaut
1978
What does my life story have to do with safety?
LESSON 1:

Within each of us exist great reserves of courageous self-leadership.

It takes courageous self-leadership to achieve and sustain great safety performance.
LESSON 2:

We’re more capable than we think.
And so are our team members.
LESSON 3:
Genius is overrated.
Tenacity counts BIG!
LESSON 4: Envision Mission Success
Safety Fundamentals:

A shared vision of ‘Zero Harm’ operations.

Guard yourself against ‘normalization of deviance’.

Embrace responsibility and accountability.

Maintain yourself as a courageous self-leader.

“It only takes a moment.”
Countdown to Safety

www.MikeMullane.com
Riding Rockets, a memoir by Mike Mullane