Description of document:	National Aeronautics and Space Administration (NASA) Lessons Learned: Gemini Check-Valve Problem, 2008
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Source of document:	FOIA request NASA Headquarters 300 E Street, SW Room 5Q16 Washington, DC 20546 Fax: (202) 358-4332 Email: hq-foia@nasa.gov FOIA.gov

National Aeronautics and Space Administration

Headquarters
Washington, DC 20546-0001

January 12, 2026

Reply to attn. of: Office of Communications
History and Information Services Division

Re: FOIA Tracking Number **26-00032-F-HQ**

This responds to your Freedom of Information Act (FOIA) request to the National Aeronautics and Space Administration (NASA), dated October 25, 2025, and received in this office on October 27, 2025. You seek:

> *A copy of the SLIDES for each of these NESC Academy (NASA Engineering and Safety Center) videos. The SLIDES are locked on the website so they cannot be viewed by the public.*
> *A copy of the SLIDES and VIDEOs for parts 2 and 3 listed in item 12 below.*
>
> *1) Lunar Landing*
> *https://nescacademy.nasa.gov/video/427d8334fa41482797cae5cddf7d71a41d*
>
> *2 and 3) Selected Apollo & Shuttle Lessons Learned ({Parts 1 and Part 2)*
> *https://nescacademy.nasa.gov/video/9edb3c4de48e46d7b66f2a91ace96a171d*
> *https://nescacademy.nasa.gov/video/27784b7aa2ce4c628d77143c86232d621d*
>
> *(4, 5, 6 and 7) Failure Recovery (Parts 1, 2, 3 and 4)*
> *https://nescacademy.nasa.gov/video/9efbd739aeae4da6b8a80b7370ccff051d*
> *https://nescacademy.nasa.gov/video/4e202def3eb943c99e4ba2744676392c1d*
> *https://nescacademy.nasa.gov/video/9965475c1f2649c4a56aad45cbc553ab1d*
> *https://nescacademy.nasa.gov/video/44323a56200341a198d3911002f0eb211d*
>
> *8, 9 and 10) Lessons Learned from Fifty Years of Observing Hardware and Human Behavior, Parts 1, 2 and 3*
> *https://nescacademy.nasa.gov/video/c81ccbfd7909415ea72070bbf1c8e38f1d*
> *https://nescacademy.nasa.gov/video/e84a2cc167244d14ac623358f2e9526a1d*
> *https://nescacademy.nasa.gov/video/79e6fd6fc7544b0ba7525f31ed2d866e1d*
>
> *11) Using TRIZ for Engineering Innovation*

https://nescacademy.nasa.gov/video/a42a19ce39a14cd49dfb669e774812b71d

12) Orion Landing Attenuation: slides for Part 1, Part 2, and Part 3. Copy of the video presentation for Part 2 and Part 3
https://nescacademy.nasa.gov/video/806485bdd20041cda2445409cf5737e21d

In response to your request we conducted a search of NASA's Langley Research Center, Engineering and Safety Center (NESC) using the information from your request. NASA's search began on November 18, 2025 and any records created after this date are not included with this response. That/Those search(es) identified the enclosed records that are responsive to your request. We determined that all **533** pages and 2 videos (Orion Part 2 - 55 minutes, 42 seconds; Orion Part 3 - 47 minutes, 52 seconds) are appropriate for release without excision and copies are enclosed.

Appeal

If you believe this to be an adverse determination, you have the right to appeal my action on your request. Your appeal must be received within 90 days of the date of this response. Please send your appeal to:

Administrator
NASA Headquarters
Executive Secretariat
ATTN: FOIA Appeals
MS 9R17
300 E Street S.W.
Washington, DC 2054

Both the envelope and letter of appeal should be clearly marked, "Appeal under the Freedom of Information Act." You must also include a copy of your initial request, the adverse determination, and any other correspondence with the FOIA office. In order to expedite the appellate process and ensure full consideration of your appeal, your appeal should contain a brief statement of the reasons you believe this initial determination should be reversed. Additional information on submitting an appeal is set forth in the NASA FOIA regulations at 14 C.F.R. § 1206.700.

Assistance and Dispute Resolution Services

If you have any questions, please feel free to contact me at derek.m.moore@nasa.gov. For further assistance and to discuss any aspect of your request you may also contact:

Stephanie Fox
FOIA Public Liaison
Freedom of Information Act Office
NASA Headquarters
300 E Street, S.W., 5P32
Washington D.C. 20546
Phone: 202-358-1553
Email: Stephanie.K.Fox@nasa.gov

Additionally, you may contact the Office of Government Information Services (OGIS) at the National Archives and Records Administration to inquire about the FOIA mediation services it offers. The contact information for OGIS is as follows: Office of Government Information Services, National Archives and Records Administration, 8601 Adelphi Road-OGIS, College Park, Maryland 20740-6001, e-mail at ogis@nara.gov; telephone at 202-741-5770; toll free at 1-877-684-6448; or facsimile at 202-741-5769.

Important: Please note that contacting any agency official including myself, NASA's FOIA Public Liaison, and/or OGIS is not an alternative to filing an administrative appeal and does not stop the 90 day appeal clock.

Sincerely,

Derek Moore

Derek Moore
Government Information Specialist

IP 1

Check valve problem

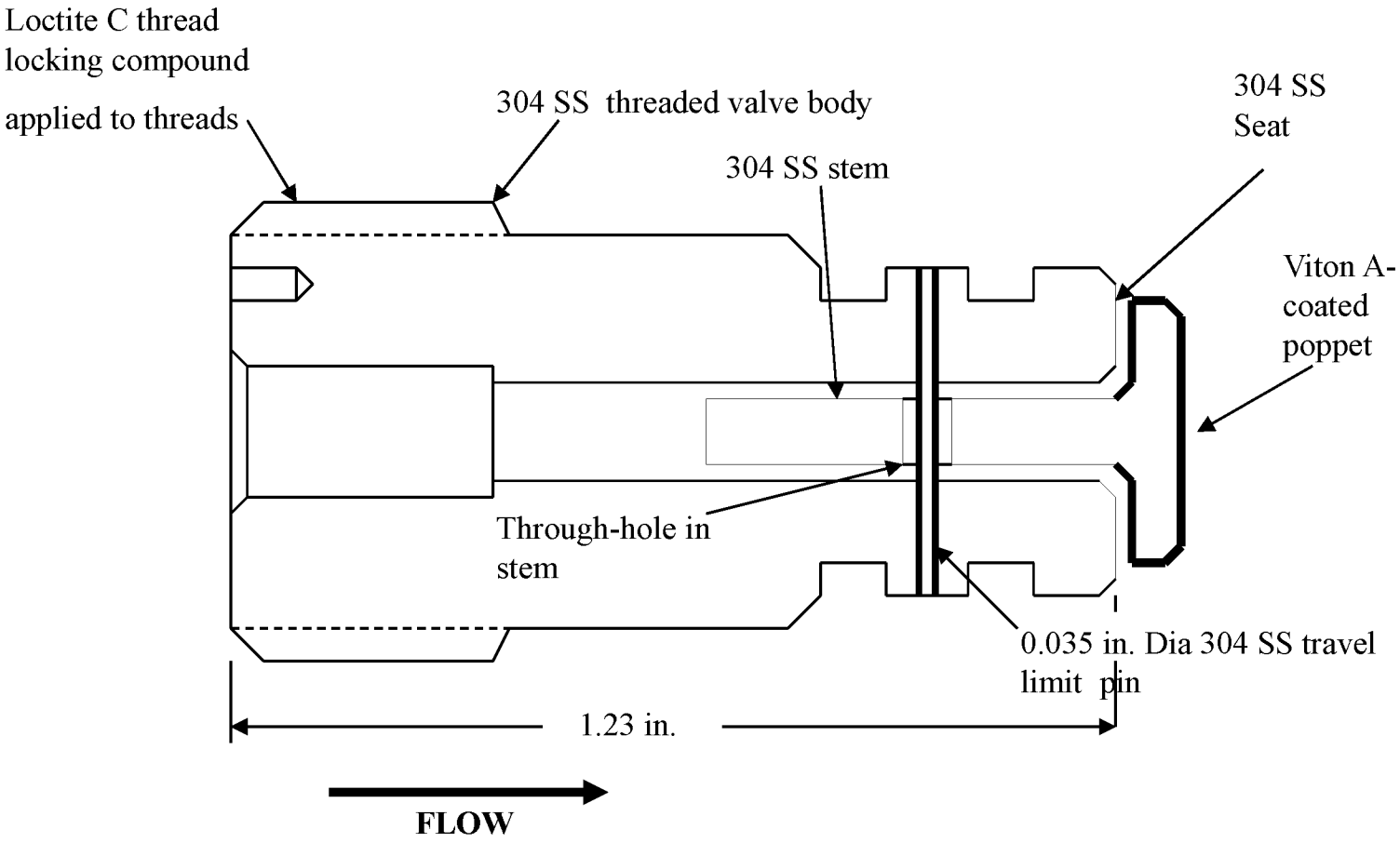
11-24-08

IP-1 Oxygen Charging Failure

- Potentially affected hardware included all ELSS's yet to be charged, including the Gemini IX-A pack, and all charging rigs.
- The Gemini IX-A mission preparations continued at KSC with its chestpack.
- The Gemini X altitude chamber run was delayed in order to await investigation findings.
  - Options to use externally supplied oxygen via hoses were rejected as a safety hazard
- As an option, the Gemini XII chestpack was started into flow early; its use dependent on investigation findings.
- Initial troubleshooting was carried out on DR, revealing the following (see next slides)
  - The procedures used were correct, and properly executed.
  - There were no environmental outages
  - Investigation of the charging system using a test receiver indicated no anomalies - no contamination or component malfunctions were found.
  - Attempts to charge the ELSS using the 2200 psi supply showed that upon disconnection of the supply, pressure was not maintained in the ELSS.
  - Further investigation revealed that oxygen was leaking back through the high-pressure check valve of the ELSS.
- A failure report was then written against the ELSS check valve.
- Plans were then made to remove, dissassemble and inspect the check valve.
- Update the Failure Recovery Plan; ACR plan; affected hardware list; IX-A plan; investigation plan; and backup plans, and postulate next actions in all these categories.

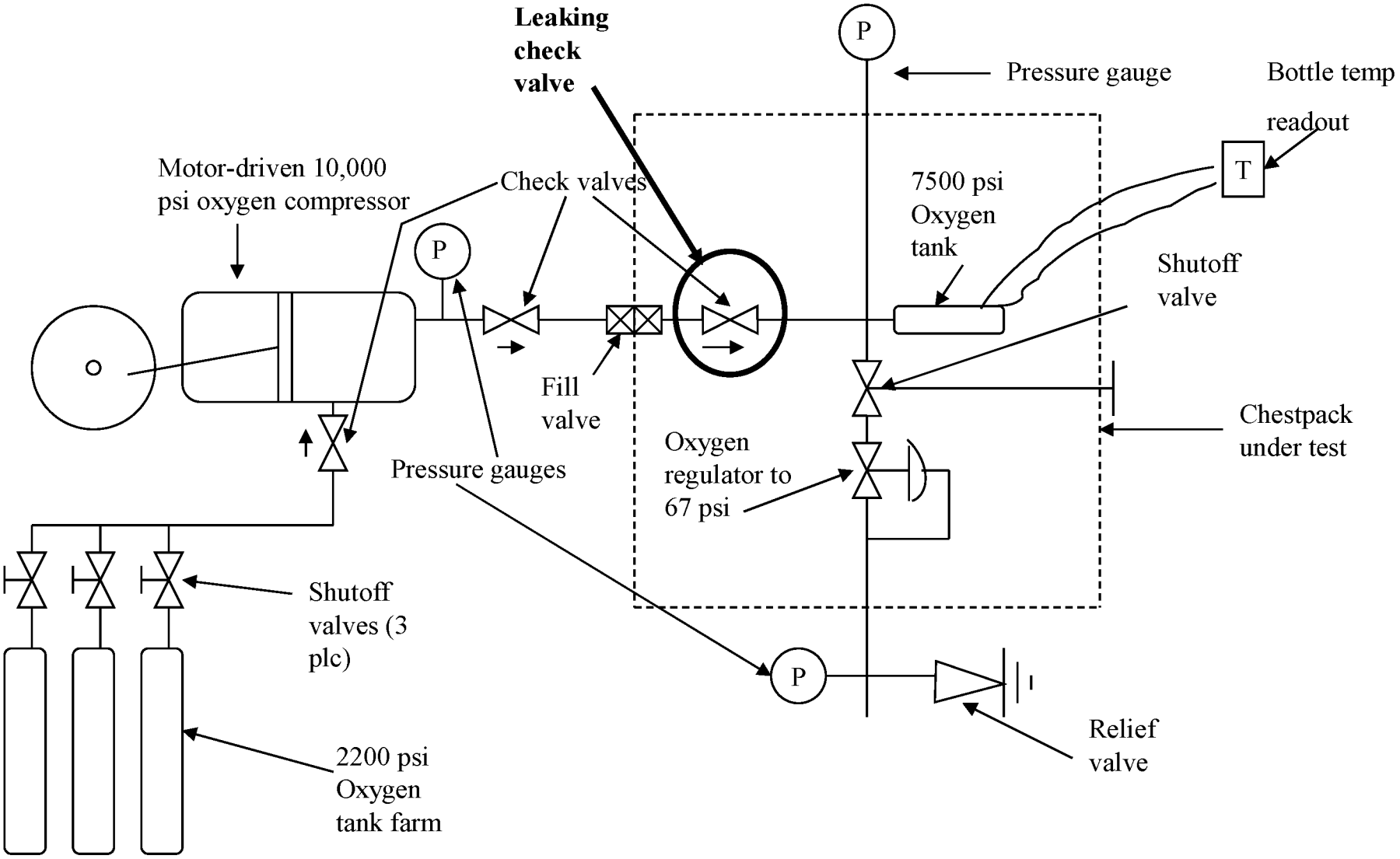
IP-1 Oxygen Charging Failure Investigation Plan

High-Pressure Check valve details



NOTE: During filling, stem moves back and forth due to pulsing action of pump. Captured pin in larger through-hole in stem limits travel.

IP-1 Oxygen Charging Failure Investigation Plan



IP 2

Check Valve Problem

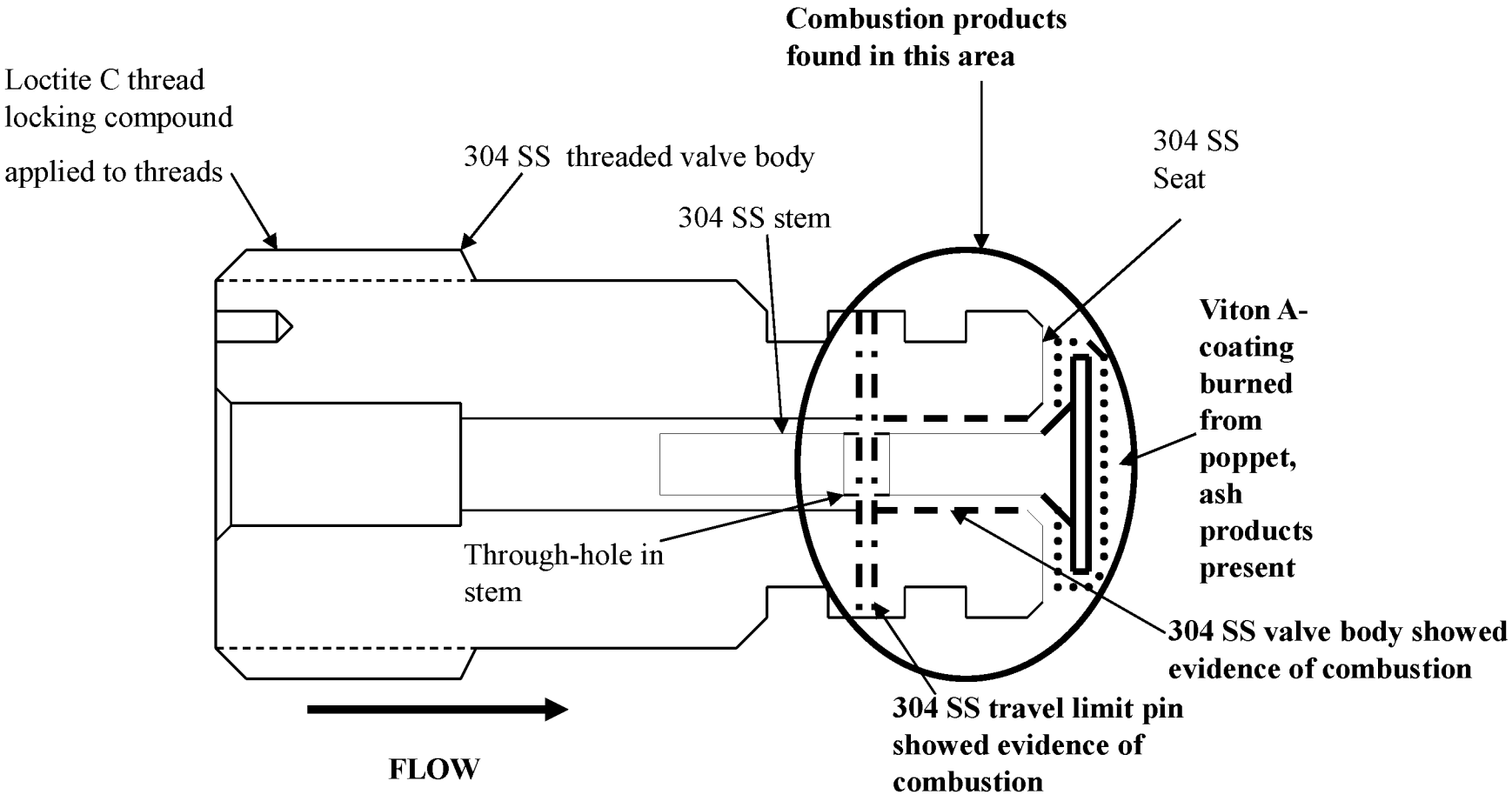
11-24-08

IP 2 - Oxygen Charging Failure

- As a pathfinder, a spare check valve was first disassembled and photographed.
- Next, the failed valve (see subsequent slide) was carefully disassembled, and findings noted:
  - The valve internal surfaces were liberally coated with combustion products
  - Parts of the SS body were severely eroded due to combustion
  - The SS travel limit pin was almost entirely consumed
  - The Viton coating on the poppet was completely gone
  - Analysis showed some residual Loctite C in the area of the bore around the valve
  - No contamination was found downstream of the fire site
- A materials analysis of the as-designed valve was conducted
  - The Viton A material, although combustible in the standard 72 ft-lb LO2 impact test, had successfully passed a configuration pneumatic impact test - it was a special formulation made by the contractor
  - Loctite C was found to be impact sensitive in the 72 ft-lb, LO2 test
  - Other lubricants (for O-rings) were found to be O2 compatible
- On May 22, during pre-flight operations at KSC, an instance of failure to hold pressure after charging was experienced on the Gemini IX-A chestpack.
- Teardown and analysis of the Gemini IX-A unit showed results similar to those encountered on the Gemini X chestpack, leading to a similar conclusion.
- Propose a failure mechanism; update all plans for Gemini IX-A and X; identify immediate, contributing and root causes with corrective actions, along with any SOF's

IP-2 Oxygen Charging Failure

Failed High-Pressure Check valve details



NOTE: During filling, stem moves back and forth due to pulsing action of pump. Captured pin in larger through-hole in stem limits travel.

IP 3

Check Valve Problem

11-24-08

IP-3 Oxygen Charging Failure

- The check valve was successfully redesigned, recertified and implemented (see previous slide for design details) on Gemini X, XI and XII
- Gemini IX-A used a replacement valve of the existing design, with the bottle filled using a reduced fill rate (250 psi/min vs original 500 psi/min) and 100 deg. Max. Bottle temp.
  - There was no back-up plan, because the Gemini IV pack was not compatible with the Astronaut Maneuvering Unit
- NO GENERALIZED MATERIALS AND APPLICATION SPEC FOR HPO2 WAS GENERATED AS A RESULT OF THESE TWO HIGH-PRESSURE OXYGEN-RELATED FIRES - IT TOOK THE SHUTTLE EMU FIRE OF APRIL, 1980, TO FINALLY IDENTIFY AND IMPLEMENT A ROOT CAUSE SOLUTION!

IP-3 Oxygen Charging Failure

Redesigned High-Pressure Check valve details