



# Apollo Spacecraft

1961 -1972



G. Blackburn  
25 November 2018  
LosCon, Marriott LAX



# Apollo One

AS-204 NAA 012

Gus Grissom

Ed White

Roger Chaffee

January 27, 1967



5.5 Hours

13.0 seconds

All copyrights G. Blackburn except where noted, 2018

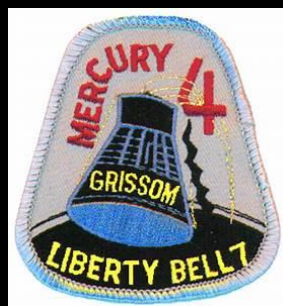


# Virgil Ivan "Gus" Grissom

40 Years Old

- Born April 3, 1926 , Mitchell Indiana
- Lt. Col. USAF
- Purdue University / Air Force Institute of Technology
- Mercury-Redstone 4 , Gemini 3, Apollo 1
- Wife: Elizabeth , Children: Scott and Mark

TIS\* = 5 Hours 7Minutes



\* Time in space





# Edward Higgins White III

TIS 4 Days 1 Hours 6Minutes

36 Years Old

- Born November 14, 1930 San Antonio Texas
- Lt. Col. USAF
- Illinois Institute of Technology/Purdue University
- Gemini 4, Apollo 1
- Wife: Patricia , Children: Edward and Bonnie





Pilot

# Roger Bruce Chaffee

31 Years Old

TIS = 0

- Born February 15, 1935 Grand Rapids Michigan
- Lt. Commander, USN
- USMA/University of Michigan
- Apollo 1
- Wife: Martha, Children: Sheryl and Stephen



# The Spacecraft

- AS-204 NAA 012CM
- Block I Configuration ( No LEM Docking )
- Velcro Use Review
- Conditional FWC
- 113 Short Items/623 ECO
- Altitude Testing ECU Failure
- SM Tank Failure
- Dec 30 Shirra Crew approve vehicle

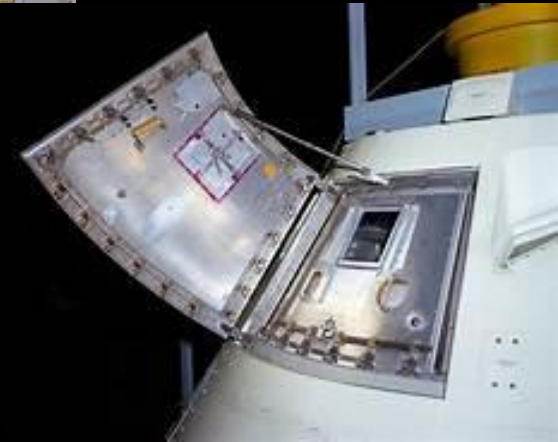


It isn't that we don't trust you, Joe, but this time we've decided to go over your head



# The Site

- Jan 6, 1967 Pad 39A Vehicle Stacked
- Isolated access
- No emergency egress



# The Test

- Two week Integrated Systems Test
- Plugs Out Test
- Non – Hazardous test No Fuel or Pyros
- Full Pressure suits
- Pure Oxygen 16.7 psi
- Evening test



You sort of have to put that out of your mind. There's always a possibility that you can have a catastrophic failure, of course; this can happen on any flight; it can happen on the last one as well as the first one. So, you just plan as best you can to take care of all these eventualities, and you get a well-trained crew and you go fly.  
— Gus Grissom, in a December 1966 interview



# The Accident

- 1:00 pm [EST](#) (1800 [GMT](#)) on January 27, first Grissom, then Chaffee, and White entered the Command Module
  - “Sour Buttermilk” Odor from suit air supply
- countdown was held at 1:20 pm ( No source found for odor )
- 2:45 pm Hatches installed
- Hatches sealed; Cabin pressurized to 16.7 O<sub>2</sub>
- Commcheck Grissom open mic, “ How will we get to the moon if we cannot talk between two buildings?”
- 5:40 pm while attempts were made to troubleshoot the communications problem. All countdown functions up to the simulated internal power transfer had been successfully completed by 6:20 pm, but at 6:30 the count remained on hold at T minus 10 minutes.
- increase in AC Bus 2 voltage occurred.
- 6:31:04.7 , “Hey Fire!”
- 6:31:06.2 (23:31:06.2 GMT) Chaffee “[I've, or We've] got a fire in the cockpit.”
- They're fighting a bad fire—Let's get out ....Open 'er up"
- "We've got a bad fire—Let's get out ....We're burning up", or
- "I'm reporting a bad fire ....I'm getting out ....“
- Command Module's inner wall at 6:31:19 (23:31:19 GMT, initial phase of the fire).

# The Fire

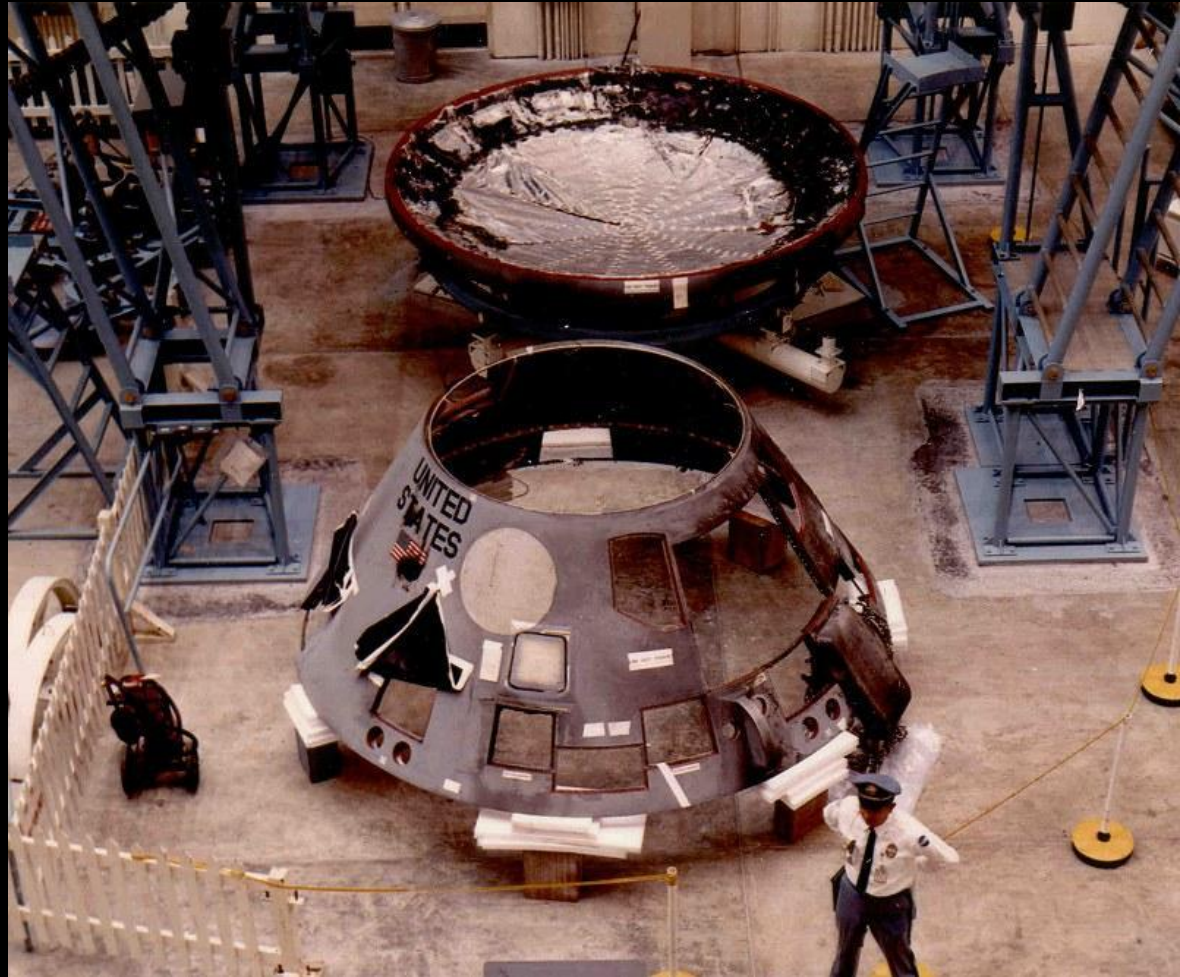
- 1<sup>st</sup> Stage Ignition
- 2<sup>nd</sup> Stage Pressure rise Cabin rupture
- 3<sup>rd</sup> Stage Toxic Gas buildup
- 4<sup>th</sup> Stage Flash Over
- 5<sup>th</sup> Stage Air quenching/ Carbon Monoxide – soot



**Ground crew access restricted for 5 minutes.**

# Investigation

- Panel formed
- Hardware impounded
- Failure Analysis

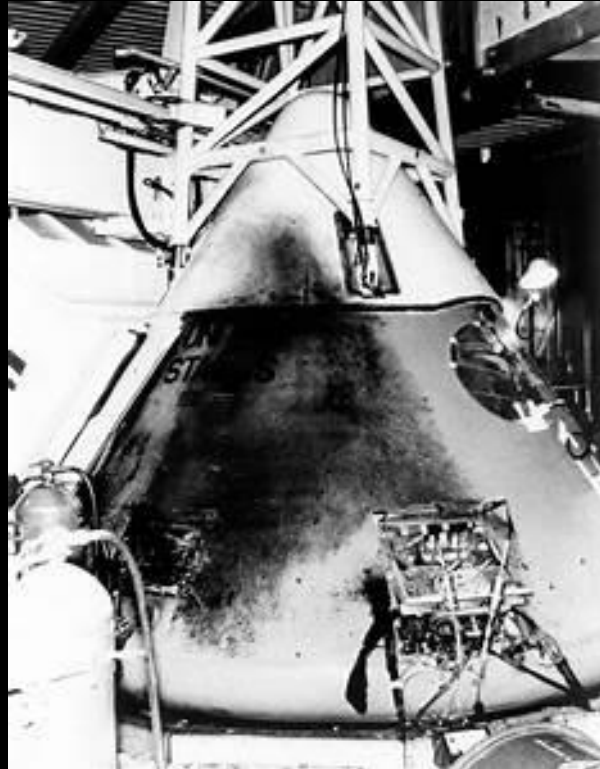




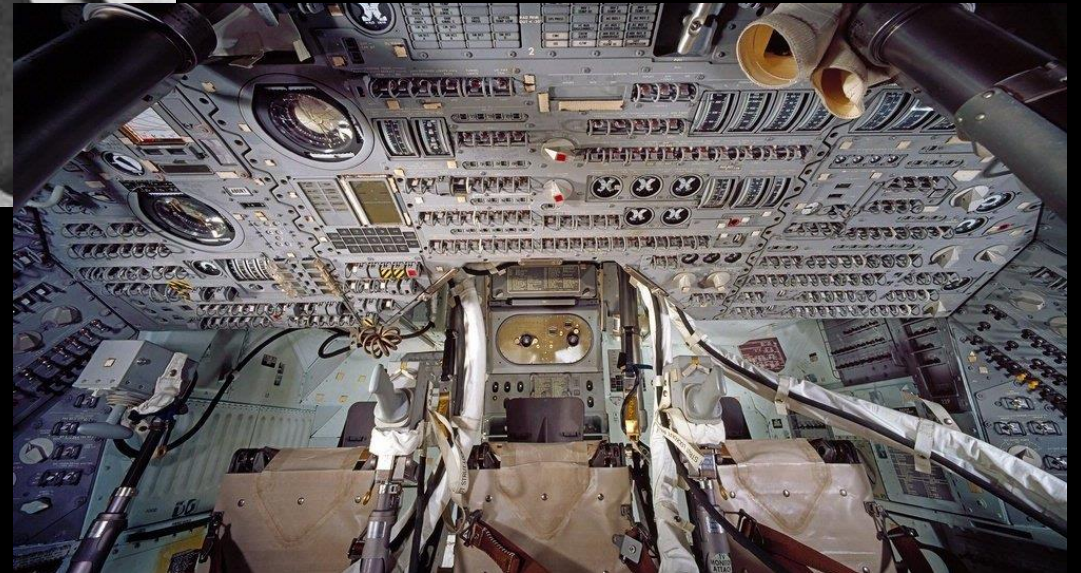
# Findings

- Cause of death Cardiac arrest due to Carbon Monoxide suffocation.
- An *ignition source* most probably related to "vulnerable wiring carrying spacecraft power" and "vulnerable plumbing carrying a combustible and corrosive coolant"
- A *pure oxygen atmosphere* at higher than atmospheric pressure
- A *cabin sealed with a hatch cover* which could not be quickly removed at high pressure
- An extensive distribution of *combustible materials* in the cabin
- *Inadequate emergency preparedness* (rescue or medical assistance, and crew escape)

# The Hatch



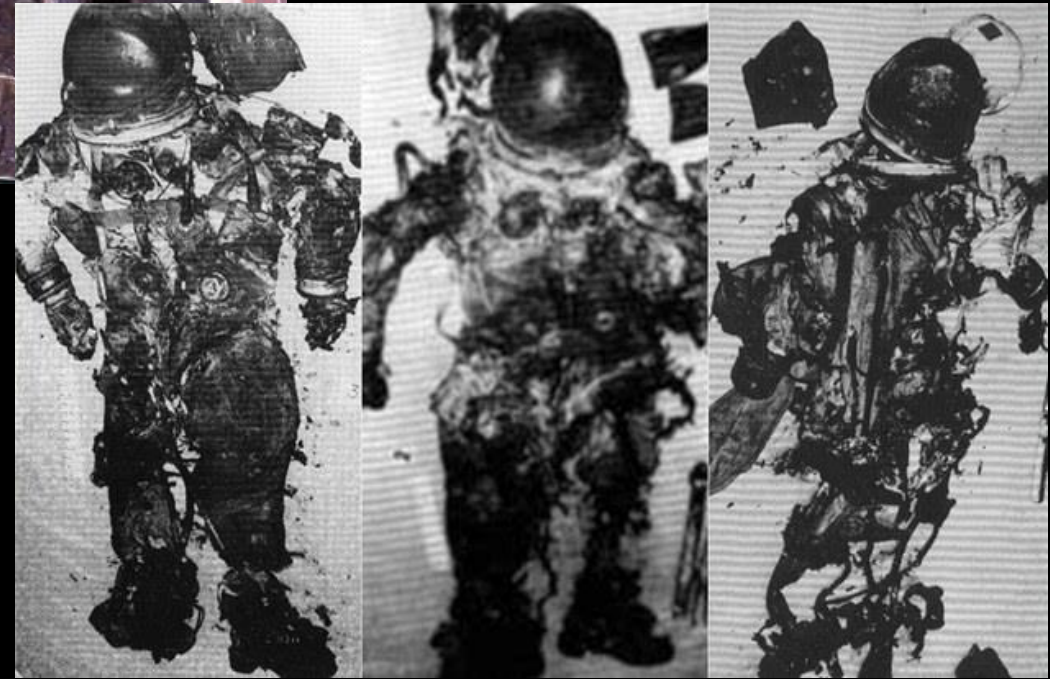
Pre Fire





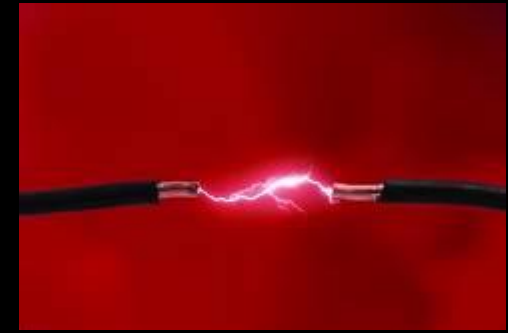
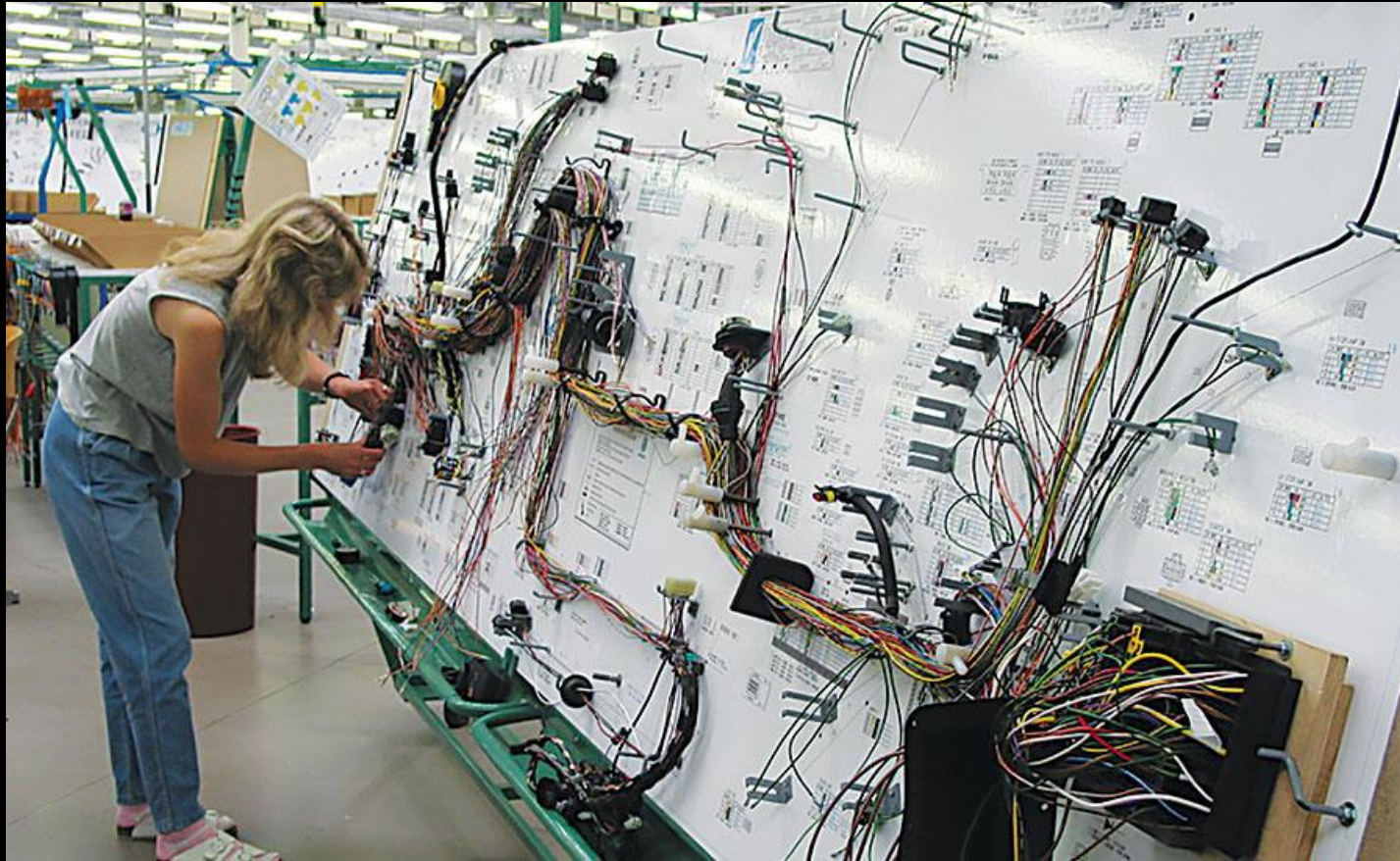


Post Fire





# Wiring Harnesses



# Lessons Learned

- People Fail, Nature Does
- Causes are Ego and Choice Centric
- Failure is directly effected by Complexity, Choices and Communication

***Failure is simply the opportunity to begin again, this time more intelligently.*** Henry Ford



# January 27, 2022 EPILOG

55 Years ago on this day in 1967 three men crawled into Americas first Lunar Spacecraft to test it and themselves in preparation for man's greatest exploration adventure. None of them came out of it.

Virgil Ivan Grissom, Edward Higgins White III, and Roger Bruce Chafee died at 23:31:19 GMT on the evening of January 27, 1967.

Their loss as those of others to come was caused by “ Failure “.

As Chris Kraft succinctly put it “ Failure is not an Option! “ and yet it would happen again and take the lives of fourteen more courageous “Pioneers of Aerospace”.

Have we learned the lessons – “Yet?”