Saint-Gobain Seals
Our Special Place in Space
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A Look Back at 60 years of History

Hopes, Dreams and Innovations
A Brief Introduction of Saint-Gobain Seals

We provide SEALING and MATERIAL critical parts for extreme applications in core systems.

In 2016, we adopted a brand promise to better help our customers understand "who we are and what we do" as well as engage our team members.

Our People and Products are CRITICAL PARTS of core systems so we CANNOT FAIL!
Our Space Application Areas

Payload & Guidance:
- Spacecraft
- Satellite
- Launch abort system

Structure & Tanks:
- Frame
- Fuel and oxidizer tanks
- Landing gears

Propulsion (Engines & Auxiliaries):
- Engines
- Pumps
- Valves
- Injectors
- Manifolds
- Pipes, ducts, flanges, feed lines and actuators

Ground Support System:
- Fuel & oxidizer storage and delivery
- Launch pad
What Kind of Solutions Do We Design and Manufacture for Space?

OmniSeal Spring-Energized Seals (103A, 400A, RACO)

Making THE difference:

Extreme pressure conditions ranging from vacuum to several hundred PSI (a hundred bar)

Extreme temperature conditions ranging from cryogenic to many hundreds of degrees

We use different seal designs but the RACO seal has been there from the beginning!
What Kind of Solutions Do We Design and Manufacture for Space?

Rulon Fluoropolymer Materials (AR, LR)

Making THE difference:

Low friction

Self-lubricating

Low wear advantages
What Kind of Solutions Do We Design and Manufacture for Space?

Meldin Thermoset Polyimide Materials (7000 Series)

Making THE difference:

Excellent mechanical integrity even at cryogenic temperatures

Compatible when in contact with fluids

Replaces heavy metal bushings
Space Trends

**Fuels**
- Variety of Cryo Combinations
- Methane becoming more common
- Solid fuel difficult to control
- Metal seals

**Reusable**
- Landing gear
- Engine components
- Launches are more affordable

**Colonization**
- Deeper Space
- Inhabit Mars/Moon
- Longer voyages
Space Trends

Quality

Space Tourism
- Immature industry
- Multiple business models
  - Mars
  - Space station
  - Orbit

Global Presence

Space Jam
- Space planes
- Micro satellites
- Space stations
- Internet of things
- GPS
- Multiple nations (France, Japan, China, Russia, India)

Manufacturing

Affordability
- Launches are more affordable than ever
- Launches can be done quicker than ever
Space Trends: Larger Spacecraft and Larger Diameter Seals
Range of our Large Diameter Seals To Date but Getting Larger!
2018  Feb 6
Falcon Heavy & Tesla

A cool rocket and a cool car head into space.

We've been there on Falcon Prime to Falcon 9.
Did You Know that Falcon Heavy is 3 rockets in one? I guess that's where they got the name!

We have hundreds of seals in the rocket but the most important are located:

Main Oxidizer Valve, Preburner Oxygen Valve - controls oxygen flow to engine and combustion chamber

Center Pusher – separates first and second stage of the Falcon 9/Falcon Heavy

Thrust Vector Control Actuator, Nitrogen Thruster - controls thrust direction of the engine and vehicle flight direction on fly back from landing

RP1 Drain and Fill Valve - loading and unloading of fuel into and out of the vehicle

Oxygen Drain and Fill Valve - loading and unloading of oxygen into and out of the vehicle
2011-Present

Space Launch System (SLS)

Part of NASA's deep exploration program

World's most powerful rocket that stands over 200 feet TALL

Set to launch in 2019
With the world’s most powerful rocket, it truly needs a SPECIAL seal ... A Large Diameter Seal to be exact!

Seal Type: RACO Inner Face Seals

Location: Liquid Oxygen Tank and Liquid Hydrogen Tank

Diameter: 74” Primary, 76” Backup Sump / Manifold 51” Primary, 52” Backup FWD Cover

Tanks hold 733,000 gallons of propellant and feed the engines to produce 2 million pounds of thrust!
1998 - Present

Falcon 9 launches Dragon Spacecraft to International Space Station

- Seals
- Piston guide rings
- Poppet guide bushings
- Valve poppets
- Trunnion bearings

All used in the Falcon 9 rocket's nine Merlin engines and thrusters.

First time in history that a commercial company launches a spacecraft to visit the International Space Station.
Did You Know that we also have critical parts on ISS?

Thousands of seals are used in core systems to support the astronauts' lives on the station.

Our seals are also in experimental equipment where the team conducts testing.
1990s to 2011

Mars Exploration Program, Atlas V Rocket and Mars Rover Curiosity

On Curiosity, the robotic arms and drilling and surface removal tools use our Rulon ball bearings.

Saint-Gobain Crystals supplied a special orange “scintillating plastic” material used in this rover’s radiation detector.
Using these tools, Curiosity can study clues about past and present environmental conditions on Mars.

So far, it’s found some COOL things:

Ancient Streambed where water once flowed (Evidence of water)

Rock samples to examine its chemical ingredients for life (using drilling tool)

Boron, an essential ingredient for life on Earth

Check out its Twitter account @MarsCuriosity to get the latest news!
1981 - 2011

Space Shuttle Program

Our seals have been in 132 shuttle missions (first space shuttle to retirement of the program in 2011)

Included in 25 critical applications in the main engine, life support systems, valves/tanks for hypergolic fuels, and external tank.

Fun fact: Our seals have traveled more than 500 million miles.
Although the Space Shuttle program is retired, it made significant contributions:

- Building the International Space Station (in orbit today to conduct hundreds of science experiments on human health and engineering)
- Launching and servicing the Hubble Space Telescope
- Visiting the Russian space station Mir
- Launching numerous satellites and probes
- Performing thousands upon thousands of hours of basic science experiments
1975

Viking Landers

2 Space probes to Mars

Sampling chambers where mission critical experiments were conducted contained RACO seals.

Our RACO seals were substituted for metal seals which failed leakage tests just months short of vehicle launch.
1961 - 1972

Apollo Program

Landing the first people on the moon on Apollo 11.

We did this on July 20, 1969 when Neil Armstrong and Buzz Aldrin landed their Lunar Module.
Our seals were on the Saturn V rocket that launched Apollo 11 but also ... 

If you want to see a piece of history up close, the Lunar Lander is at the Smithsonian National Air and Space Museum in Washington, D.C.

It displays our RACO seal, which was used to seal the triangular-shaped window on the space vehicles.
Thanks for taking this space journey with Saint-Gobain Seals.

We are excited about what the future holds and where the next generation of visionaries will take us!