

NASA SPACE POWER FACILITY

LN₂ HIGH PRESSURE TANK SUPPLY SYSTEM

CASE STUDY #10

Company:

The Space Power Facility (SPF) houses the world's largest space environment simulation chamber (vacuum chamber) measuring 100 ft. in diameter by 122 ft. high. The facility was designed and constructed to test both nuclear and non-nuclear space hardware in a simulated Low-Earth-Orbiting environment. Some of the test programs that have been performed at the facility include high-energy experiments, rocket-fairing separation tests, Mars Lander system tests, deployable Solar Sail tests and International Space Station hardware tests. The SPF is located at the NASA Glenn Research Center at the Plum Brook site in Sandusky, Ohio.

Challenge:

This system went to support the newly designed and manufactured Reverberant Acoustic Test Facility (RATF) at the NASA Space Power Facility in Sandusky, Ohio. The Space Power Facility was upgraded by SAIC Constructors (known as Benham Constructors, LLC, a wholly owned subsidiary of SAIC at the time the work was done) with vibroacoustic capabilities, which include reverberant acoustic, mechanical vibration and modal test facilities.



Chart's system is used to flow nitrogen gas through acoustic horns and as an inert purge gas. The upgrade is an integral part of Glenn's Space Environment Test Project, responsible for completing test facilities to provide one-stop space environmental testing required by the NASA Constellation Program and the Orion Crew Exploration Vehicle at Johnson Space Center. CEV is part of the next generation of manned space flight vehicles being developed for the return to the Moon and Mars.

The horn room has 36 nitrogen-driven acoustic horns to simulate the high noise levels that will be experienced during a space vehicle launch and supersonic ascent conditions. The RATF is capable of an overall sound pressure level of 163dB within a 101,500 cubic foot reverberant chamber.

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NASA Plum Brook Station



LN₂ High Pressure Tank Supply System

Solution:

Chart was able to provide technical expertise and advice in high-pressure liquid supply systems. Working with Benham/SAIC Constructors and the end user, we designed a system to satisfy all customer requirements. Chart was able to determine that their existing equipment would not work for their application. In order to reduce the maintenance of high pressure pumps, a pump-less system was designed and manufactured by Chart.

The system is capable of storage and delivery of liquid nitrogen at 780 gpm at a constant pressure of 300 psig for a duration of 20 minutes and one test per day. The liquid nitrogen flows into the water-bath vaporizer which supports a vaporization of a flow rate of 72,000 scfm.

The system utilizes a high pressure VS-6000 pusher tank at 370 psig (500 MAWP) to provide vapor pressure on two VS-9000 storage tanks at 300 psig (363 MAWP) to support the flow rates required during liquid withdrawal. The system is controlled by Benham's SCADA system by using two separate PID control loops and two CPT characterized seat control valves to maintain pressures of all three tanks for a ready-to-use status.

Chart provided the design, engineering, manufacturing, supply and commissioning of all LN₂ supply equipment. Senior Engineering Services for systems downstream of Chart's equipment of supply includes thermal and stress analysis of all cryogenic piping.

"Chart's expertise and willingness to be a team player were instrumental for the success of this project."

—Neil Waggoner, PE
RAFT Project Manager at Benham Constructors, SAIC
