Fascinating Facts

NASA Stennis and Space Shuttle Main Engine Testing

- Space shuttle main engines were manufactured by Rocketdyne (later Pratt & Whitney Rocketdyne and Aerojet Rocketdyne; now L3Harris Technologies). It was the only large reusable liquid rocket engine at the time – and the **MOST TECHNOLOGICALLY-ADVANCED, HIGH-PERFORMANCE** engine ever produced.

- Thanks to **INTENSIVE GROUND TESTING**, the space shuttle main engine is the best-understood rocket engine in history.

- NASA Stennis tested and proved flightworthy every main engine that helped power **135 SHUTTLE LAUNCHES** from 1981 to 2011.

- No space shuttle mission **EVER FAILED** due to main engine malfunction. The only shuttle (STS-51-F) to experience an early engine cutoff was able to reach orbit and complete its mission.

- Shuttle main engine testing followed a **"TEST LIKE YOU FLY"** approach. NASA Stennis teams worked through an exact countdown process for hot fire, just as during an actual launch.

- Shuttle main engine testing involved several NASA Stennis **SUPPORT FACILITIES** – the High Pressure Gas Facility to supply gaseous hydrogen, air, helium, and nitrogen; the High Pressure Water Facility to flow hundreds of thousands gallons of water per minute to the test stand; and the Cryogenic Storage Facility to supply liquid oxygen and liquid hydrogen propellants.

- NASA Stennis test stand propellant run tanks could not hold enough liquid oxygen and liquid hydrogen to support a full-duration (500-second) space shuttle main engine test. Run tanks were replenished from docked barges, a **PRECISE TRANSFER PROCESS** controlled by test teams.

We (went) from sitting on the launch pad at Kennedy Space Center to traveling at 17,500 miles an hour … in eight-and-one-half minutes. It is still mind boggling to me. … The effort that you contributed made it possible for us to sit back and ride. We couldn't even make it look hard.

NASA astronaut Robert L. Crippen, speaking to NASA Stennis employees following the successful STS-1 space shuttle mission, 1981

- During the shuttle program, main engines and their components underwent several upgrades and modifications. **EVERY MAJOR CHANGE** was tested and proven flightworthy at NASA Stennis, helping to ensure astronaut safety and mission success.

- Space shuttle main engine testing at NASA Stennis helped the agency (1) prove the engine design, (2) certify engines as flightworthy, (3) understand and verify engine **OPERATION AND PERFORMANCE**, (4) identify and mitigate problem areas prior to flight, and (5) investigate and resolve performance anomalies.

- In addition to establishing startup and shutdown sequences for the new space shuttle main engine, operators at NASA Stennis had to **DETERMINE AND DEFINE** proper processing guidelines for handling the engines both before and after hot fire.

- Testing at NASA Stennis from 1975 to the first shuttle flight in 1981 helped identify various engine issues that were **SUCCESSFULLY ADDRESSED** prior to the maiden launch.

- NASA Stennis operators carefully introduced malfunctions at various points of hot fire to determine how space shuttle main engines would perform. They also pushed engines beyond prescribed limits to fully define **OPERATING PARAMETERS**.

- By the launch of the first shuttle mission in April 1981, more than 700 main engine tests had been conducted. **ALMOST 600** of those were conducted at NASA Stennis.

- Extensive space shuttle main engine **DEVELOPMENT AND TESTING** helped advance several engineering disciplines, including fluid dynamics, structural dynamics, and materials.

- In addition to supporting shuttle missions, the space shuttle main engine has been upgraded by L3Harris Technologies (formerly Aerojet Rocketdyne) as the RS-25 engine to help power NASA's initial **ARTEMIS MISSIONS** to the Moon.

Testing was an integral part of the space shuttle main engine project and was critical in the success of the Shuttle Program. … Without testing, the effects of modifications to systems as complex as (the) space shuttle main engine are impossible to accurately determine.

NASA Deputy Chief Engineer Katherine P. Van Hooser, co-author of Space Shuttle Main Engine – the Relentless Pursuit of Improvement presentation paper, 2011