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LIQUID HYDROGEN

The Douglas Aircraft Company-built S-IV stage of the giant Saturn space vehicle is propelled by the most advanced rocket propulsion system developed since rockets were first fired in quantity in the 1940's.

The early German rockets, as well as most of the "new" liquid-fueled launch vehicles in the nation's current space programs, use a combination of liquid oxygen and a kerosene-type fuel as propellants.

S-IV, however, uses liquid hydrogen as a fuel instead of kerosene. Because this cryogenic combination of liquid hydrogen and liquid oxygen is many times superior in thrusting power, aerospace engineers declare it will be the dominant space propellant for many years to come.

For the S-IV stage, Douglas Missile and Space Systems Division is prime contractor to the National Aeronautics and Space Administration. Pratt and Whitney Aircraft Division, United Aircraft Corp., produces the six RL-10A3 liquid hydrogen engines that will propel the S-IV.

The problems of confining liquid hydrogen in the lightweight tanks of a space vehicle -- and those associated with piping it to a rocket engine and combining it with liquid oxygen to furnish the fiery power needed -- have required many advanced developments in propulsion technologies.

As the name suggests, liquid hydrogen is nothing more than a liquid state of the common combustible gas. It is much colder, however - a frigid, minus 423 degrees Fahrenheit.

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Liquid hydrogen can leak through the tiniest hole in a tank or pipe that would seal in ordinary liquids.

Because of its super-cold temperature, it must be heavily insulated from heat sources to prevent "boil-off" -- and from liquid-oxygen to prevent it from actually "freezing" the -297°F liquid-oxygen within the S-IV.

In its gaseous state, hydrogen is the most common element of earth. It accounts for 93 per cent of the total number of atoms and 76 per cent of the weight of all matter in the universe. Compared to other fuels, the combination of lower molecular weight and greater energy formation makes liquid hydrogen a near-ideal propellant.

Only in the last 10 years has liquid hydrogen been removed from the status of a laboratory curiosity to its current prime role as a space fuel.

In the S-IV stage -- the largest space vehicle in advanced development to employ liquid hydrogen -- Douglas engineers and technicians are helping to shape this new technology into a reliable system that will contribute to the success of the nation's manned spacecraft program.

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