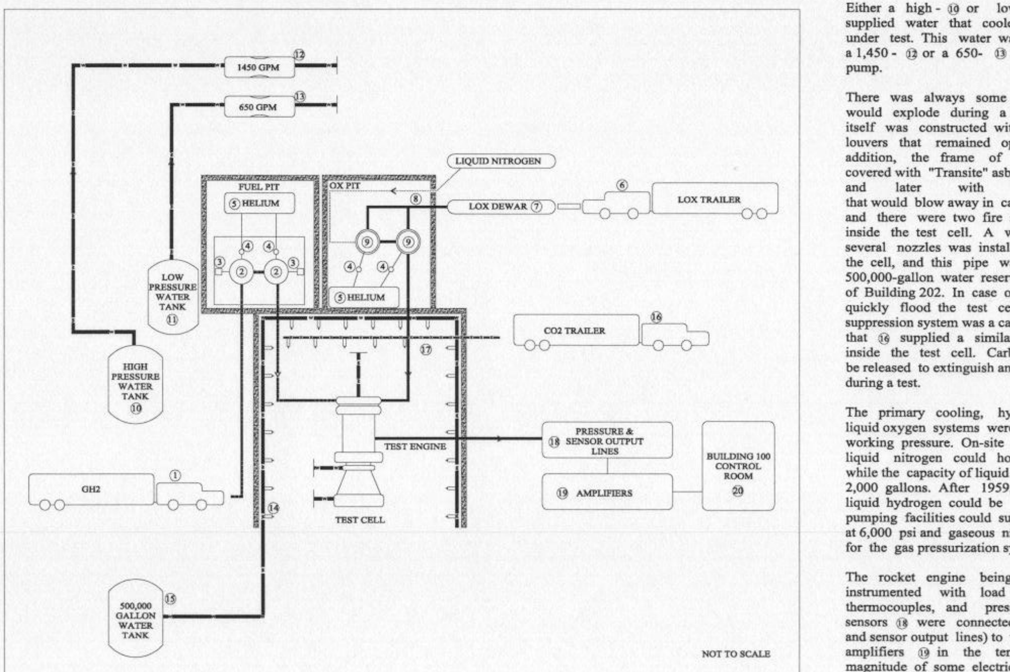
ROCKET REACTANT FLOW CHART

By the late 1950s research engineers and scientists working at Lewis Flight Propulsion Laboratory believed that hydrogen was the optimum fuel, and oxygen the ideal oxidizer, for upper-stage rockets. However, before NASA researchers could achieve the theoretical advantages of hydrogen/ oxygen propulsion, they had to develop practical solutions for the engineering problems involved in devising such a propulsion system. The first major issue was that hydrogen is a powerful fuel that must be handled carefully to minimize the risk of explosion. In addition, large quantities of hydrogen were not available during the early years of the rocket research program.

From a practical standpoint, many rocket engineering design problems could be resolved using other, readily available fuels. In addition, the testing and operation of prototypical rocket engines would be useful regardless of which reactants were used. Consequently, the first experimental engines tested at the Rocket Engine Test Facility were gasoline-fueled and run on the 89-kilonewton (20,000-lb.) high-thrust vertical test stand.

Researchers followed standard operating procedures to prepare an engine test. Gasoline was pumped from a mobile tanker-trailer ① into cylindrical tanks ② housed in the fuel pit. These tanks were mounted in a framework that contained load cells ③ in the suspension. The load cells weighed both empty and full tanks. Weight was measured while fuel was being drawn from the tank. By comparing the weight of a full tank with the weight of the tank after fuel was used in a test, researchers could accurately determine the amount of fuel burned during the test. They could then calculate the rate of fuel use by plotting tank weight against run time. Variably positioned hydraulic valves ④ controlled the pressure of inert helium gas ⑤ flowing into the fuel tanks. The pressure of this gas forced fuel from the tanks and into the rocket engine being tested.

Liquid oxygen was transferred from a mobile tanker-trailer ⑥ into a double-walled, vacuum-insulated tank called a "Dewar" ⑦,



which was located on the hill west of Building 202. Oxygen flowed through a pipe, which was jacketed with a liquid nitrogen bath ⑧, into liquid oxygen tanks ⑨ in the oxidizer pit. These tanks were encased inside outer tanks that contained a liquid nitrogen bath.

These liquid nitrogen baths around the piping and tanks caused the oxygen to remain liquid. Helium gas ⑤ under pressure forced the liquid oxygen from the tanks and into the engine being tested.

Either a high- ⑩ or low-pressure tank ⑪ supplied water that cooled the rocket engine under test. This water was transported using a 1,450- ⑫ or a 650- ⑬ gallon-per-minute pump.

There was always some risk that an engine would explode during a test. The test stand itself was constructed with blast doors and louvers that remained open during tests. In addition, the frame of Building 202 was covered with "Transite" asbestos cement panels, and later with fiberglass panels, that would blow away in case of an explosion, and there were two fire suppression systems inside the test cell. A water pipe ⑭ with several nozzles was installed on three sides of the cell, and this pipe was connected to the 500,000-gallon water reservoir ⑮ located east of Building 202. In case of fire, water could quickly flood the test cell. The second fire suppression system was a carbon dioxide trailer that ⑯ supplied a similar piping system ⑰ inside the test cell. Carbon dioxide could be released to extinguish any fires that started during a test.

The primary cooling, hydrocarbon fuel, and liquid oxygen systems were rated at 5,000 psi working pressure. On-site storage systems for liquid nitrogen could hold 28,000 gallons, while the capacity of liquid oxygen storage was 2,000 gallons. After 1959, 18,000 gallons of liquid hydrogen could be stored on site. The pumping facilities could supply gaseous helium at 6,000 psi and gaseous nitrogen at 3,000 psi for the gas pressurization systems.

The rocket engine being tested would be instrumented with load cells, strain gages, thermocouples, and pressure gages. These sensors ⑱ were connected by wires (pressure and sensor output lines) to terminal blocks and amplifiers ⑲ in the terminal room. The magnitude of some electrical signals would be small, and signal losses would exceed allowable limits. Consequently, electrical signals would need to be amplified before transmission to the control room ⑳ located 1600 feet away. The sensors would be transmitted over data transmission cables to the control room recording and readout devices (Building 100 data recording).

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NASA ROCKET ENGINE TEST FACILITY RECORDING PROJECT
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