



## NASA Space Shuttle External Tank Unsteady Buffeting Problem

by Dr. John C. Adams



In the early-to mid-1970s, the von Kármán Gas Dynamics Facility (VKF) was heavily involved in configuration development testing of the NASA space shuttle, both orbiter and launch vehicles (external tank and solid rocket boosters). The external tank went through aerodynamic force and moment testing in VKF's Tunnel A over a range of Mach and Reynolds number with Harry Carroll from Martin Marietta (now Lockheed Martin) the on-site user representative.

Martin Marietta was the prime contractor to NASA for external tank design and construction. At that time Billy Griffith was the assistant branch manager in the aerodynamics projects branch of VKF. Griff, as he was referred to, made a special point to meet with the on-site

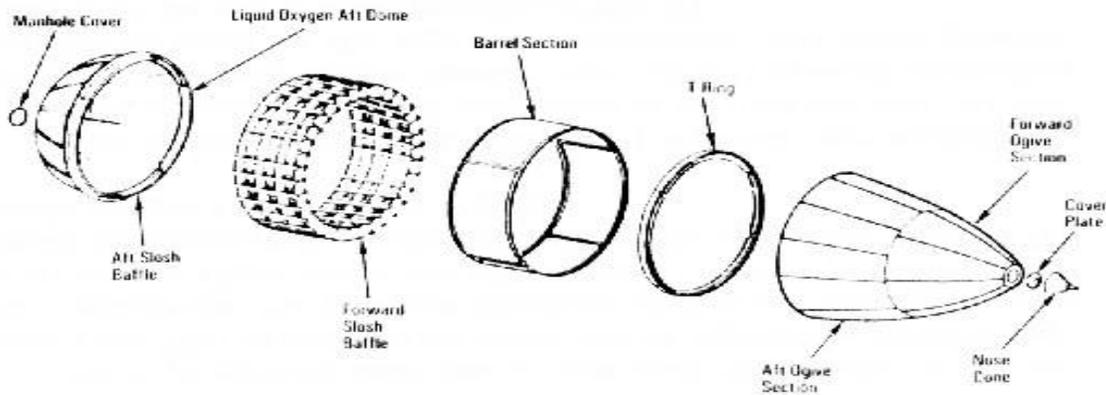
user representative early every morning to see how the previous night's testing had gone and if there were problems which needed to be addressed during that day in order to be ready for implementation the next night.

One morning Harry came in with a request for help – the external tank was experiencing an



Space Shuttle External Tank in the von Karman wind tunnel facility

unsteady buffeting at some flow and model attitude conditions. Griff called me in and we looked at the real-time Schlieren movies of the



*Liquid Oxygen Tank Structure*

buffeting phenomena where it quickly became apparent that the root cause was the blunt-nosed cover for the oxygen valve on the very front of the tank. Harry referred to this blunt-nosed cover as the “fire hydrant” and indeed it did resemble a fire hydrant attached to the front of the tank.

Griff and I suggested that the “fire hydrant” be replaced with a sharp biconic nose cone, which Harry was agreeable to try. Using computational fluid dynamics (CFD), we designed an appropriate biconic nose cone, gave a sketch of it to the VKF machine shop for modification of the external tank model and were ready to test that night. In our next morning

meeting, Harry was ecstatic over how well this biconic fix had solved the buffeting problem. Martin Marietta refined and implemented this biconic nose cone concept on the production external tank and the entire shuttle flight program utilized this configuration.

Just another example of how AEDC has helped to locate and solve problems using ground test before flight. Remember the red white and blue AEDC button “TEST BEFORE FLIGHT” slogan.



**Space Shuttle External Tank**