# HENRY O. POHL

Education: BS Mechanical Engineering, Texas A & M.

38 years with the federal government. Worked at the Army Ballistic Missile Agency, under direction of Werner Von Braun, Marshall Space Flight Center and Manned Spacecraft Center (now Johnson Space Center).

Test Engineer on Redstone, Subsystem Manager on Apollo, Section Head, Branch Chief, Division Chief, and Director of Engineering at Johnson Space Center.

Worked on Redstone, Jupiter, Saturn 1, Saturn 5, Mercury, Gemini, Apollo and the Space Shuttle.

Member AIAA since 1957 (American Rocket Society then)
Fellow: AIAA
Fellow: American Astronautical Society

Numerous Awards, Including ASME Westinghouse Gold Medal, Presidential Medal of Freedom, Presidential Meritorious Executive Service, NASA's Outstanding Leadership, Dwight Look College Of Engineering Outstanding Alumni Honor Award and Several Patents.

There should be a lot of information available about me on the internet. In 1996 the Johnson Space Center did an Oral History Project where they spent about 4 hrs interviewing me, along with most of the other people that worked on Apollo and the Space Shuttle. I know that is available on the net along with a lot of other

stuff. Some of that may differ from my thinking now as time has a way of changing what one remembers and what a person thinks is significant. I would suggest that any interested student visit those sights. Thibodaux and Faget would be particularly good ones to look at and read.
While with ABMA, I designed and tested the roll control system used on the first Jupiter's. That consisted of 4 small 25 lb peroxide thrusters on the base of Jupiter. It was later replaced with a nozzle using the exhaust from the main engine turbine.

I designed and did all the testing on the vernier correction system for the warhead on the Jupiter. That consisted of a single gimbaled 500 lb peroxide thruster. The first one failed to work as I did not realize that when the Jupiter main engine shut down all the fuel would go to the top of the tank and the nitrogen just bubbled through the fuel and produced no thrust. To make matters worse no one could tell me where the gravity vector would be or if there would even be one when the start command was given. We had 3 days to come up with a fix and get it retrofitted in the next system. One of the technicians suggested we put a flex hose in the tank with a weight on the end. That is exactly what we did. We took a braided bellows flex hose, cut the braid off it and welded it to the end of the inlet fitting to the tank, put a weight on the end of it and stuffed it into the tank. That was perhaps this country's first zero gravity expulsion system and it worked. The bellows inside the braid was very thin and very flexible. Since there was no delta pressure across the bellows there was no need for the braid on the outside of the bellows.

I designed a 500lb thrust LOX/RP1 engine for use in wind tunnel and high altitude studies. Eight of these thrusters were clustered in a 13 inch diameter rocket for a 1/20 scale model of the Saturn 1B. This model was used for wind tunnel testing on Base heating, design of the launch deflectors and high altitude testing in a vacuum chamber. A variation of this model was used to solve the

base heating problem on Polaris, to understand the base heating on Saturn 5 and the Space Shuttle. That was the best program I worked on. I did the design, the hardware was fabricated in our machine shop and I did all the testing. That project set the stage for everything that came later. I learned about materials, heat transfer, fluid dynamics, Combustion dynamics, Instrumentation, control systems, tolerance buildup, Machine shop tools and capabilities. The program was so successful that I was asked to make a 20 minute movie which I did mostly from test film. Dr. Von Braun showed the movie to congress in about 1959. Those were the days when we had good supervisors. They gave us a lot of flexibility and a lot more responsibility then we deserved. I probably designed 20 different injector designs, and 5 or 6 camber designs. I remember needing to put a copper chamber inside a stainless steel chamber and we didn't have sufficient room to put a mechanical connection between the two so I wanted to weld the two together. I was told we could not weld copper to Stainless so I hung around that afternoon until everyone else left work. I got a piece of copper and a piece of stainless, clamped them in a vice and using a TIG welder and a tungsten rod I practiced until I could glue the two together. The next day I showed the technicians that you could weld the two together. I quickly learned that when you try and come up with a 1/20 scale of the H-1 engine that some things don't scale. For example the nozzle on the H-1 engine was less then _ inch thick. To scale that to 1/20 would have made it 0.025 inches thick. Trying to put a cooling system in that would be impossible. I could run a test, look at the data and make a few changes, take the sketch by the machine shop when I left work. The next morning I would stop by the machine shop, pick up the part and test it that day, look at the data and sketch up a new part and drop it back by the machine shop that evening. At first I would sketch up the changes I wanted and give the sketch to the drafting group but that proved much too slow to get anything done. I made many mistakes and with each mistake I learned a lot. We did a lot of cut and try with very little analysis.

When I transferred to the Manned Spacecraft Center in Houston I knew as much or more about what could be, what may be and what was not likely then most everyone else there when it came to small propulsion systems. I remember sitting in a meeting one day where the contractor was going over the plans for one of the altitude facilities for testing small rocket engines. When they finished with the briefing I told them that it was a very fine design, there was but one small problem it would not work and told them why. The reason I knew that is that we had taken some big tanks welded them together and put a vacuum pump on them. We could pump the system down to about 200,000 foot altitude and fire my little rocket engine. The exhaust had to make a 90 degree turn about 5 ft from the engine. Instead of turning the gas just bounced back and killed the vacuum around the engine. I then spent several weeks with the contractor re designing the facilities.

These are just some typical examples of my early years with the Government. We had good facilities, very good technicians and outstanding management, not only at ABMA, but at Langley, the Lewis Research Center and the Navy Research centers. I am absolutely convinced that, had it not been for this experienced group of individuals that had accomplished so much in their own right, we would never have made it to the moon. I am equally convinced that had we not started the Space Shuttle when we did it would not have been successful. When we started the Space Shuttle program we had a very large cadre of people in industry that were experienced in all the disciplines required to build manned space vehicles. This country for many years had this industrial capability in the Aircraft industry. In 1972 we also had this capability in Space. Just to use the Space Shuttle main engines as an example: Within the span of a persons working life span the same people that designed the Redstone engine, designed the Jupiter, Thor, Atlas, Saturn 1, Saturn 5 first, second and 3 rd stage engines and the Shuttle Main Engines. The development of the

Space Shuttle engines was started in 1972. We have done nothing in this country since. Now we are thinking about going back to the moon. We no longer have that cadre of experienced people to lean on because we did away with the government labs and haven't had a consistent program within industry to maintain the experience base necessary in industry. I think this country is going to discover just how difficult it really was to go to the moon. Going into space is still not easy. It takes just too much energy and the equipment has to be too light. Since the Apollo program we have made much progress in most of the areas required for space travel but have accomplished little in the way of propulsion. It is just not natural for earth bound engineers to think in terms of the absence of pressure and the absence of gravity.

I hope this will be of some benefit
Henry Pohl