
# an interview with dr. frank KOSDON

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introduction by gary rosenfield

## Dr. Franklin "Frank" Kosdon is widely known for his unique, no-nonsense high thrust reloadable motors. What is not as well known is his fascinating educational and business background. In the following interview, Frank "bares all" for Extreme Rocketry

**Extreme:** Where were you born and raised?
**Kosdon:** I was born in East L.A. on November 14, 1941, about six miles east of the Civic Center. I lived in Los Angeles until about the second or third grade, around 1949 or 1950.

**Extreme:** When did you first become involved with rocketry?
**Kosdon:** My involvement in rocketry began when I left east L.A. My dad and my uncle purchased some ranch property, near Buttonwillow, California which is west of Bakersfield. While I was out there, I became interested in astronomy and constructed several telescopes. After looking at things through these telescopes, I decided I wanted to visit them. This is what first spurred my involvement in rocketry

**Extreme:** When did you launch your first rocket?
**Kosdon:** It was about 1956. Well, perhaps "launch" is the incorrect term (laughing). Actually, I'm rather lucky that I'm still here. The first rocket I designed contained a mixture of sodium chlorate, charcoal and sulfur for propellant—an analog for black powder. I constructed a casing that had a washer brazed over the aft end for a nozzle. I laid a trail of powder coming from out of the nozzle-washer and I placed the rocket on a gallon paint can. Fortunately it was at right angles from myself. I was back about 5 or 10 feet when I lit it. When the burning powder trail entered the casing, a large amount of flame issued forth which produced a whistling sound that became increasingly louder. Suddenly the rocket just disappeared and there was a big indentation in the top of the paint can. I never found the rocket, and fortunately none of it found me. That was the first and last time I was that close to one of them again. Readers, don't try this at home. I also experimented with smaller quantities of a sugar-sodium chlorate propellant in powdered form, wetted with gasoline to try to fill in the voids. I could get rockets up to a few hundred feet powered by this concoction. Eventually in high school, I obtained a sample of biological casting resin. From this resin, I probably constructed the first amateur composite propellant from which several motors flew successfully with sodium chlorate as the oxidizer.

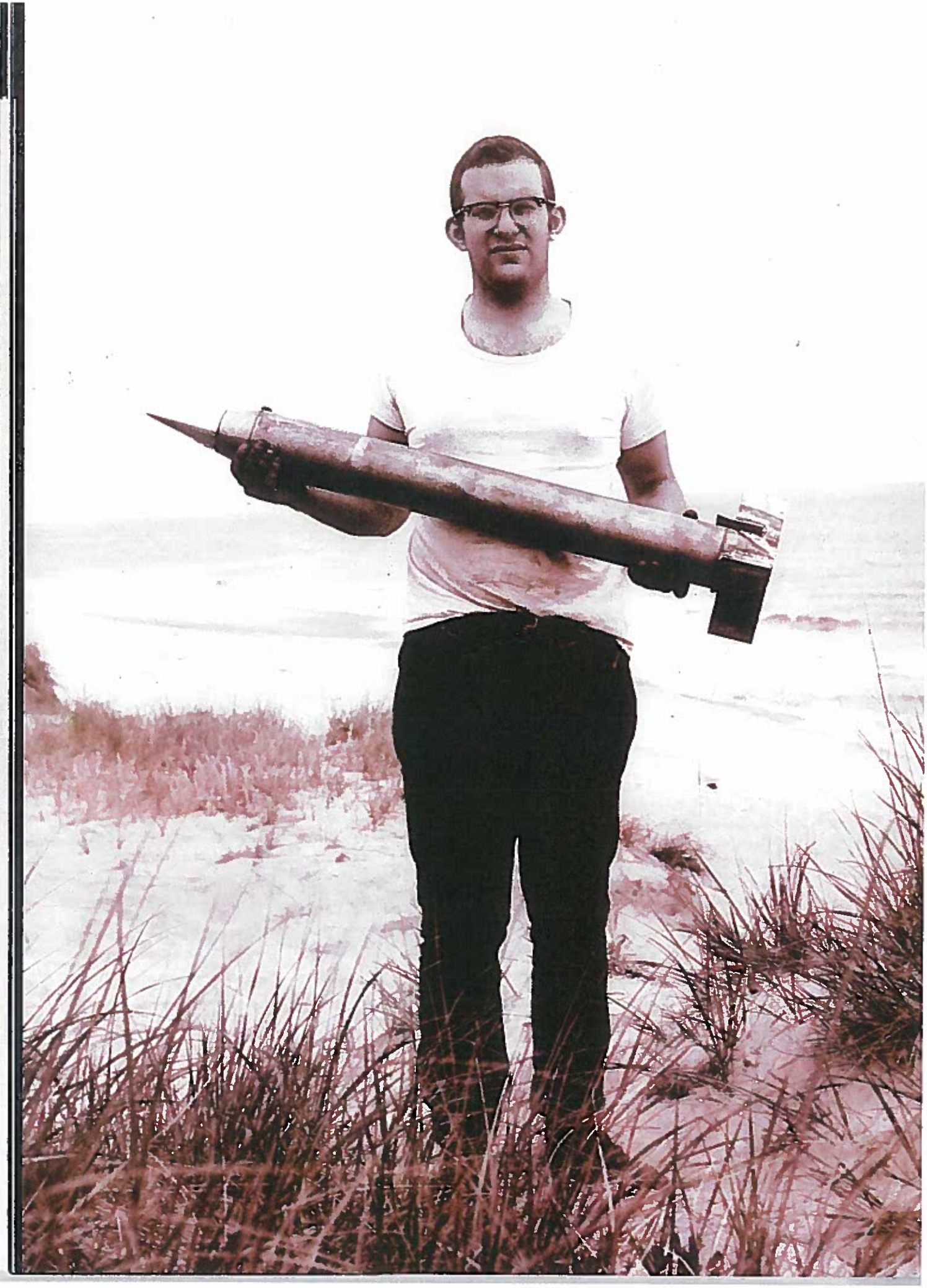
**Extreme:** Where did you first learn how to build rocket motors?
**Kosdon:** I was attempting to read Sutton, but I don't believe that really helped me much. Then along came 1957. I remember I was with my parents and we were going to the only Jewish delicatessen in Bakersfield on October 4, 1957. I remember the newspaper headlines which read, "Russian Moon Circling Earth at 540 Miles Out." That was when everyone really became interested in rocketry. I never really got that far with rockets while I was in High School. However, I do remember attempting to use liquid roofing tar for motors because I no longer had a supply of the biological casting resin. If it didn't work as a rocket, it exploded, so it was a win-win situation.

**Left: 1998 at Delemar Nevada. Frank Kosdon inserting a 54mm K-350 into a PML Quasar (photo by William Inman).**

**Extreme:** When you finished with high school, what were your career aspirations?
**Kosdon:** As with many times in my life, I never really knew what I was going to do. I finally decided to attend MIT, to some extent because they had a rocket society.

**Extreme:** What did you study at MIT?
**Kosdon:** Physics and Aerospace Engineering. I was still experimenting with propellants at the MIT rocket research society. In my Freshman year at MIT I was experimenting with potassium perchlorate and polyvinylchloride and had some success with that. However, the burn times were too short and the pressure went up and down too abruptly. In my Sophomore year a friend of mine, Ronald Winston, located a sample of polyurethane called Adiprene L100, which was made by DuPont at the time. We also obtained quantities of ammonium perchlorate. We had good luck making composite propellant with Adiprene L100 which is well known under the name X14. The rocket society maintained a test cell at MIT. During the course of my Sophomore, Junior, and Senior years there, I conducted hundreds of firings of these propellants in that test cell. We developed test motors in which the propellant was castable into metal cylinders. These were perhaps one of the earliest reloadable motors. The grain configurations tested were end burners, star grains, and rod and slit which was a neutral burning combination of a rod for part of the grain length and two parallel slabs for the remainder of the length. We learned how to eliminate combustion instability. Some of the propellants were highly aluminized. This is where I adopted my first motor sizes of one inch and two and a half inch outer diameters.

In my Senior year, we started to fly rockets and managed to make contact with the Atlantic Research Corporation, who had an armor-piercing cannon range in southern Massachusetts a couple of hours from MIT. This was also at a time when I was in the rocket society with a member I didn't get along with, and what was to become my first political hassle. One time, I went



to the Boston Fire Department and they classified a certain propellant at the most benign classification level they could give it. They didn't consider it a hazard at all. At that time we could transport the propellant. We conducted several test flights at the cannon range with this propellant. Unfortunately, the test range was surrounded by a swamp, so just about everything we launched we didn't get back. These first rockets didn't contain parachutes until finally one of the members obtained a parachute and some pyrotechnic delay timers. These were pyrotechnic delay trains that could be set for a specific number of seconds by the manufacturer. The intent was to attempt to construct a recovery system. The motor casing was made out of phenolic tubing or Bakelite, which is the same thing.

**Extreme:** Did the recovery system work?
**Kosdon:** Not exactly. It didn't work because there was a design flaw; two ignition systems. One system was intended to set off the pyrotechnic delay switch and the smoke charge to produce a tracking trail through the entire burn. As far as we know, the dye to produce the smoke eventually wound up on the EPA's hit list as being a carcinogen. During the final assembly of the rocket, the motor igniter leads shorted out because when we threw the switches the pyrotechnic delay switch and the smoke charge ignited but the rocket motor didn't. We were experimenting with this in May of my Senior year and it was never repeated again, we just ran out of time.

**Extreme:** Did you receive any awards at MIT?
**Kosdon:** In those days at MIT there was an Undergraduate Student Award which was presented by the American Rocket Society in conjunction with the Chrysler Corporation. They had one for graduate students as well. So after our Sophomore year, Ronald Winston and I documented our research and submitted it. That's how we won the award which included a thousand dollars. The award was presented in November of 1961 in New York City. It was a big thing because Vice-president Johnson, Lady Bird Johnson, Donald Douglas, and John Glenn were there. They had Jim Backus there too; you know, the voice of "Mr. Magoo." There were several big shots from the National Ballistic Missile Program in attendance as well. I've only worn a tuxedo twice in my life so far. The first time was when I won this award.

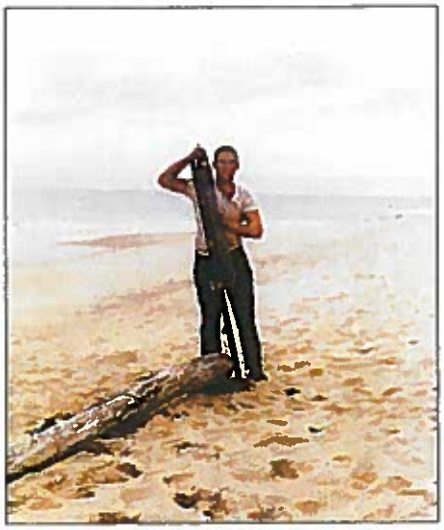
**Extreme:** Who presented the award?
**Kosdon:** I actually don't remember, but I do remember meeting Lyndon Johnson and Lady Bird Johnson. It was quite an experience. The next year we won it again for the continuation of our work. That year the award ceremony was held in Los Angeles. That was the second and last time in my life that I wore a tuxedo (laughing). That was November of 1962, so I haven't worn a tuxedo since then and my manner of dress has continually deteriorated since then, all the way down to nude beach attire.

**Extreme:** Tell me about your graduation present to yourself.
**Kosdon:** Myself and another student, Victor Scheinman, had static fired a tremendous number of motors in the MIT test cell. The biggest one I had flown at the cannon testing range was a 1" diameter motor. This is where my two current sizes of motors evolved from. The two size motors I would test would be 1" or 2.5" motors. Probably the biggest thing I had launched at the cannon test range was the equivalent to an H motor. So since I knew I was leaving MIT, I figured I would go for broke. It was a couple of weeks between turning in my thesis and graduating. I decided to go for a four inch motor. I knew of bigger motors up to this point containing zinc and sulfur which had been fired. But I'm sure this was the first amateur M or N motor containing composite propellants. I still have photographs of this motor at home. This motor was composed of X14 or polyurethane propellant cast in quart steel oil cans with a star mandrel. This was an early version of a BATES grain. After the propellant had cured sufficiently, we ripped the can off since the propellant was too big in diameter, we utilized a lathe to machine it down to the proper diameter, wrapped it with friction tape, then coated it with alternate layers of friction tape and polyurethane. This technique was developed to inhibit the external surfaces of the grain and the ends. I have a photograph at home showing the propellant being mixed and of me holding these grains. During these two weeks, we were machining the rocket and the end closures which were held in place by threads. My guess is, from what I know now, it was probably equivalent to my 5-grain N motor, and it had a boat tail on the aft portion of it. It had a pyrotechnic igniter constructed of one of my F size 1" motors down the grain from the forward end. We finished the rocket right before graduation, but we waited until we actually received our diplomas to launch it, so they wouldn't hold our degrees in case something went wrong. The following day after graduation, Vic Scheinman and I transported the motor down to Cape Cod. We found a deserted stretch of beach facing south and set up a crude rail launcher. We were on a low hill overlooking the beach from which we had stretched out our ignition wires. To ignite the motor we only had to complete the final wire connection, like a clamp onto a battery. The rocket was a good four feet long and there was no recovery system because the rocket was almost all propellant.

**Left: Just after graduating from MIT, Frank Kosdon on the beach with his first N powered rocket prior to launch.**

**Right: May 1963 at the Atlantic Research Range, launching a rocket powered by an H class motor. The motor was one inch in diameter and nine inches long. Two smoke charges were inginted from the top and motor ignition was from the front end.**

June 1963. Assembly of all metal rocket on the beach while holding a star grain in his left hand.



Placing the rocket on the launch rail on the beach.

A very blurry lift off shot taken from 16mm movie camera frame.

Positioned next to the launch pad was a 16mm camera encased within an armored container. Upon ignition, a quantity of flame came out of the rocket for a period of time while the igniter burned. Then suddenly, the rocket lifted off like a bat out of Hell. Due to all of the inhibitor surfaces between the grains, the motor burn produced this thick trail of black smoke. As I recall, it was a partly cloudy day, and a short time after launch, we heard these loud, twin sonic booms. The rocket was last seen at motor burnout. From what I know now, I'm sure it went up to approximately 30 to 40,000 feet or more before landing in the ocean.

**Extreme:** So you had a slight angle on the rail toward the ocean?
**Kosdon:** Yes. The funny thing was after the launch, someone else who had witnessed the rocket flight came running over to us in a panic. He thought that the Russians had launched it from a sub! (laughing). After that I went to grad school at Princeton. This was the last of my rockets, even though I was still in college between Princeton and then later on at UCSB. I didn't do anything more with rockets for quite a while until I became a Born Again Rocketeer in 1985.

**Extreme:** What were your career aspirations as you graduated from MIT?
**Kosdon:** I was going to Princeton to study under Martin Summerfield on the ignition of propellants. This is in a place called the Forrestal Research Center. Martin Summerfield was one of the founders of Aerojet General, so I wanted to study under him, however, it was not a very pleasant experience. I didn't fit in and I found there was a lot of tension there. I was accused of not having a Princeton image (laughing). The previous summer I had gone to Europe with one of my friends who was also at the Physics Department at MIT. We both had brought back our racing bikes we used in Europe. Martin Summerfield and some of his buddies believed that riding a racing bike and not having a car was below the dignity of a Princeton student. These were in the days when people wore coats and ties to classes and they didn't like students wearing Levis and t-shirts. I was the forerunner of styles in those days. I'm sure what I wore in those days is how students are dressing now. There were a lot of hassles at Princeton, however I obtained my Masters from there.

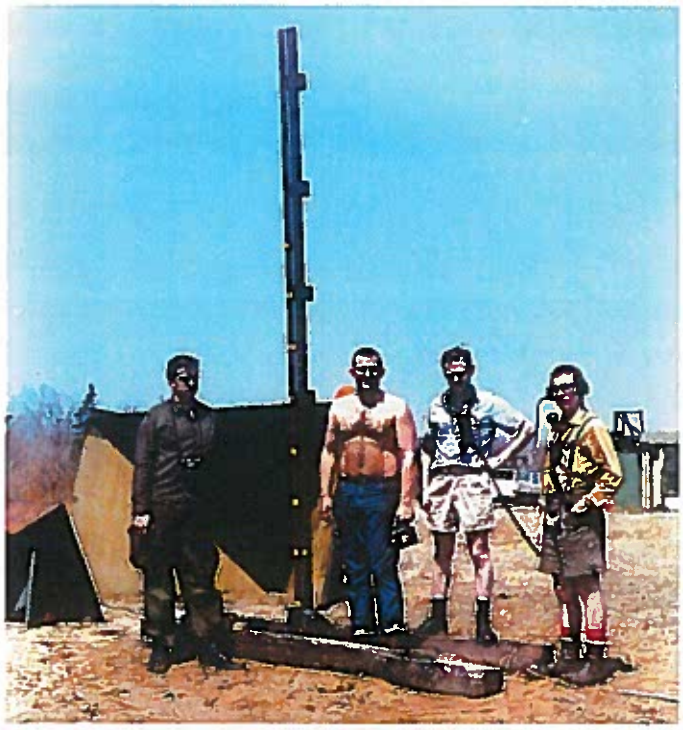
**Extreme:** Can you tell us about your masters thesis?

**Kosdon:** At Princeton they had an Aerospace Engineering Jet Propulsion option and my thesis was on the ignition temperature of various solid propellants. The propellants were cast in a rubber-like surgical tubing. Hot air would then be forced over these while using an infrared radiometer to measure their surface temperature. The specimens would get hotter and hotter until they ignited. Martin Summerfield had his own theory on how propellants ignited. He believed the ignition was caused by the reaction of the gaseous mixture of oxygen from the decomposition of ammonium perchlorate and the binder products above the surface of the propellant, as opposed to igniting under the surface of the propellant or to having a reaction within the propellant. It turned out both polybutadiene and polyurethane with ammonium perchlorate ignited this way according to Summerfield's theory. I also recall that double based propellants and polysulfide composite propellants, had some solid state reactions before they ignited. I think the polybutadiene propellants didn't ignite until about 600 degrees Fahrenheit, which as we know is long after about anything else that will ignite. In any event, I was happy when I found out that polysulfides propellant actually had a reaction on or under the surface before they ignited. So at least Summerfield's theory wasn't entirely correct. By then I didn't like the guy very well, so I was happy there was an exception to his rule.

**Extreme:** After you came to California, what was your Doctorate based on?
**Kosdon:** It was based on fire research where we tried to determine two things. The first part of the thesis was to determine how alpha cellulose cylinders would burn and the second part was to try to determine how the flame would propagate in a room containing many of these cylinders. We needed to determine if flame propagation was by radiation, convection, or if these things were so small they needed to touch one another to ignite.

**Extreme:** What did you do after you finished with all your schooling?
**Kosdon:** When I got out of school, I took about a six month trip around the world. When I came back I was faced with unemployment. That was when the Apollo program and the Vietnam war were winding down. It was the first major crash in the aerospace industry. So, I went back to what I had been doing during the summers when I was an

undergraduate. During those summers I was selling Collier's encyclopedias door-to-door. Actually I found that a lot of fun. Between Colliers and selling my own photography in poster form, I obtained my bad attitude towards business licenses, solicitor's permits, and government regulations. To me they're nothing more than rip offs created by parasitical politicians who only want to rip off your money. It's bad enough that you can't just give the government money, they want to take your guts as well. I used the money I made to invest in the gold market. I rode the gold boom in the 1970s, but unfortunately I stayed in it too long and lost most of my money back. Somewhere in there in 1976 I met my wife and I was married a few years. Now I'm divorced, but she and I are still on real good terms. And I have one son, who just turned 21. So by 1985 I decided to get out of the posters and become a "Born Again Rocketeer."



**Right: May 1963. Standing left to right, Quentin Pankey, Frank Kosdon, Alec Rowe, and unknown person at Atlantic Research Range.**

**Extreme:** Why did you want to get back to rocketry?
**Kosdon:** I wanted to go back into Aerospace Engineering and I didn't want to have to work for somebody else. So I decided I would try to be self-employed in a rocketry related business. I didn't really know I was going to go on to make hobby rocket motors at that point. But at least that was the part of Aerospace Engineering I found most exciting. So I decided I would attempt to return to the proficiency of producing propellants as I did at MIT. I found out that they were still making the same binder, the Adiprene L100 that I was able to get before, except that by then it was made by Uniroyal. I found the curing agent was also now deemed a carcinogen and DuPont didn't want to deal with it anymore. As I started making propellant, I obtained a polysulfide binder called LP33 manufactured by Thiokol which produced some very good propellant. I continued to make motors until shortly after my mother died in 1987, when I met an individual who will remain nameless at this point; we all know who this person is. He was the first member of Tripoli that I had met in the flesh. Talk about bad beginners luck, some other people and I all decided to go into business with him to manufacture expendable motors. At first I thought these motors composed of phenolic or epoxy fiberglass tubing with the ends epoxied in were really neat. While attending launches, I would examine some spent motors, especially the ones with fiberglass tubing. I noted that if they had been constructed properly, just about all the parts in them were still good sans the propellant. I had always been making motors out of metal all my life. However, in the late 50s when I was first involved in the hobby, several people had been killed which had resulted in the prohibition of metal motor casings. When I got back into it years later, I began using aluminum for the motor casings. I attempted to create a 16% aluminized motor with Adiprene L100. As it turns out, this propellant grain with the 16% aluminum and Adiprene L100 in it was unable to accommodate that high of a solid loading. I fired the motor (it was in an aluminum casing with threaded end closures at both ends) and subsequently, the propellant grain cracked and the casing ruptured. But what was interesting was that instead of producing shrapnel, the casing had flattened, stretched, and ripped—everything stayed together. That was before I met anyone from Tripoli, but that had always stayed in my mind as opposed to using steel cases that you would get shrapnel from. With aluminum you could see a tremendous amount of stretching which resulted in ripping and tearing, but it all stayed in one piece; it was more ductile. I eventually got this motor to work with 16% aluminum, polyurethane, and Adiprene L42 because it was a higher molecular weight binder and it could withstand the elongation and higher solid loadings better. I started getting the idea of doing reloadable motors even when I was in business with this other individual. He was supposed to be "Mr. Rocket," yet he thought I was wasting my time with reloadable motors; that nobody would want them. It also turned out that he had a tremendous fear of metal rockets because he had been brainwashed along with everybody else. In 1989, I started making what I would later call a modern generation of reloadable motors. They consisted of aluminum motor casings with threads at both ends. Some of them were actually case-bonded motors. And then an individual suggested that I try snap rings. That was about three or four days before the Springfest launch in 1990. I had a vague recollection of what snap rings were. I acquired some of them and designed a 1" motor and fired some of them right away. My first one failed because it contained bad propellant. The second one actually contained PBAN propellant. That worked very well. I had an idea that an aluminum nozzle might work because even though it had a low melting point, the conductivity would be real high so I concluded that perhaps it would conduct the heat away rapidly enough so nothing bad would happen. This worked very well for about half the burn and then it vectored off as the nozzle reached its melting point. After that I used graphite and it worked real well. So from these tests evolved the current motor design with snap rings and graphite nozzles.

**Extreme:** Tell us about 'Uncle Bob' and Lucerne Dry Lake.
**Kosdon:** That's Uncle Bob Baker. I used to make the motors and Bob Baker would fly them. I remember at the Summerfest in June of 1990, I kept my motors under wraps. I would load the motors up in Bob's trailer or motor home and then put them in a rocket and no one else, except for a couple of my buddies, were allowed to see what was going on. At that launch we took off to some mound on the other side of the lake bed and Gary Rosenfield went off

**Left to Right: Frank Kosdon and Bill Selders roasting a wienie over a motor test stand. Photo by Jeff Stai.**

the other way to test his motors. Gary came up to me sometime during this launch and said "I heard you're developing reloadable motors," I gave him this kind of blank stare. Then Gary said, "Do you hold the end enclosures with pins?" I just said, "No, guess again."

**Extreme:** So you had already used the threaded end closures and rejected them to use snap rings instead?
**Kosdon:** Well I had used threaded end closures, but there wasn't anything to reject. It was just a Hell of a lot easier and faster to machine in one snap ring groove instead of threading the ends. Actually I thought there might be a problem with the threads. Bob and I thought the guys that bought the product could possibly cross-thread the motors or they would get grit on them which would result in damage to the threads. However, that actually never turned out to be a problem. I found it kind of surprising. Anyway, it just turned out that snap rings are a Hell of a lot easier. The only drawback is that somebody needs a set of snap ring pliers.

**Extreme:** What do you like about rocketry?
**Kosdon:** It satisfies my need for speed. I don't use cars for speed. I actually rarely go faster than the speed limit because I know what happens to rockets if the recovery system doesn't function properly—the same thing happens to cars. It's a great feeling at Springfest 2000 breaking Mach 1. The rocket is a hundred feet or so above the ground and you hear the sonic boom. Instead of achieving acceleration in terms of 32.2 feet per second squared (one G), it's more like one Mach per second squared or more.

**Extreme:** What do you like least about rocketry?
**Kosdon:** The U.S. Government and a few jerks who have gotten involved in the sport. I can't leave out Tripoli motor testing either. I believe I should be grandfathered in because this regulation garbage didn't exist when I got into it. And then there are these government officials who lie. There has never been a good explanation of why they came up with the 62.5 gram stipulation. It's already obvious that the bigger propellant grains are much safer than an equivalent weight of smaller grains. The DOT and ATF will say whatever they want in order to be able to maintain their control. If it's a flammable solid, they can't control it. So, I don't like having to deal with that garbage. I have a bad history going back to my days selling Colliers encyclopedias door-to-door in June of 1960 of not liking licenses, regulations, etc. Collier's used to take $1 out of each commission to go into the "Fine Fund." If you ran into trouble for not having a solicitors license, your fine was paid through this fund.

**Extreme:** What's your favorite project that you ever worked on?
**Kosdon:** I don't know if there's any one single project, so I'll give you a few of them. One was the motor I launched off of Cape Cod after my graduation. I guess the next real exciting one was the 2.5 inch motor flown several times by myself and Bob Baker on an L1650 in a 2.5" OD rocket. The first time was at Black Rock in the summer of 1991. Another one that sticks in my memory was my first 54mm motor with a delay. It was about a 700 Newton-second one. It was fired over at El Dorado in a rocket made by Tim Collins. Another one that comes to mind was my first 38mm reloadable motor that I fired in January of 1991 at Ocotillo Wells. That was a really beautiful day and the sound reverberated off of all the mountains on the other side in Mexico. The other one I really enjoyed was the second Thunderbolt. That went up real fast. I'm pretty sure it went a little over 100,000 feet (also my first 0-10,000 at Argonia). The next one was the OuR rocket project motor. Those are some of my favorite ones.

**Extreme:** What can we expect to see from you in the future? What are your goals and projects coming up?
**Kosdon:** That's another good question. I've reached a fork in the road to the extent of whether to continue doing what I call 'conventional rockets.' I have a degree in physics that I have never really done anything with. A lot of it was because I never found a project I was really interested in and now I have found something. It's roughly known as zero point energy. A lot of people including myself think that there is a tremendous potential energy tied up in the vacuum of space. I have good reasons to believe that

Photo by Dave McCue

it's not just a guess or a hope. Some of my theories have evolved from questions I had back at MIT. Just like reloadable motors was a big leap over what came before them, I think that no matter how fast we kick reaction mass out the back end of a conventional rocket motor, reaction mass will never be sufficient for space exploration. There has to be some other way to do it. That's what I want to work on. It would have to be some way to manipulate the structure of space, or produce a bubble and take it along with you. I think in order to get anywhere with this, your going to have to be either awful smart and perceptive or have good intuition. I don't know if I have what it takes to do it. I'm just interested in it. I also think that any of your readers wanting to get into space are not going to do it with regular rockets. They're not going to do it with NASA either. There has to be some other way. If UFO's are indeed real, this is probably their mode of propulsion. It's not rockets.

**Extreme:** Do you have any advice for our readers?

**Kosdon:** Live long and prosper. Enjoy the hobby and regarding the government, there is a Latin phrase which literally translates into: "Don't let the bastards grind you down."