

A Mistress in the Garage

Rebuilding a 1969 Lotus Elan

by Steve Larsen



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Text and most photographs by Steve Larsen

© by Steve Larsen. Author retains sole copyright to his contributions to this book. The rebuilding of the Elan, on the other hand, was truly a group effort by a remarkable group of people - specifically these guys on the right.



Pictured from foreground to background: Wayne Viall, Steve Larsen, Brett Engel, Brian Buckland and David Barnett.

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Beginnings

On a Saturday morning in the fall of 1972 at the retail store where I worked in Rochester, MN, a call came in from Jeff Munger, service manager at Munger Imports. Jeff told me my 1965 Triumph Spitfire was complete and ready to be picked up. The store was not busy and fully staffed, so I drove over to pay the service invoice and pick up my car. Arriving, I saw Jeff and one of his guys pushing a yellow sports car toward the open showroom door. It was a 1969 Lotus Elan that had come in on trade earlier that morning. It had just 3,112 miles on the odometer and looked new. A short test drive left me stunned. I'd never experienced anything like a Lotus. Rounding the curves at the end of 4th street, the car not only seemed to hug the road, but I felt as if I were being launched from a slingshot coming out of the corners. I instantly realized I had to have this car. I knew nothing about it other than it felt simply amazing and went like snot. I also realized it was clearly a better car than I was a driver.

Back at Munger Imports I summoned all of my self-control and attempted to appear outwardly calm. To get a deal, to be able to afford this car, I had to disguise what had become an overwhelming desire to own this car. So, I casually asked Jeff what he had in it. He told me and I instantly said "OK, I'll take it." Confused, he said, "Wait, that's what we have in it, not what we'll sell it for – besides, your Triumph is here, aren't you picking it up?"

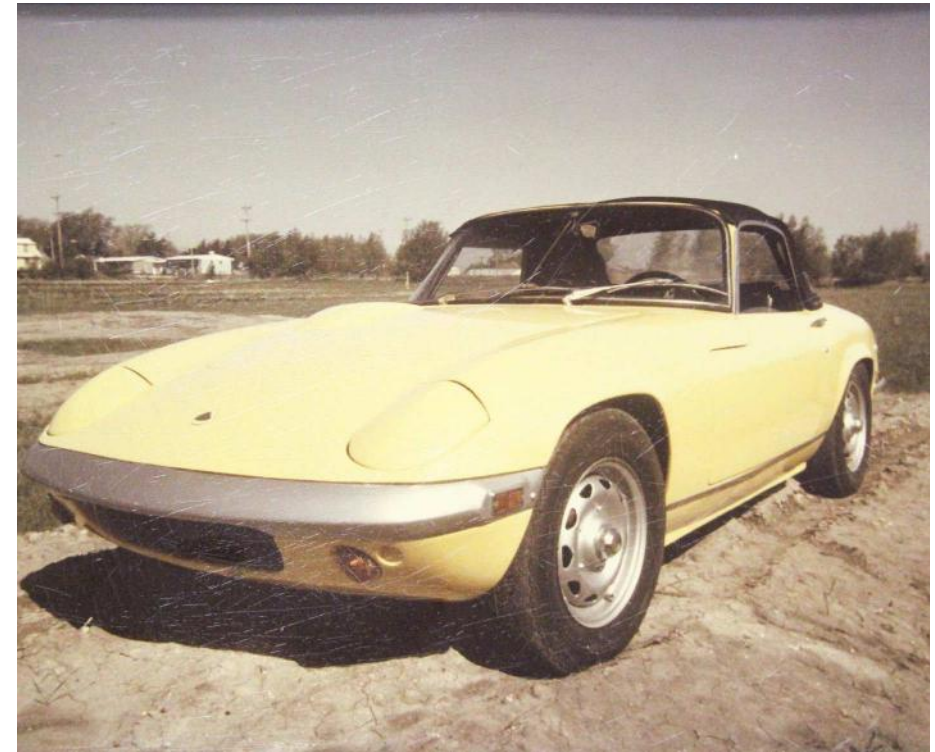
After a half-hour of negotiation with Jeff's father who owned the dealership and ran the sales department, I agreed to pay them \$150 over what they had in the car - \$2,850, if I remember correctly. With the stipulation that this was a cash deal. They would not take my Triumph in on trade and I had to pay my bill to the service desk for the Triumph in full. All terms were accepted and by that afternoon I owned a yellow, 1969 Lotus Elan SE. A love affair began then that has lasted over 40 years.

Early years

The first several months with the Elan were just crazy. I took the longest way possible to get to work. In the parking lot, after leaving my car, I'd walk slowly backwards to the entrance, watching the Elan the whole time.



Me, in 1971 with my 1965 Triumph Spitfire, what I owned and was driving when I found the Lotus.



A new Canon SLR film camera was put to good use, taking one of my favorite pictures of my car, about a year after I purchased it.

At work, my thoughts would constantly drift to the Elan in the parking lot. Occasionally I'd slip out and check on it; just to be sure it was still there. I couldn't wait for the day to end, so I could drive it. I dreamt about the car. I literally could not believe my good fortune. I kept thinking this was a dream and I would wake up and it would be gone.

I was embarrassed by how little I knew about the Lotus Car Company and this amazing car and began doing research. Well before the Internet, this meant searching back issues of car magazines at the library to find articles about Lotus cars and the Elan in particular. I visited foreign car dealerships and asked people what they knew about my car. I slowly came to understand that my Elan was unique and while not widely acclaimed, it had caught the imagination of many discerning journalists and more than a few hobby racers. It seemed the more someone knew about cars, the more impressed they were with the Elan's handling and capabilities on the road.

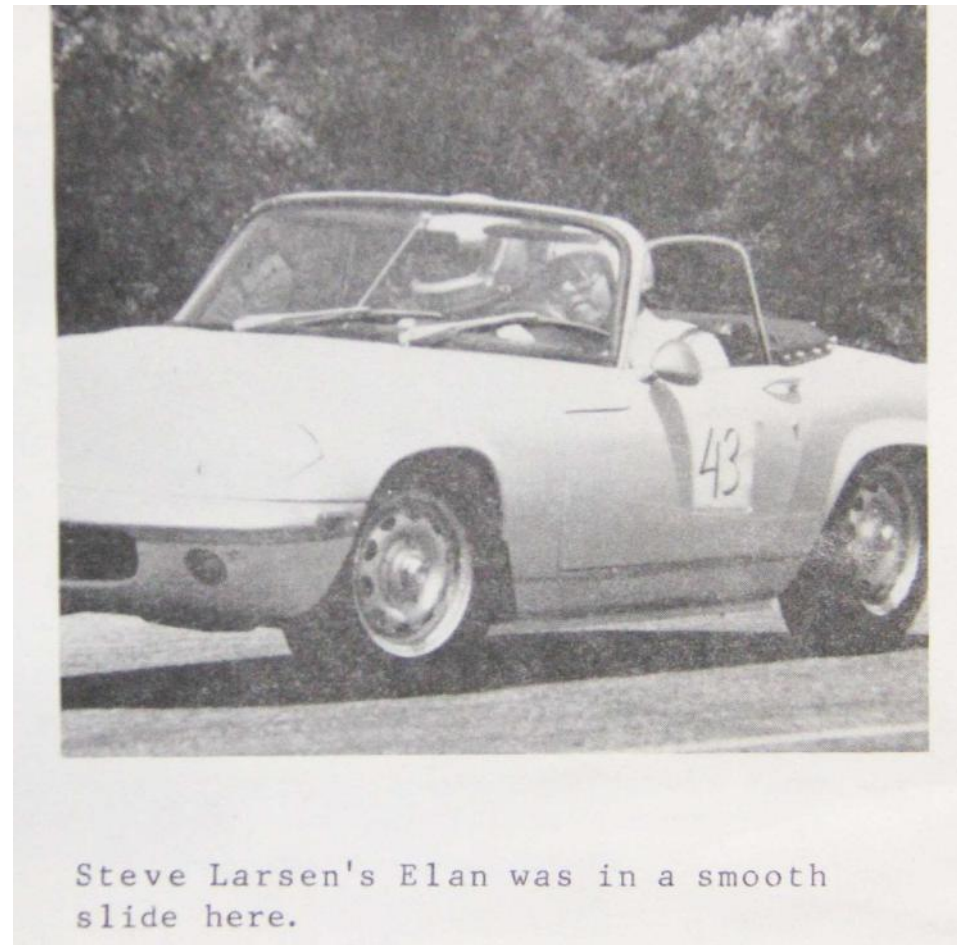
Early years (Cont.)

For the first several years I owned the Elan, it was my daily driver. Although told to expect poor reliability, it was remarkably trouble free. I even drove it in the Minnesota winter, although not when there was snow on the road. To learn to better drive and appreciate the Elan's performance, I entered club-sponsored Autocross and Gymkhana competitions. More a tribute to the Elan's remarkable handling than my driving abilities, I even managed to win a few trophies – several for first place. After a while I found a driving instructor at a slalom training day familiar with how to leverage the Elan's twitchiness and I got even faster.

England

Eventually, I decided if I wanted to really understand this car, I'd need to track down her birthplace. But how? One day an ad for a low-cost round-trip airfare to England appeared in the paper. With little thought and no real plan, I booked it. Arriving in London, a train took me to Hethel, near Norfolk. From the train station a taxi drove me to the address I had for Lotus. I arrived mid-morning and walked in.

Naive, I had not made an appointment. After waiting about 20 minutes in the lobby, the head of Lotus PR at the time came out to greet me, and I explained I came from Minnesota in the US and had a Lotus Elan and wanted to see where it was built. This guy was great. Apparently, spending time with me seemed more appealing than whatever else he had to do that day. He gave me a tour of the entire place, introduced me to all sorts of people with "this bloke owns a Lotus Elan in the United States - he came to visit its birthplace." I shook lots of hands. He took me to lunch in some sort of prototype car I don't remember, regaled me with stories of Lotus's early years and racing history. Back at Lotus headquarters, he loaded me up with Lotus swag; brochures, reprints of reviews, t-shirts, pens, John Player Special cigarettes and a Lotus lighter and such. He even gave me the Lotus Annual Report for 1971. I still have it, along with most of the other stuff. What could have turned into a major disappointment worked out extremely well.



I found the best place to experiment with the Elan's handling was on a Slalom course with an experienced instructor/rider giving me tips.



Gary Eiesland was my boss and mentor for several years. I typically followed his clues on what was cool to own. It was a real point of satisfaction for me when he began looking for and eventually found and purchased this Europa, several months after his first ride in the Elan.

Driving the Lotus to area auto races was especially fun. Here knowledgeable car fans fawned over this car that was somewhat rare in the Midwest, and asked a lot of questions. One time, at the Brainerd International Speedway, I was in the stands when what appeared to be a Lotus Elan that must have started near the rear passed several cars on the first far turn and then, coming down the straight in front of the stands, pulled away as the other cars appeared to stand still. I pointed and yelled, "that's my car, that's my car, I have one of those." This Elan lookalike went on to handily win the race.

Later in the pits I found the Lotus and announced to the team in the pits that I, too, had one of these cars. "You have a 26R, they asked?" "Um, no," I said, "What's a 26 R? I have an Elan SE and it looks almost like this one." "Oh," they said, "the 26R isn't really the same as an Elan. And we've done a bit with this one, too."

I took the Elan on a camping trip to Colorado with no mechanical problems other than it didn't run well at high altitudes. At the time, Coors beer was as rare as Lotuses were in Minnesota so I mailed my camping gear home and filled the Elan with cases of Coors beer. It is amazing how much beer will fit in an Elan. We had a great party when I got back.

On a trip to Iowa, one of the rotoflex donuts gave out. Remarkably, a Lotus dealer in Des Moines was able to make the repair.

Opposite: I have more than 45 repair invoices from 1972 to 1986 showing nearly all the repairs done on the Elan in its first 30K miles. This is the first.

22915

MUNGER IMPORTS

FIAT

JAGUAR

ROOTES

RENAULT

1812-2ND STREET S.W. PHONE 282-7702

ROCHESTER, MINN.

ALL BILLS DUE 30 DAYS FROM INVOICE DATE

NAME <u>Steve Larson</u>		DATE <u>Nov 3 1972</u>	
ADDRESS		PHONE	
CITY		PROMISED	
MAKE <u>Lotus</u>	MODEL <u>Elan</u>	LICENSE NO. <u>OCV998</u>	MILEAGE <u>3747</u>
MOTOR NO.	SERIAL NO.	SERVICE SALESMAN	CUST. ORDER NO.
			PHONE WHEN READY?
			YES ☐ NO ☐
OPER. NO.	DESCRIPTION OF WORK		AMOUNT
	LUBRI-CATE ☐ CHANGE OIL ☐ FLUSH TRANS. ☐ FLUSH DIFF. ☐ WASH ☐ POLISH ☐		
	<u>change oil</u>		<u>W/c</u>
	<u>Add brake fluid</u>		<u>W/c</u>
	<u>Adjust idle</u>		<u>2.00</u>
Not Responsible For Loss or Damage to Cars or Articles Left in Cars in Case of Fire, Theft or Any Other Cause Beyond Our Control.	GAS, OIL AND GREASE		PRICE
	GALS. GAS @		F. S.
	QTS. OIL @ <u>10</u> ☐ <u>40</u> ☐		<u>85</u>
	LBS. GREASE @		<u>340</u>
	TOTAL GAS, OIL AND GREASE		
TOTAL LABOR		<u>2.00</u>	
TOTAL PARTS		<u>75</u>	
ACCESSORIES			
GAS, OIL GREASE		<u>3.40</u>	
TIRES, TUBES			
OUTSIDE REPAIRS			
TAX		<u>17</u>	
TOTAL AMOUNT		<u>6.32</u>	

I hereby authorize the above repair work to be done along with the necessary material, and hereby grant you and/or your employees permission to operate the car, truck or vehicle herein described on streets, highways or elsewhere for the purpose of testing and/or inspection. An express mechanic's lien is hereby acknowledged on above car, truck or vehicle to secure the amount of repairs thereto. I understand estimates are for labor only, material is extra.

AUTHORIZED BY: _____

RECEIVED BY: _____

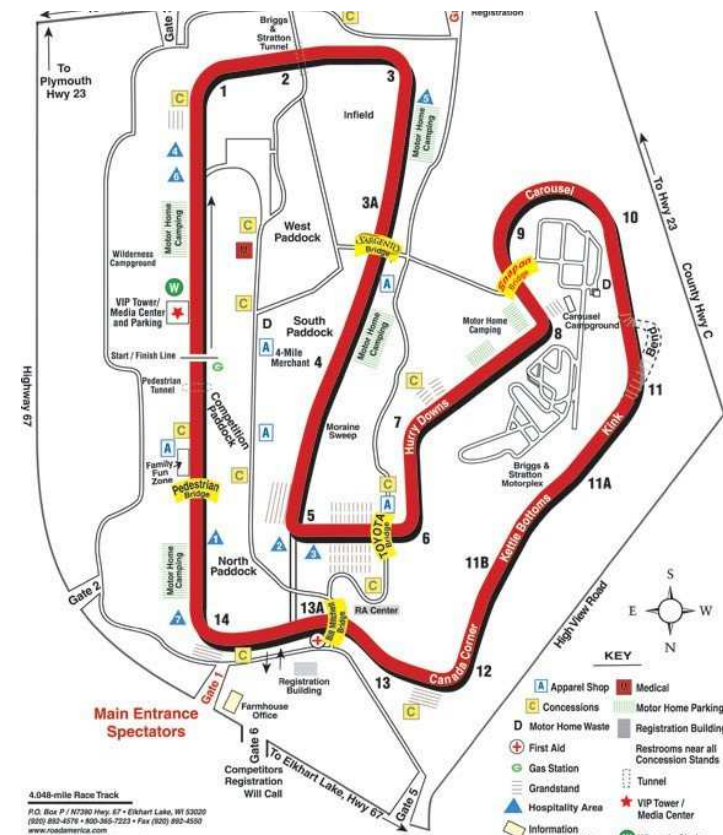
Milwaukee

After a few years in Rochester, MN, my employer, Schaak Electronics, transferred me to Milwaukee, WI. I soon grew to love Milwaukee. The presence of so many different ethnic groups meant an introduction to wonderful new foods and friends. The Elan was my only driver the year I spent there and it adapted well, taking trips to Chicago and one memorable trip to Road America.

The parade lap around the historic, four mile, 14-turn Road America circuit with a dozen other Lotuses became a genuine adventure. Lined up alphabetically by car club, I was the second car in our small cluster of Lotuses. Following the group in front of us, we began driving around the track at a sedate 25 - 30 mph. Growing frustrated with single file and the slow pace – this is a race track after all – with little thought to consequences, I pulled out and passed the Lotus in front of me, and then began to pass the car club in front of us. Glancing in my rear view mirror, I noticed the Lotus I had passed, as well as all of the other Lotuses, had pulled out and were now following me. Off the Lotuses went at speed, engines revving, passing one car club after another. We could hear fans around the track begin applauding, whistling and laughing. A couple of miles into the circuit we came around a turn to find a group of angry race officials running onto the track, frantically waving black flags and pointing to a road leading off the track. We exited the track where they had indicated and followed the narrow road to a parking area. Soon I was surrounded by beaming Lotus owners, whooping and pounding me on the back. We had been bad, really bad, but it sure felt good.

Gary Eiesland from Schaak Electronics (and my former manager) arrived in Milwaukee with his Lotus Europa. We had a ball together. Out driving one spring day, I stopped at Mitchell Park, and there was a Lamborghini Mura. I was smitten. It was so low and wickedly exotic, mean and scary. I was walking around and admiring it when its owner appeared.

We got to talking. It turned out he was a big fan of the Elan. He asked if we could switch cars for a few miles. For the next hour or so we took turns following each other around several cool roads in the area. When we pulled into a gas station to switch back to our own cars, I heard for the first time a question I would end up hearing over and over again throughout the years. Once people saw, rode in or experienced my car, the inevitable query is, *"Well, if you ever decide to sell it, will you please let me know?"*



The historic, four mile, 14 turn Road America racing circuit in northern Wisconsin was the spot for a genuine Lotus adventure.

Minnesota

(LOONS: Lotus Owners Oftha' North)

The day came when I was transferred back to Minnesota, this time to Minneapolis. After a few years, the Lotus became a second car, although I drove it at least once a week. I changed companies, started a new career and met a new love – Maggie.

Marriage

At our wedding reception, my dear aunt Effie asked my bride, “Now that Steve's married, will he be getting rid of that little yellow girl catcher of his?” Maggie thought a moment, looked at Effie and said, “If my husband is going to have a mistress, I'd prefer to have her in the garage, so I can keep an eye on her.”

Maggie was true to her word. We've been married over 32 years now and she's never once complained how the Lotus has taken up precious garage space, the cost of putting the Elan on moving trucks to Los Angeles, then to New York, then back to Minnesota and finally to Phoenix. The Elan always got the most preferred and comfortable spot on the truck, although getting it on and off wasn't always easy. And there were years when the Elan got a heated garage stall and the Toyota commuter sat outside.

In Minneapolis we met other Lotus owners in the LOON group. Meetings were often potluck affairs in various members' homes around the twin cities area. The group was always knowledgeable about their cars and willing to pitch in and help with nagging issues. Most stashed the cars in warm garages during the winters. One of the first rites of spring was the initial Lotus ride, a favorite of all.



*“If my husband is going to have a mistress,
I prefer to have her in the garage, so I can
keep an eye on her.”*

Margaret Larsen
December 19, 1981

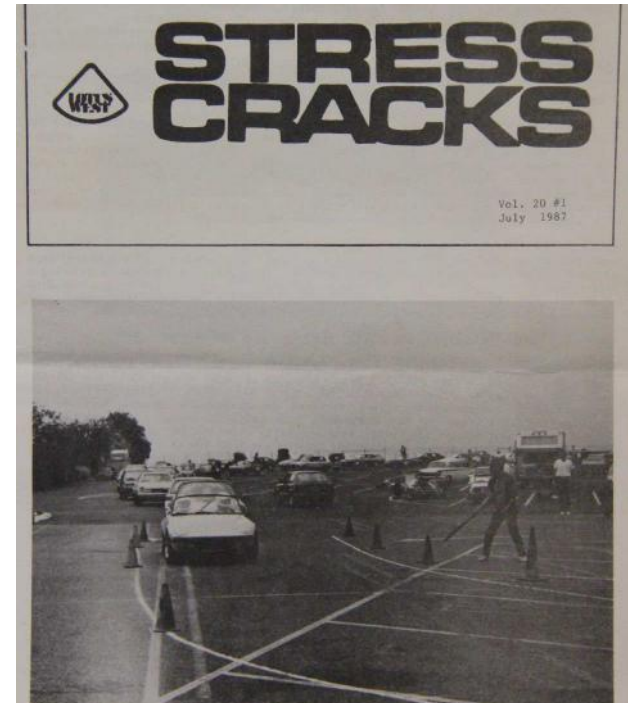
Los Angeles

In the late 80's, a year after joining AT&T, I was transferred to Los Angeles. The Lotus and I came to love California, especially southern California roads. Living in Pasadena, I'd frequently take the Elan on drives into the San Gabriel Mountains or from the Valley into Hollywood on Laurel Canyon Blvd or into Beverly Hills on Coldwater Canyon Drive. Southern California was full of great Lotus-friendly roads and thousands of car lovers. The top came off the car and never went back on.

A group of auto nuts from my office drove US 1 to Monterrey to a vintage race at Laguna Seca: my Elan, a Porsche 928 and a new Z51 Corvette. We took turns in each other's cars. The Elan always ran away from the other two, no matter who was driving it. The close, tight, technical turns along the coast north of San Simeon to Pebble Beach seemed to be custom made for the Elan. What a weekend!

When it came time for service, other Lotus owners recommended Frank Monise motors in Pasadena. I took the Elan in and talked to a middle-aged guy about what I wanted done. After a few minutes, an older man came out and said, "Hey, Frankie, let me take this one." It was Frank Monise, Sr. I didn't know it then, but Frank Monise Sr. raced various Lotus cars such as the 6, 11 and 23's then moved to Lola in the late 70's. He was was one of the fastest drivers in California. Frank Jr. raced formula cars throughout his career, driving cars from Lotus, Brabham, March and RALT. Monise Motors, with Frank Jr's son Greg, still repairs and maintains British cars in Southern California.

Probably most fortunate was meeting up with the folks at Lotus West. The group was active with rides, workshops and slalom schools. I met Bedford MacIntosh who had one of my dream cars – a Lotus Seven. They published a newsletter called Stress Cracks and I still have a pile of back issues. In October of 2014 the Elan will again attend a Lotus West event in Lake Tahoe, CA. It will be interesting to see if any of those folks are still around.



In California I made friends with people in the Los Angeles Lotus club as well as the Golden Gate Lotus group.

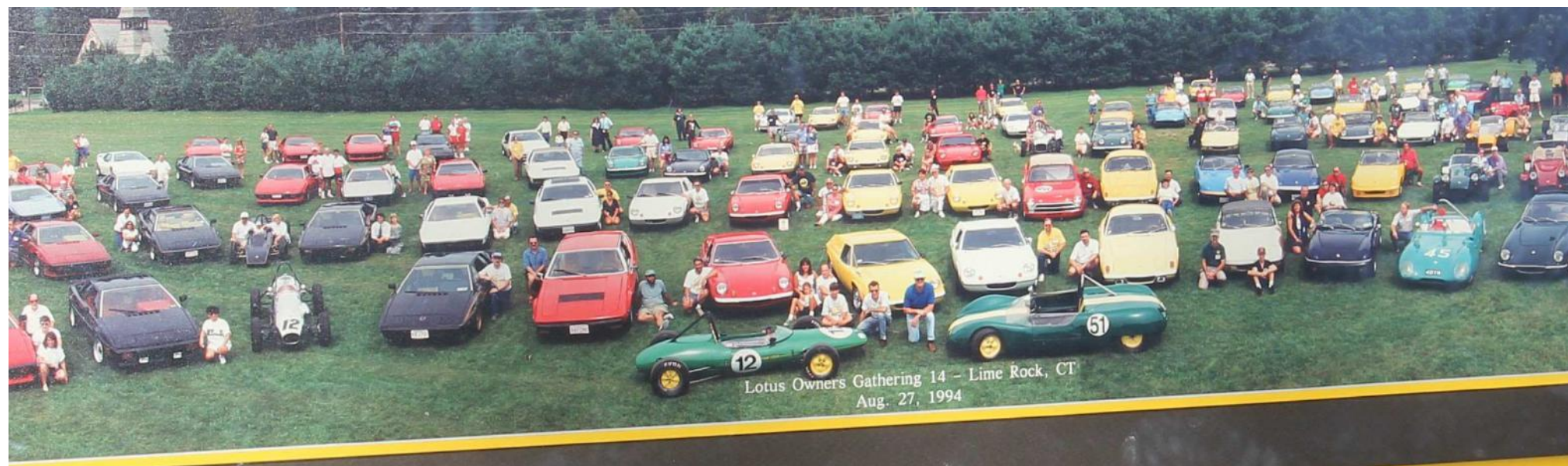


Little did I know at the time, but the guys working on my Elan were famous Lotus racers from years past.

NEW YORK

1992. By this time, I'd switched to IBM's new startup called Prodigy Services. They transferred me to New York. In late August of 1994, my daughter Ginger and I drove the Elan to Lime Rock in Connecticut and attended a LOG (Lotus Owners Gathering) in Lime Rock, CT. A subscriber to the ReMarque magazine since the early 70's (and keeping every one), this was a dream come true. It was a great time meeting fellow Lotus owners and seeing their fabulously restored cars. It was also fun for Ginger and I to go this far in the Elan together. She'd always loved the "yellow car," and couldn't wait to jump in and go for a ride.

In the late 90's we moved back to Minnesota, renewing friendships with the Lotus Owners "oftha" North (LOONs). By this time, my job was getting more and more demanding and the Lotus was driven less and less.



LOG 14 (Lotus Owners Gathering, 14th annual) in Lime Rock, CT in late August, 1994. Find me and my daughter, Ginger, in the third row, just to the right and above the words "Lime Rock, CT." I'm kneeling on the passenger side of the car, Ginger is sitting on the back. In August of 2015 in Colorado Springs, CO, LOG 35 will be held. I plan to attend.

ARIZONA

Over the years, we lugged the Elan from the Midwest to Los Angeles to New York and back to the Midwest. We finally arrived in Phoenix about ten years ago and have stayed put. Over the years, opportunities to sell the Elan have presented themselves along with good reasons to seriously consider it: It took up needed garage space, we weren't driving it all that much, etc. What kept those discussions from ever getting serious was the all-too-frequent stories heard from men years my senior who looked at my car and wistfully said something like, "Ya know, I used to have an Austin Healy 3000, Mk II (or MG, or Jaguar, Morgan or Triumph), and I sold it when...." And their voices would trail off, frequently ending with, "that was the dumbest thing I ever did. I've regretted it my entire life. Don't ever sell this car, son."

In 2003, with me spending more time in California, and Maggie now in Phoenix with the Lotus, I had to make a call on what to do with the Elan. I was driving it less and less. My nephew, Isaac Stickney, had taken a real liking to the car. In January of 2006, he helped to get it running by installing a new distributor and rebuilding the carbs. The two of us drove it a few times in the Arizona, but as the heat began to arrive that summer, I decided it was time to put her in moth balls until I could properly rebuild her. I recall thinking, "I'm going to need a bigger radiator."

I followed my traditional practice: Washed and waxed her, changed the oil and filter and poured small amounts of oil into the top of each cylinder. This time I also drained the gas tank and removed the battery and pumped the tire pressures way up. The final step before putting it under a good car cover was to liberally spray 303 UV Protection on all the rubber and vinyl areas and spray all metal parts with WD-40 and another water displacement product I like, called Bombardier Lube.

Inspiration to rebuild

In March of 2011 we moved to a house in Phoenix with an extra 3-car garage/workshop - separate from the 2-car garage for daily drivers. Air conditioned, too, and tall enough for a full-size car lift. Finally I had a place to rebuild my Elan. The first year in the house, the Lotus just sat, as home remodeling projects and my work took precedence on my time. But my research began.



In March of 2013, Jay Leno released an 18-minute video on his re-build of a 1969 Lotus Elan S4 (find it via Google: search on "Youtube, Jay Leno, 1969 Lotus Elan"), a car nearly identical to mine. Watching what he and Jim Hall did to his Elan, I was inspired. Jay's changes, as recommended by Lotus expert Jim Hall, served as the perfect guide for me on where to start and what to change. Leno has become a major Elan fan since, speaking eloquently on its merits and acquiring several more.

Two local experts gave me the confidence to proceed by volunteering to help. The first was David Barnett. I'd met David a couple of years earlier at a Lotus Owners of Phoenix (LOOP) event and been to his shop and seen his cars. A skilled and creative engineer by training and profession, David has been involved with cars and racing all his life. He has restored, that I know of, three beautiful cars with immaculate results: A 1960 Lotus Elite, a 1948 MG TC 3 and a 1962 Porsche 356. His 1965 Corvette has never been restored, but it is like new due to David's careful and meticulous maintenance. While each of David's cars are of museum quality, they are all driven regularly. David agreed to help me with my project.

The second individual, Wayne Viall, has a late model Lotus Europa that he is restoring. Wayne is a talented mechanic and agreed to jump in and help me with my project. With these two guys on the team, I began to get more confident that we could have a great result.



One of the last pictures of the Elan before we start taking her apart. Sort of scary. I wonder, "Will I be able to get her all back together?"



Another of the several hundred "before" pictures. This one shows the only real body ding here on the driver's quarter panel. I don't even know how it happened. All original badges are on the car. Photographs will help make sure we get them back in the right spots.

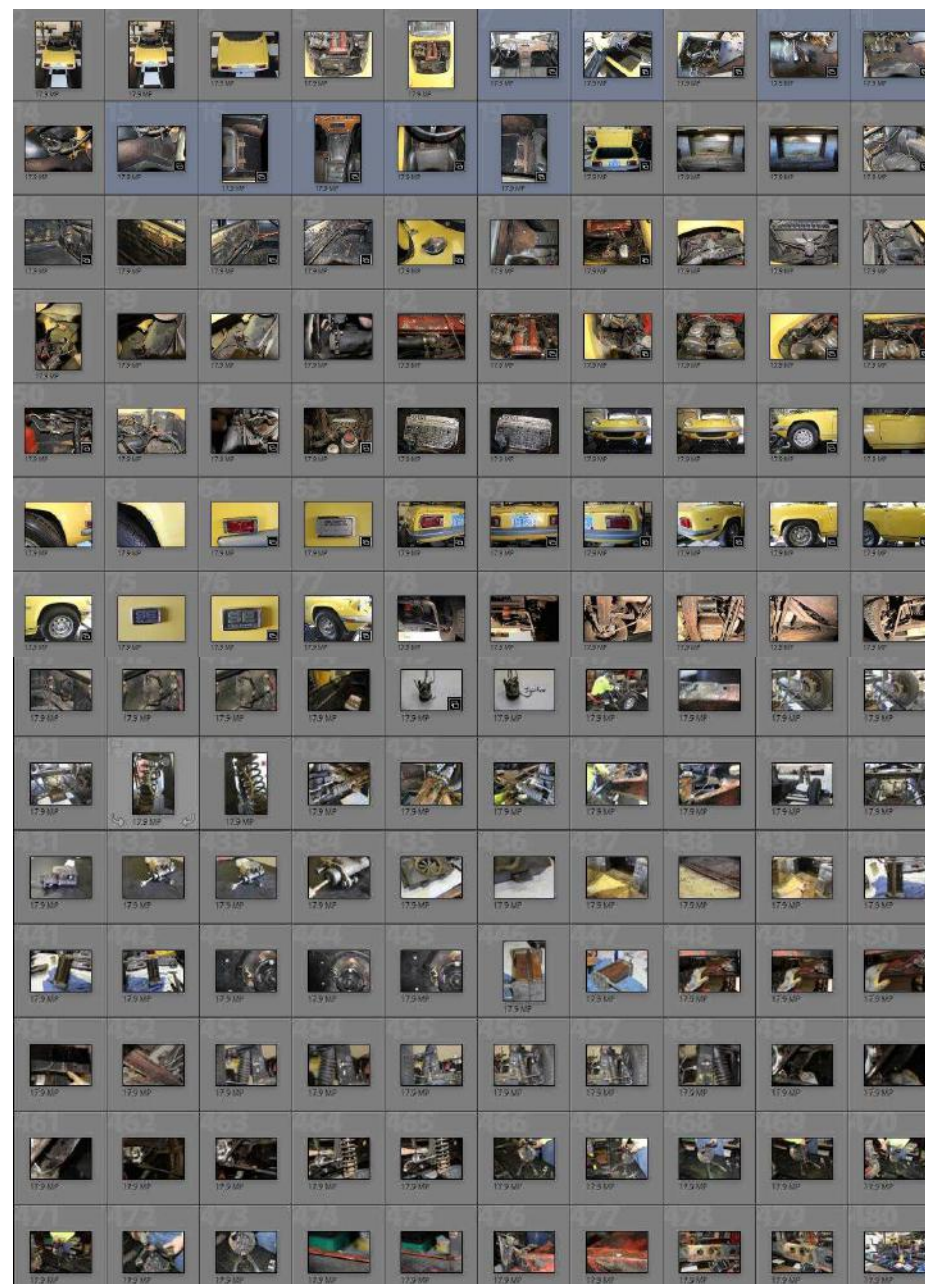
Rebuilding: The Beginning

As I began to contemplate an Elan rebuild, the first step was to prepare the garage/workshop. A lift was installed a year earlier and the narrow Elan fit the rails perfectly but without any room for error in tire placement. I added an air compressor, an overhead reel with 100 feet of hose and some air tools. David Barnett provided guidance and help during the compressor installation. Two large workbenches were installed, a remarkably useful decision. Next, the garage was outfitted with several sets of heavy-duty shelves to hold all the expected parts. An engine hoist and engine stand were borrowed, compliments of David. Then I cleared the workshop of all the other stuff; a trailer, Polaris RZR and several motorcycles. I sold my boat and a few dirt bikes. I had been warned that even though the Elan is a small car, once you start disassembling it, it EXPLODES and takes up far more space than you can imagine. That is the understatement of the year.

While the car was still together, I photographed it from every angle and point of view that I could: top, sides and underneath. If I could get a camera lens and some light into a space, I took a picture. The “photograph everything” mantra turned out to be extremely helpful when we got to the reassembly phase.

Lastly, I bought, scrounged and amassed plastic and cardboard boxes, several big bins and large quantities of plastic Ziploc bags in several sizes, as well as plenty of magic markers and 4X6 cards for making labels. In the appendix to this book there is a list of all the things I bought to prepare the garage.

The garage preparation checklist was finally complete.



Over 900 pictures were taken of the Lotus before, during and after the rebuild. They proved exceptionally valuable on more than one occasion.

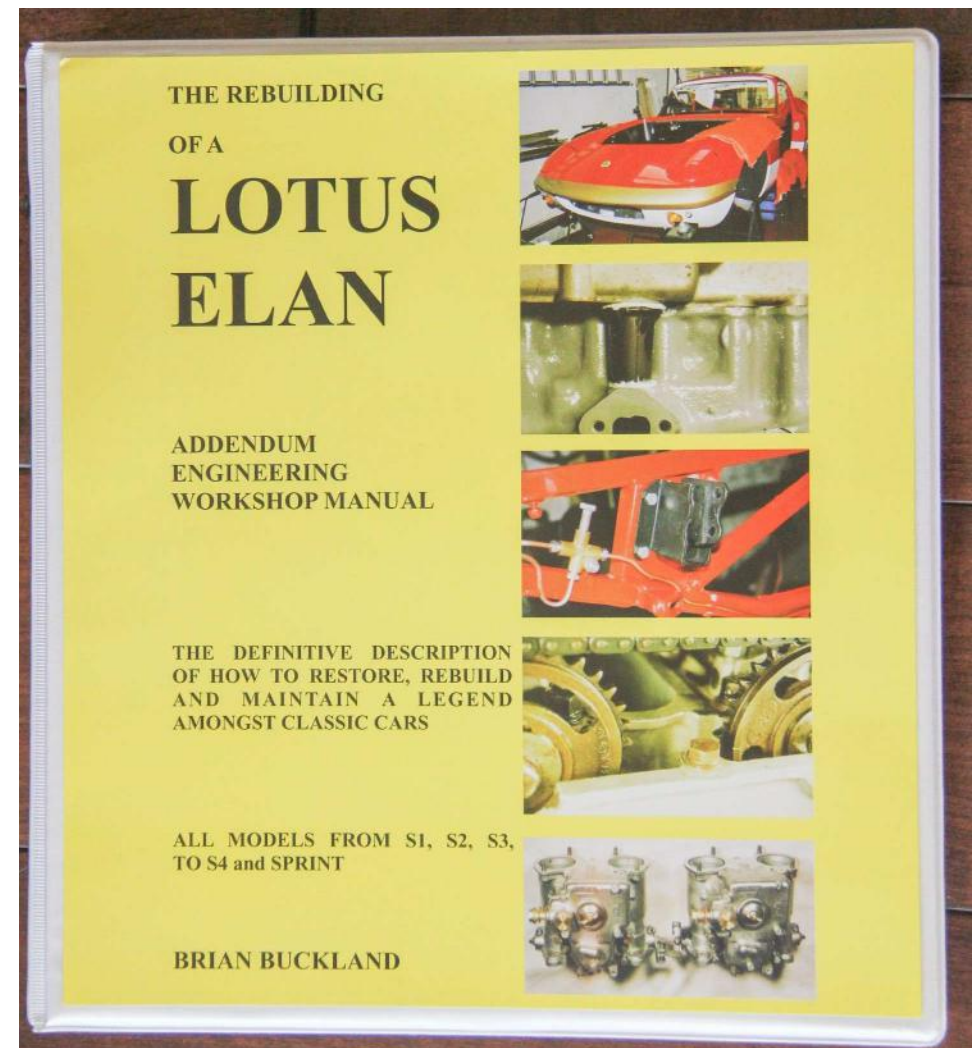
Brian Buckland's book a treasure

As I began research for this rebuild, I learned of a book on the LotusElan.net forum called “Rebuilding A Lotus Elan: Addendum Engineering Workshop Manual.” After several weeks of searching, I found a copy at an online bookstore in the UK and ordered it. It turned out to be tremendously useful as did its author, Brian Buckland.

Brian’s book is based on his own experience rebuilding his own (and countless other) Elans. He is, without a doubt, the most authoritative person on planet earth about the Lotus Elan. Reading the 700+ pages with pictures and step-by-step instructions, I now had a blueprint on how to proceed. Little did I know at the time, but mid-way through my re-build, Brian Buckland would come to the East Coast of the US for a visit. With some persuasion, Brian extended his trip and spent a week helping me with my car, in person.

With David Barnett, Wayne Viall, Brian Buckland’s book, Jay Leno’s video and a vast amount of online information at LotusElan.net, a tipping point arrived and it was time to start.

So, let's take a look at what we started with.



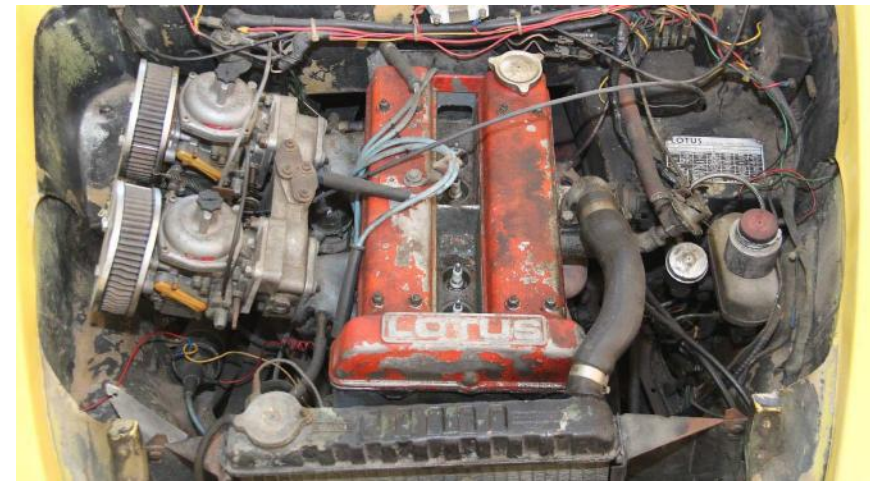
Brian Buckland's 700+ page, 4-ring bound masterpiece on how to rebuild a Lotus Elan was an invaluable guide, augmenting the original Lotus Workshop Manual. More than anything else it provided a well articulated guide and step by step instructions.

Plus Side

- Essentially, a one-owner car since new - almost. It had 3,112 miles on it when I purchased it in 1972. Never abused, never raced, other than a few amateur autocrosses in airport parking lots. Never seriously tracked.
- Everything done to the car, I know about. I have 42 service invoices from 1972 to 1986, covering most of the car's miles. This eliminates "what were they thinking" moments.
- It has never been hit. The body is in good shape with only one small parking lot bump on the driver's rear quarter panel.
- It is, by and large, original. When something broke, I fixed or replaced it, nearly always with original Lotus parts.
- It was stored, reasonably carefully – nearly always in garages.
- When stored, oil was always added to the top of the cylinders. Rubber and plastic parts were treated with 303 UV protection spray. Metal parts sprayed with WD-40 or other water displacement products like Bombardier Lube.
- Miraculously, there is very little rust. Lotus' propensity to leak oil seems to have protected all sorts of parts from any major visits from the rust fairies.

Minus Side

- It was filthy. The engine compartment looked horrible. The carburetors have NEVER been rebuilt. Plastic connecting pieces have cracked.
- For six months of the three years it was stored, it was outside. Although under a high-quality California Car cover, several mice and/or rats moved in and began chewing things. By the time they were discovered, most of the wiring was shot. They also ate carpet and corners of interior panels and dragged in all sorts of food which they stashed.
- The paint had a good number of stress cracks. While not really noticeable from 10-20 feet away, get close and they are obvious.



Top: The engine compartment is filthy and tilting to the right due to a broken motor mount.

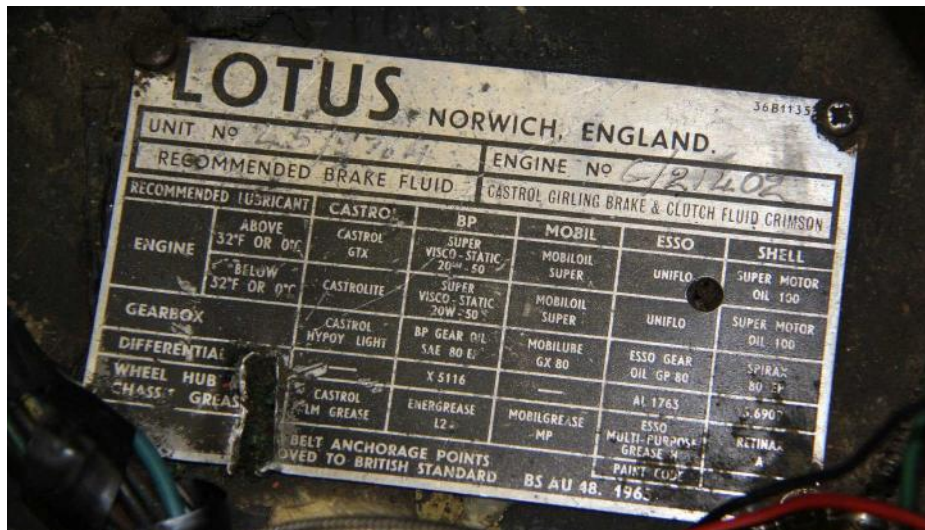
Middle: Closer up view of the exterior dirty motor, but good preservation practices mean the interior is in great shape. **Bottom:** The interior is dirty, worn and the dash cracked.



Minus (Cont.)

- Most of the rubber on the car was dried and cracking. For instance, while the tires looked new, they were hard as rock. Rubber bushings, seals, O-rings, all needed to be replaced.
- The windshield was pitted and has a crack from the time I attempted to reattach the review mirror with super glue. Bad idea. The windshield surround rubber was very dry.
- The dash crash pad had a crack in the center.
- None of the known Lotus Elan design defects from the factory had ever been addressed, such as:

- Colin Chapman never anticipated the Elan operating in Arizona heat. The radiator is far too small and factory-mounted fan hopelessly ineffective.
- Rotoflex couplers, while ingenious in the 1960's, they don't last (especially in Arizona or California air), and are a weak point.
- The generator weighs 19 lbs. and produces just 20 amps.
- While the stock 115+ hp is nice, taking modest steps to improve performance and longevity makes a lot of sense.
- The Elan chassis, while a marvel in weight and efficiency, could be improved by strengthening key areas, reinforcing others and replacing things like the cross brace with something stronger – and removable.
- The Elan head could be improved with larger valves and better flow.
- The stock ignition technology is 40 years old, existing distributor and points would improve performance.
- The main grounding point for the chassis is in the bottom of the trunk, a perfect spot for corrosion to develop.
- Like all Elans, the doors stick out on the bottom and visually appear not to fit - especially on the driver's side.



Top: The original Colin Chapman signature steering wheel is in good shape. **Middle:** The identification plate with the original VIN and engine numbers etched into the aluminum. **Bottom:** Suspension pieces are all in place although dirty and most rubber bushings dried and cracked.

A wise man once said, *"Begin with the end in mind."* Our "end game" for this project was quite simple
-- rebuild a great driving car, and don't mess it up.



Side by side comparison of the original engine compartment and then immediately after the new rebuilt engine is placed back in the engine compartment. A careful look at the engine compartment (left) shows a filthy engine, canted to the right due to deteriorating motor mounts. The rebuilt engine (right) installed on reinforced motor mounts, with a new radiator and fans mounted. Towels protect the new paint.

Our goal was not to restore, but to rebuild. When this car was created, it was built to be driven, so our objective was to make the car at least as wonderful to drive as when it was new, and better, if we could. Consequently, every single component of the car was scheduled to be cleaned, painted and reattached, as feasible. Any and all worn parts, bushings, bearings, seals, gaskets, lights, covers, cables and wiring would be replaced with new. Whenever possible and appropriate, improve on the original. Make it more reliable and have it perform better. If modern options exist, such as for the radiator, alternator, CV joints and engine components, they would be upgraded.

Things come apart.

Saturday, March 16, 2013

Removing the engine/transmission/body

I'd begun to remove simple things, but one Saturday in March, a few guys from the Lotus club joined to help take the engine and transmission out. After removing and dismantling the engine (and, in the following weeks, the rest of the car), major components were distributed to various experts for them to receive tender and transformative care.

Distribution of Stuff

The head and carbs go to Jim Unsworth, a master restoration mechanic and engineer. Jim has a flow bench and experience in this effort. Jim will rebuild the head and the carburetors. Jim's background includes rebuilding everything from Austin Healeys and MGs to Ferraris and Lamborghinis, but more about that later. The other parts as follows:

- The engine was delivered to Brian Duffee Motorsports, one of the top engine builders in the Southwest.
- The transmission was dropped off at a Cottman Transmission Repair dealership where they have a gentleman in his 60's who specializes in older transmissions.
- The differential headed off to Phoenix Differential where it was totally cleaned and had all worn gears and seals replaced.
- The brakes stopped for a spa treatment at Phoenix Brake in Chicago, Illinois, where they get lifted and tucked back to perfection. Upon return they had new calipers, wheel cylinders and all new seals. They look awesome.
- The brake master cylinder was rebuilt by Phoenix Brake in Chicago, also. Later we learned that it was too pitted to fully seal properly. After the car has been reassembled, the brake fluid slowly began leaking out, necessitating intervention by White Post Restorations in Virginia. They disassembled the cylinder, glass bead cleaned it, bored it oversize, pressed in the new brass sleeve and sized them to original specs. This ensures that it will never rust, pit or corrode, ever. White Post provides a lifetime warranty on this repair.



With a good bit of help from Brett Engel and Jim Unsworth, we pull the engine and transmission. As Brett is removing the transmission he looks at the clutch and says, "How many miles did you say you had on this car?" I reply, "A bit over 36,000." Brett says, "You can drive any of my cars anytime you want, this clutch is like new."



Removing the cams from the head, the tolerances were so tight that they remained in place when we removed the keepers. We re-torqued the head, then slowly took the keepers off in the opposite order, tapping gently as we went. This time the cams popped right up, but it was another sign that the engine was in good shape – really good shape.

Distribution of stuff (Cont.)

- Gauges were removed from the dash and hand-delivered to RS GaugeWorks. Randy has a lead time of 12-14 weeks. Ninety percent of his business is through ads in Hemming Motor News and the Robb Report. His work is just remarkable and to learn that his shop is just a few miles north of here was a real treat.
- The dash, sans gauges, but with extensive pictures, was shipped to Madera Concepts in Goleta, CA, for refurbishment. No woman ever had a finer facelift. Once the dash and gauges come back and the new wiring harnesses arrive, David Barnett takes on the task of wiring the dash.
- The body was entrusted to Avo Kullukian, a highly respected Porsche restoration expert. Dave has seen and experienced his work.
- I kept the frame and pretty much everything else. The task I had set for myself was to restore life and youth to all the suspension parts, body pieces, headlamps, wheels, brake lines and, essentially, all the rest. There were boxes and bags of stuff to sort through and clean – easily months of work. What fun!



If it "takes a village" to raise a child, it takes a car club working together to get a perfect rebuild. In this case it was LOOP, Lotus Owner's Of Phoenix. The engine is out, doors are off, most everything has been removed. Now to lift off the body and separate it from the chassis.



The brakes come back from Chicago looking better than new.



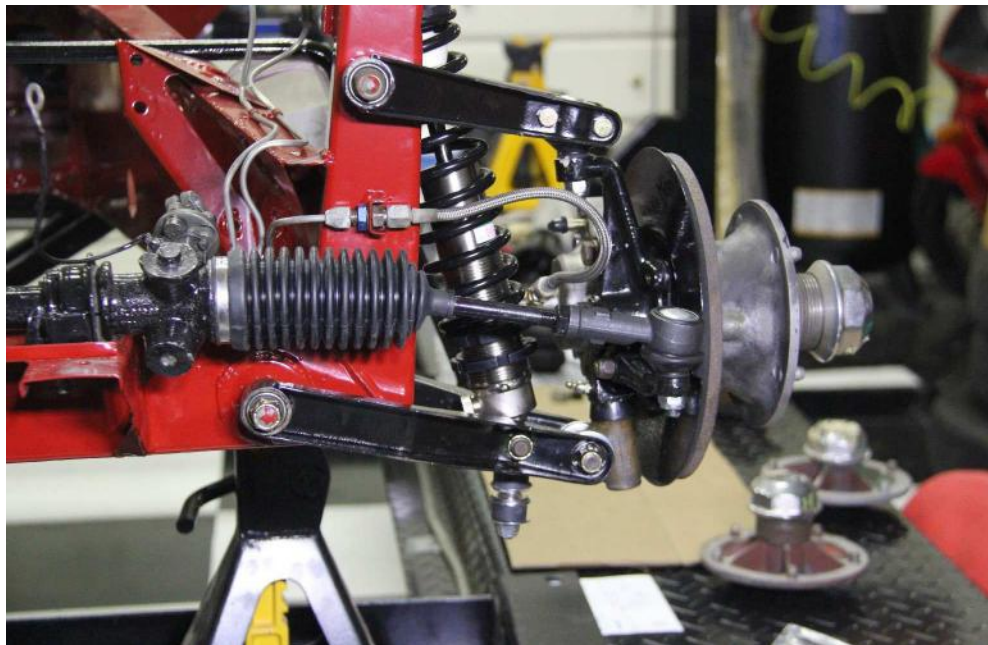
Brett Engel built a wood frame with casters for storing his Elan body when rebuilding his racing Elan. It worked out so well, he built me this identical one. It made moving the body much easier and perhaps more importantly, kept the light fiberglass frame straight and true as it is mounted to the wood frame using the same mounting spots as when it is mounted to the body.



With enough guys gentling lifting and others searching around to find what was still sticking, the 220 lb. body quickly comes off. We carry it back into the garage and bolt it to Brett's custom made ingenious wooden frame structure.



Outside experts are always a good idea. Here Brian Buckland, a living legend in Lotus lore, talks a half dozen local Phoenix Lotus owners through precisely how to get things right from the start.

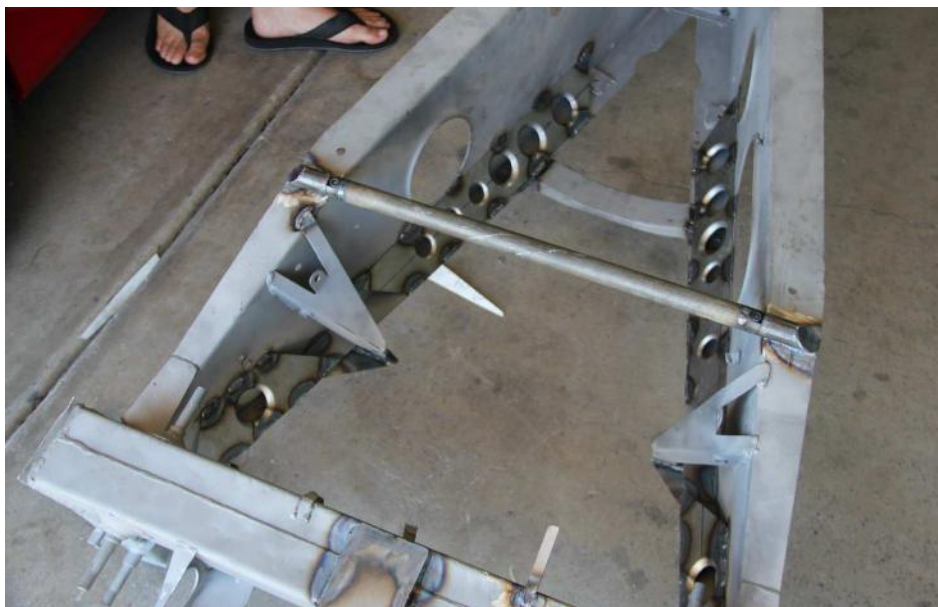


A Lotus is all about chassis and the suspension. No modifications here - just getting things back to the way they came from the factory, although with modern bearings and bushings and every part beadblasted and then painted with POR15.

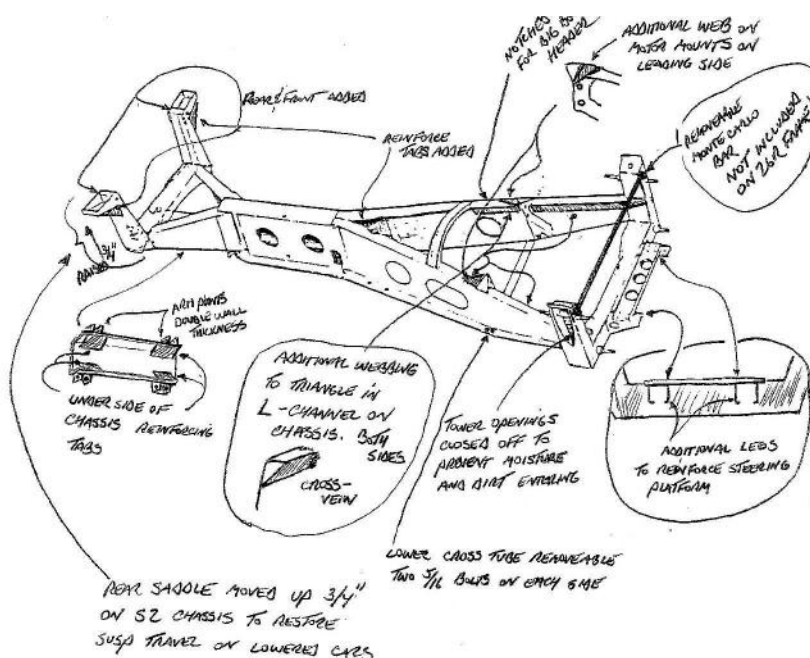


Dedicated experts in each discipline applied their best efforts to each task, not the least of which was Avo Kullukian, who did the body work.

Frame / Chassis



With everything off the car and the major elements delivered to those who will take the next step, we take the 85 lb. frame and attempt to clean it. First we tried taking it to a power washer and used a lot of degreaser. This didn't work very well at all. Ultimately we took it to Arizona Powdercoat. They have a large enough bead blast area to do the job. Once totally clean, the frame was delivered to Junior Rios at Fathead Fabrication. Junior is a master fabricator and welder, known for his design work for race cars and off-road vehicles. Although in no way an expert on Lotus, he's an expert on car frames.



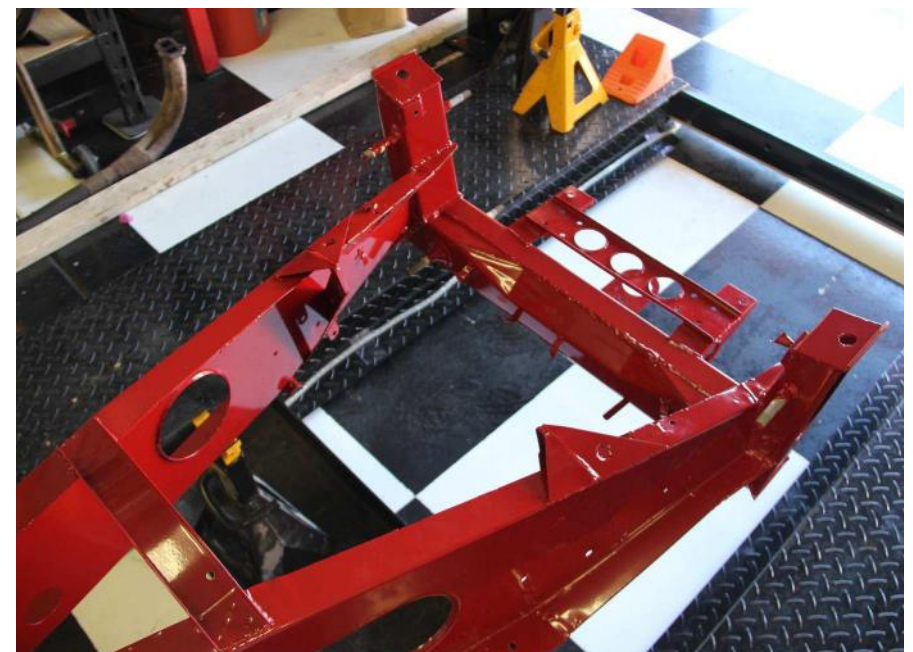
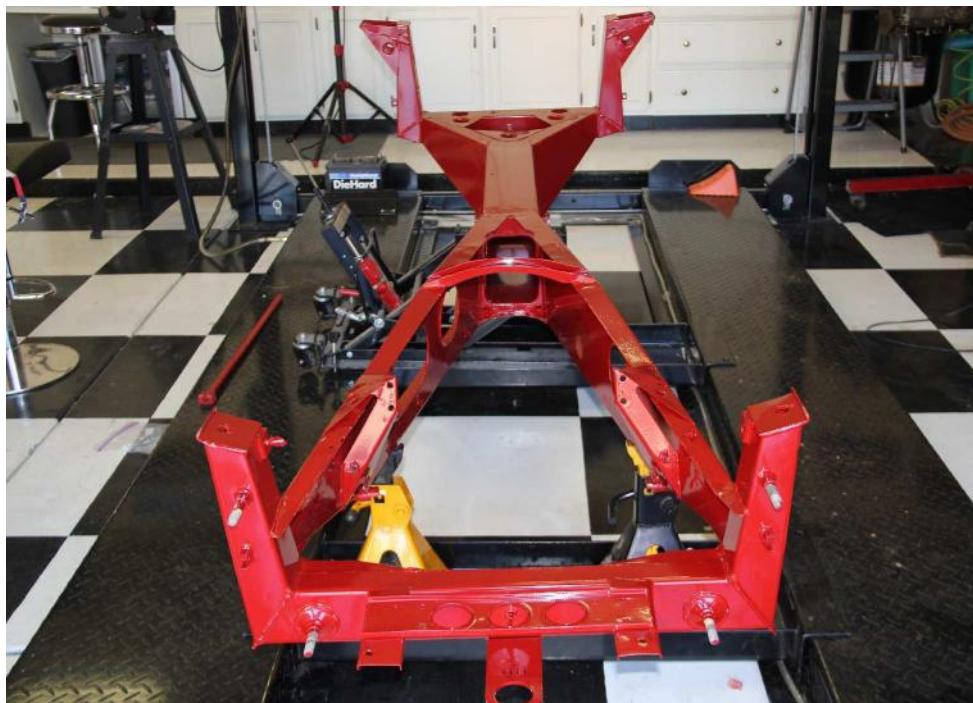
Given the great shape of the existing chassis, we decided to keep it and upgrade it. Using the 26R chassis enhancement diagram as a starting point, Junior Rios, an intelligent, creative fabricator and master welder with experience in building frames for race cars and off road vehicles made valuable suggestions, minor touches and improvements that added little weight but made the frame stronger and better. In the end, the chassis improvements included:

- Reinforced motor mounts.
- Welded piece to front cross member to provide a tow hook and lift point. Same for the back.
- Four reinforcement strips welded to the underside of the central frame on both sides. Strategic placement of holes with formed flanges allows for a reduction in weight. According to Rios, these increase the strength of the particular piece by up to 40%. Who knew?
- Reinforcement of strut towers via new triangle gussets.
- New, heavy-duty cross member under the engine. Solid metal piece. Better yet, it is removable, making service easier.
- Added triangle plates to the inside of the front towers and outside of the rear towers.

Top left: After studying the experience of previous Lotus owners with their frames as described on LotusTalk.com and www.lotuselan.net, we provide Junior Rios with the 26R frame reinforcement diagrams. Key are four reinforcement strips welded to the inside of the frame. **Top right:** This new heavy-duty cross member is far stronger than the original and is now removable. **Bottom left:** Diagram from LotusElan.net of various suggested reinforcements to the Elan frame.



Top: We spent a lot of time on the chassis. A Ferrari, some say, is the engine with the rest of the car thrown in for free. A Lotus is the chassis and the suspension, with the rest of the car thrown in for free. We devoured information from the GGLC (Golden Gate Lotus Club) site and on LotusElan.net and local expert, Brett Engel. **Below:** The newly powder coated chassis from the front. Note the new tow hook.



Above: Once Junior Rios is finished with it, we take it back to Arizona Powder Coat where it gets powder coated red. It looks great and still only weighs a tad over 86 lbs. The consensus of local Lotus intelligentsia after close examination of the finished product is that this may be one of the best Elan frames ever.

BODY

Once off, the body goes to body expert and paint master, Avo Kullukian. We researched half a dozen top paint shops in Phoenix before deciding on Kullukian. Kullukian has been the “go to” painter for Porsche owners, new and old, for years in Arizona. His paint work on a restored Pantera that won national honors gained particular mention for the outstanding paint. Avo wasn’t the lowest cost option, by any means, but he promised he’d treat the car like his own and that is exactly what he did. It was always fun visiting the Elan at his shop as he almost always had a new-ish Lamborghini or high-end Porsche inside having work done.



David Barnett standing next to the body as it is mounted on my trailer before beginning its short ride to the paint shop.



Prep work involved completely removing all old paint. Once down to the fiberglass, Kullukian (**pictured right**) made everything straight and true, including reforming the doors (**pictured left**) so that the legendary Lotus door overhang is eliminated and there is a smooth, precise, ¼ inch gap all around the door. This was a MAJOR effort and it turned out great.



Before applying something called "kitty hair," we added fiberglass to several areas including the trunk and fiber-glassed in new bobbins.



Body work comes down to hours and hours of hand labor.



Based on Buckland recommendations, Kullukian reinforced areas of the body. The area holding the windshield got extra fill. Sometimes people reach for the windshield and use it to pull themselves out of the car – a really bad idea. Although not a problem on my car, it was smart to strengthen here.



One noticeable flaw in nearly all Elans is ill-fitting, sagging doors. Some insist that originality requires leaving them this way. We elected to invest in the substantial effort to make them fit, no easy task. Here you can see the perfect fit, even before the car is painted.



Top: Once all the old paint is removed and the body is perfect it is sprayed with “Kitty Hair,” a long strand fiberglass reinforced body filler. **Bottom:** After application of the fiberglass kitty hair and before the primer coat.



Above: This is what the primer coat is applied to and is designed to keep stress cracks from appearing for many years. It also helps that my fiberglass has matured and has quit moving around and shrinking in localized areas. This paint job should continue to look pristine for many years.

Eventually the body is returned
and reunited with the chassis.
It is gorgeous!

Headlight pods: Reassembling the headlight pods, after cleaning the interiors and verifying everything worked, was straight forward. Getting the vacuum to smoothly operate opening and closing the light pods was more difficult. Part of this was our fault. We'd eliminated a lot of the old leaky lines and so now had a lot more suction. We'd also eliminated the original headlight combo switch (an electrical switch combined with a pinch valve on the dash) and put a 4-way solenoid valve up-front to control the vacuum from the intake manifold to raise or lower the lights. In the end, we installed individual needle valves for opening and closing which allowed us to fine-tune the air flow and precisely adjust the speed at which the lights go up or go down individually. Probably overkill, but they sure work well now.

Badges and Emblems: All of the original badges and emblems were cleaned up and reused. They look great on the car. I cleaned up and polished the original side mirror and it looks great. It doesn't provide outstanding visibility to the rear without bending your head a bit, but the windshield rearview mirror does and it let me reuse an original element. As someone said, "Hey, in an Elan, you're not looking back that much anyway."

The day the dozen or so bolts re-attach the body to the Elan chassis is a major milestone. Even though the paint has fully cured for 3-4 weeks, it looks so wet we're almost afraid to touch it.



SUSPENSION

While the body, transmission and engine were gone, we got busy examining, repairing or replacing everything that was attached to the chassis -- and where possible -- re-attaching it. Having a beadblaster in the garage made things go a lot faster than if I'd had to rely only on the parts washer. I got up close and personal with Wayne Viall's beadblaster. We spent a lot of hours together. It was a sad day when I gave it back to him. But he got it back with a new gun, new lights, and new Plexiglas panels.

While the suspension pieces were in good shape, they were filthy. A Harbor Freight press helped speed pressing out all of the old bushings and bearings. We ordered new ones.

While waiting for them to arrive, I took our cleaned suspension parts and painted them with POR15. Available online, this remarkable rust proof paint is the next best thing to powder coating. If you prep your surfaces carefully, it is every bit as tough and strong as powder coated surfaces. POR15 chemically bonds to metal, forming a rock-hard, non-porous coating that is guaranteed not to crack, chip or peel. That's the good part. The bad part is it is difficult to work with. If you get it on something -- it stays there. Gloves are a very good idea, because if you get it on your fingers, it will be there until the skin grows out: difficult, but well worth the trouble.

Ken Gray recommended new adjustable Koni shocks from TTR (Tony Thompson Racing) in the UK, so we went with them. The front shocks come with new springs. The springs in the rear were fine, so we kept them, and ordered the new adjustable shocks for the rear. We paid a bit extra to have them here in time for Brian Buckland's visit from the UK.



Dave Bean supplied new U-joints, input shaft, tailshaft bushings, differential hanger mounts, tons of new bushings, new lotocones, track rod ends, upper ball joints, new bellows kit and trunions. They also loaned us a hub removal tool.



I ended up purchasing a heavy-duty shop press which aided the removal and re-insertion of all these bearings and bushings.



Rack and Pinion

We removed the rack and pinion (left) and took it to Phoenix Rack & Axle on 32nd street to have it completely disassembled and rebuilt with new bearings and U-joints. When it came back, it seemed a bit stiff. We returned it and they pushed it around a bit and said they were all a bit stiff at first, after a rebuild.

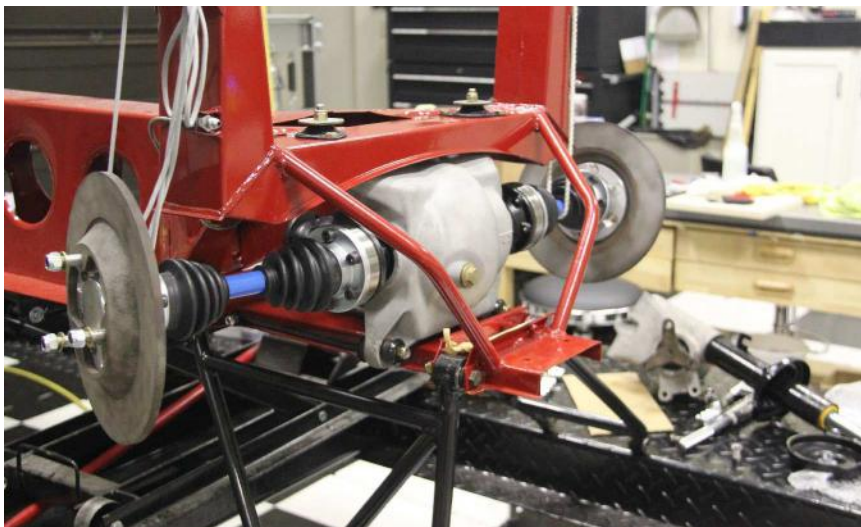
When it still did not seem right when we got it back in the shop, we disassembled it ourselves. It soon became clear that they'd not done the work as claimed. The rack was in such rough shape, we decided to replace it. Ken Gray at Dave Bean found us a brand new Triumph rack & pinion that fit perfectly, we only had to shorten the shafts a few inches. This was the only real let down from any of our service suppliers. We received a full refund on the non-refurbished rack.



CV Joints

Once our new, clean and well-oiled differential was back on the chassis, we elected to give up on the rotoflex couplers for good and went with first rate, genuine CV joints. David Barnett, Brett Engel and I spend several weeks researching the various options. This is an expensive (\$1700 or so) upgrade, so we wanted to be sure to get it right.

In the end, we found two options that offered what we felt were comparable specs and equal build quality. We chose the Dave Bean-supplied joints. When they arrived we could tell that they were exceptionally well made. They were beautiful to look at on and off the car. And one additional bonus, they came with new axles, so we saved a bit there, too. We were thrilled with our choice.



On the Car

Bolting the new CV joints onto the frame was a task made much simpler in that we did it before the body and other suspension parts were attached. This allowed unparalleled access.

Workshop Tasks

Using Buckland's book as a checklist, I began placing orders for things we would need; a new soft-top, windshield, bushings, bearings, cables, etc.

I also began tackling all the parts and components in the boxes, bags and on shelves in the shop:

- Heater box: Dismantling, cleaning, painting and repairing the motor in the heater box.
- Windows: Reworking the electric windows in the doors. Replacing a cable on one, pulleys on another. Cleaning and painting the motors. Putting in new felt strips in the windows.
- Bobbins: Locating new bobbins so Avo can mold them into the body so the frame and body will solidly connect together like new.
- Top frame: Cleaning, beadblasting and powder coating the frames that hold the soft top up.
- Gas tank: Inspection of the gas tank, inside and out, to ensure no rust. I'd purchased a camera with its own LED lights in front, typically used to find plumbing leaks and it did a great job of letting us look around inside the gas tank. I repainted the exterior of the gas tank with POR15 to prevent any future rust. I rebuilt the gas sending unit and tested it. We then ordered and replaced the gaskets around the sending unit.
- Brake lines: After cleaning them, Wayne and I put all brake lines back on the chassis. It was amazing to realize that the nuts on the brake lines had never had a wrench on them in 40 years. Again, having photographs of the original routing sure helped in reassembly. We ordered and installed all new brake pads, except for the parking brake pad, as it looked almost new.
- Handbrake cable: Purchased a new emergency brake cable and installed it.



The heater box was a mess, but an easy, uncomplicated, satisfying project.



The back tray/top supports are a highly visible and easy fix. They look GREAT now.



Extensive photographs were a big help in routing brake lines back the same way they were at the start.



Gas tank “refurb” is straight forward. First, ensure not rust inside or out. Repaint exterior with POR15 and test and reinstall the sending unit with new gaskets.



Here’s the old radiator. The new one provides over 4-5 times the cooling capability – and that’s without the new high powered fans.



On a visit to the Penske Museum we found this tiny Nippondensu alternator on a Formula 1 racing engine. Hey, if good enough for a Penske racing machine – it's good enough for my Elan.

- Drive shaft and yoke: The drive shaft had some scarring and so it could potentially leak oil. After some searching, we finally found a repair sleeve for this particular drive shaft yoke. Instructions from the place where we got it worked perfectly and it went on far easier than I’d expected.

- Installed a Lumenition Magnetronic Ignition Module. This fit inside the current distributor but eliminates the points and condenser resulting in more reliable triggering of the spark. A fast charging/discharging capacitor allows for a stronger spark, meaning more complete burning of the fuel, less mis-firing, less hiccups at low RPMs as it puts out multiple sparks to the plug, not just one.

- Fuel line: The old plastic fuel line looked pretty wimpy, so I ordered a 3/8 inch heavy duty aluminum fuel line. We needed 9 feet. The smallest available quantity is 20 feet. Anyone need some fuel line?

- Radiator: I took the old radiator (left) to a radiator fabricator (Commercial Radiator Service, Inc. on West McDowell Road in Phoenix) and had them build me a new radiator that will keep the Elan cool in hot, hot Arizona and still fit in the front of the Elan. Once the new radiator (\$561.12) arrived, I researched the best fan set up possible, given this radiator size and ordered it. (Old radiator left)

- Generator: The 20 lbs., 19 watt generator is replaced with a 4.8 lb. Nippondensu Alternator that puts out 62 watts. It should have no trouble powering whatever we throw at it. The Nippondensu is a favorite of hobby aircraft builders, although we first found this model at the Penske museum. It was on a Penske Formula 1 racing engine. I hear it's also used on a Suzuki Samari. Who knew?

- Create reassembly plan: The garage shelves are filling up with parts, lots and lots of parts. I confer with Brian Buckland's book and then create an EXCEL spreadsheet listing each part, it's location in the garage, whether it is complete or not (meaning has it been replaced or refurbished and has the new part arrived or has the refurbishment been completed and lastly, where does this part fit in the reassembly process? Is it early, middle or late?

Engine

Brian Duffee is the premier engine builder in Phoenix. He was capable and willing to modify the engine to just about any level of performance we wished. In the end, given the great condition of the existing cams, we decided to reuse them. This helped determine everything else.

Brian disassembled the block, inspected and measured everything, then put the block into the vat. He chemically stripped the front covers and measured for custom pistons. They pre-honed the cylinders to figure final piston size and then ordered top-of-the-line, weight-matched, C-P (Carillo) pistons. Once they arrived and were sized, new rings were ordered and the block was given a final hone for the cylinders.

A trial assembly was done to measure and check clearances. The deck block was true to desired specifications. The crank was sent to a shop in Denver, Colorado that Brian Duffee feels does the best job of balancing and polishing cranks. The water pump was replaced with a new one, cut to Dave Bean specs. The mechanical fuel pump was removed and plate put in place to cover that opening. The oil pump was disassembled, inspected and reassembled. Total engine work, not counting the head, ended up costing \$6,552. Work on the head totalled \$3500. So for both, a bit over \$10K for the engine and head.

During this phase, we contemplated how to ensure the engine always had enough oil. I purchased and downloaded the instructions for a double-gated oil pan baffle created by Col Croucher of www.elantrikbits.com in Australia. These guys have a host of great products to make Elans run better and last longer.

After going over the plans in detail, we determined that since I was not planning to race the car, this solution was more than what I would need. Instead, Duffee built a special baffle to reduce oil splash in the pan and to ensure the engine always has plenty of oil.



Packaging on the new CP-Carillo pistons rivals that of a new iPhone.



The original block is inspected, measured and then goes into the vat for cleaning. Then it's "decked" to insure it is perfectly true.



Duffee motorsports builds an oil pan baffle/windage tray that will reduce frothing in the oil pan and ensure the Elan always will have enough oil.



Jim Unsworth (left) and Brian Duffee (right) confer on the head at Duffee Motorsports. Close coordination between Brian and Jim's efforts was critical to getting the very best outcome. See section on the head, next.



The completed engine, freshly back from Duffee Motorsports, is attached to the transmission. The two are put on the hoist to slide it back into the car. The towels are there not because the Elan is going to the beach, but to protect the paint.

Top: View of the engine from the bottom, after the new, polished and balanced crank is installed.

Middle: The engine, finally fully assembled, awaits attachment of the clutch and transmission.

Bottom: The newly rebuilt engine is back home in the engine bay on its brand new motor mounts.

The head

Jim Unsworth is an aerospace engineer with a passion for restoring and rebuilding cars. Jim's rebuilt Jaguars: SS100, C-type, D-type, 120, 140, XKE and a lightweight E-type. Austin Healeys: 100-4 and 3000. An MG Midget, MGB and Triumph's; TR2, 3, 4, 250 and 6. He's done a Lotus Elan before as well as an Esprit. Ferraris: 212, 250, 330 and 328 as well as a Lamborghini Mura and Countach, among others.

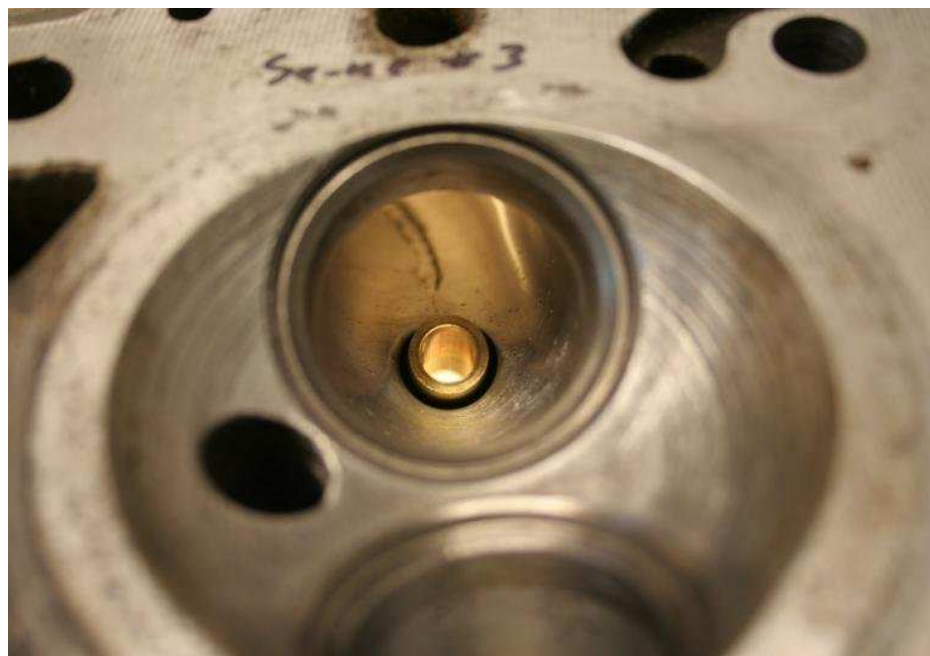
In addition to being a skilled engine rebuilder, he's adept at engine modifications including computer simulations of proposed modifications, porting and flow testing, tuning and even transmission rebuilding. Plus, Jim has a flow bench in his garage.

Before describing the work Jim did on the Lotus head, some background might help. As Jim explained it to me, porting a cylinder head is a game of finding small improvements in many places and working them together so that in the end you get a significant improvement to flow, resulting in a significant improvement in performance. The general rules of thumb are:

- Every percentage point improvement in flow is a percent improvement in HP
- Every CFM of air flow (measured at 25 in H₂O) will result in 1 Hp on a 4 cyl (assuming a high compression race engine)



The Process: First the Elan head was flow tested in baseline condition (combustion chamber and valves decoked first). Then the carbs were installed and baseline testing was repeated. Testing established where the most gains were likely to occur.



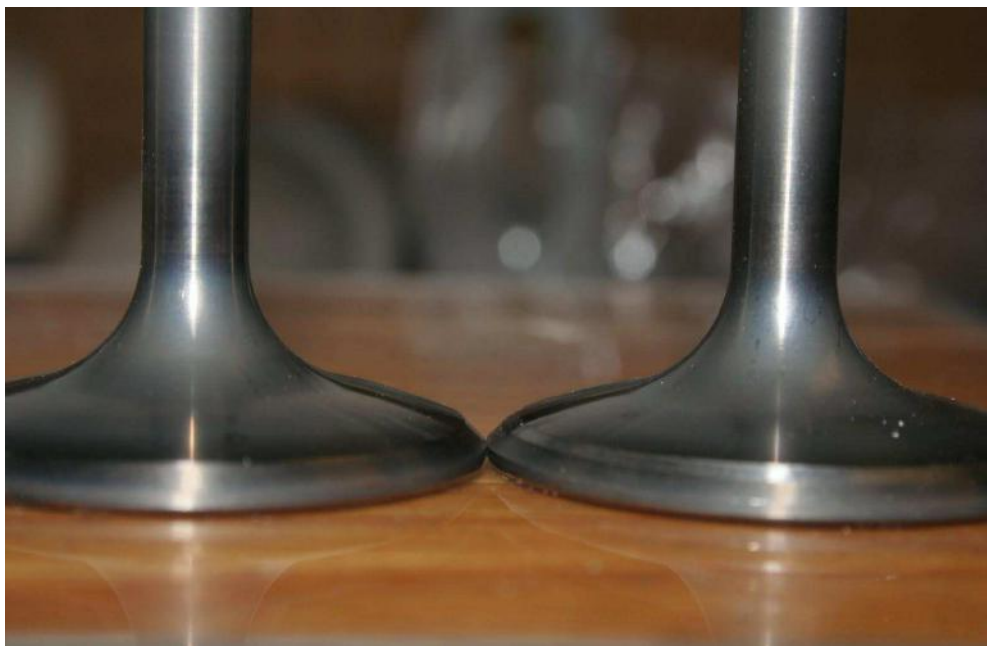
Next the intake and exhaust ports were ported. The ports were cleaned up but not opened up to maximize the air velocity in the port. Short turn (see above where light is shining in) was opened up slightly and very carefully shaped to maximize flow. This is one of the critical areas to get right.



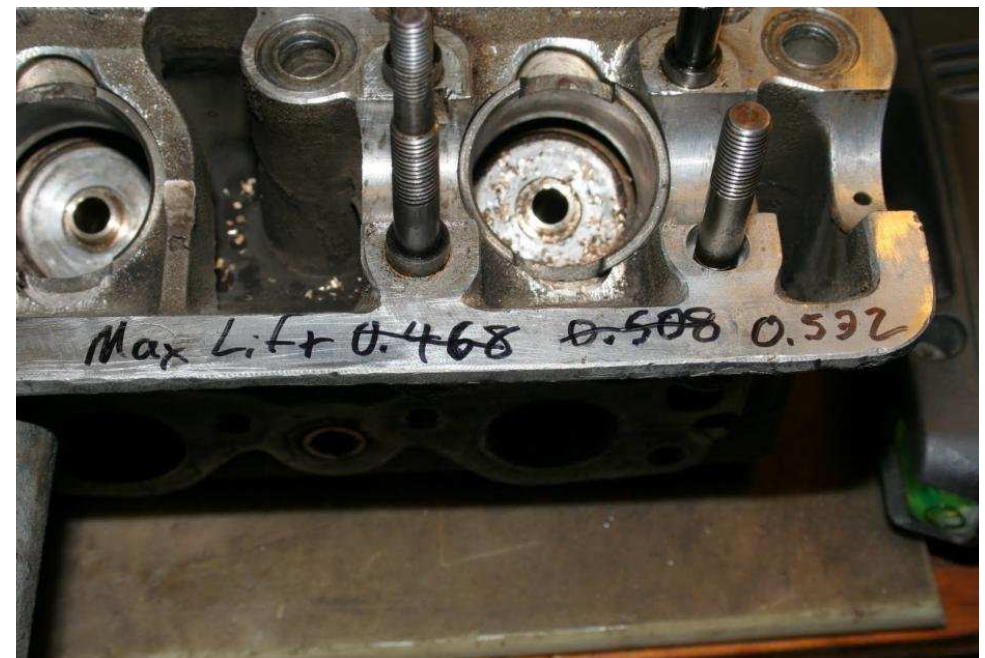
A multi angle valve seat was cut. Many valve seats from the sixties are just one 45 degree cut, the Elan is no exception. Opening the seat to precisely the same diameter as the valve effectively makes the valve bigger. Carefully tailoring the width of the seat and adding two extra cuts is critical to improving the flow.



Top of the line valve seals were used and the seals were customized to fit in the Lotus. The Lotus has very little room between the valve guide and the valve spring retainer. Valve seals are critical to minimizing oil consumption and smoking. Valve springs were shimmed to insure all the springs provide the correct seat pressure.



New valves were used, intake increased from 1.53 inches to 1.56 inches. The inlet valves were carefully backcut to improve flow. If you look at the valve on the right, you can see how it has been backcut while the one on the left has not been backcut yet.



The seals required modified retainers, shortened per Dave Bean's recommendations. Guides were trimmed and measurements taken to insure there is enough room for the seal with some safety margin. Seals are installed with custom tooling to assure proper installation.



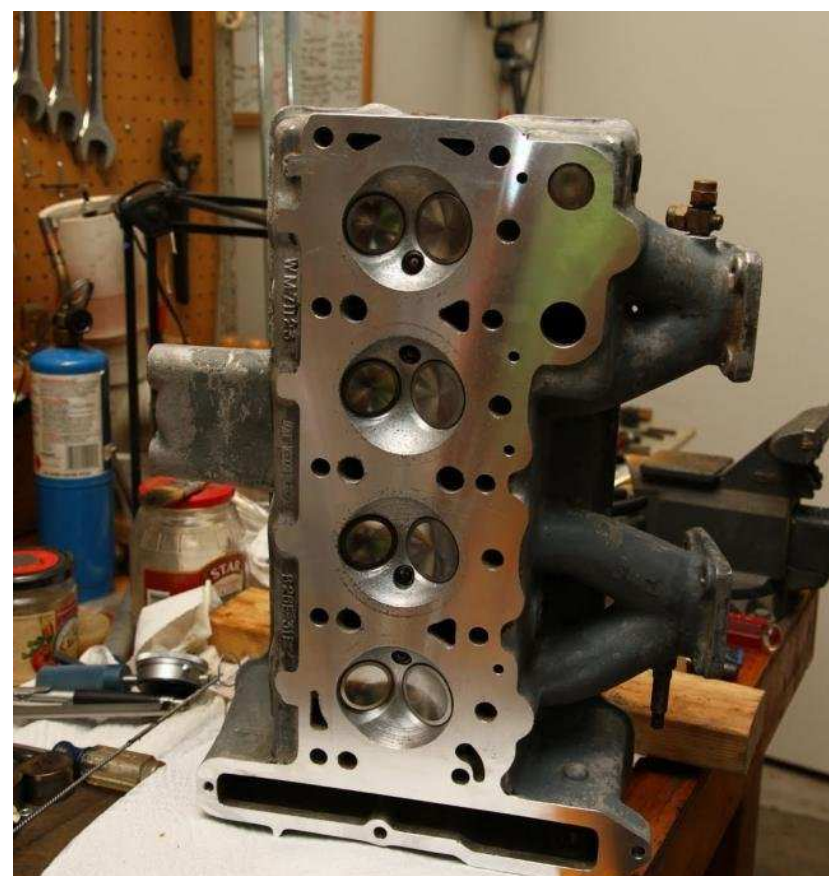
Bronze tappet liners were installed on the exhaust side.



Each carb was rebuilt, preserving the original emissions stickers.



Cams installed with new bearings and valve lash set. Dave Bean's thin top tappets were used on the intake side to compensate for the 0.030" longer Sprint valves used. All hardware was cleaned. Caps for the crossover were reshaped and painted. All threads were chased.



The finished head, ready to deliver to Duffee Motorsports with a 15% improved flow over stock at 0.350" lift. This is significant and well worth the extra work and diligence to get it right.

Wiring / Electrical

Given the mice had done a major number on the existing wires, we completely removed them all and ordered new wiring harnesses from British Wiring in Bally, PA. These 3 new wiring looms were not cheap – costing just under \$750 with shipping. But looking at the remarkable workmanship when we opened the box, we felt we had made the right choice. But in retrospect, we hadn't.

The first step was reinstalling all of the rebuilt gauges into the revitalized and completely refurbished dash. This task fell to David Barnett and he built a rack to hold the dash to make it easier to work on (right).

The problems began when we attempted to install the dash in the car and connect the three harnesses to everything. Our problems were largely due to having five different sources of information. There was 1) the old harness, 2) the new harness, 3) the original wiring schematic, 4) a modified wiring schematic and 5) the Lucas color code chart from LotusElan.net which identified the function of each wire by its base color and tracer color.

First, no two sources agreed 100% nor was any one of them without omissions. In hindsight, what could have been a straightforward job (if we'd just used individual wires, point-to-point) turned out to be a nightmare amplified by the insecure bullet connectors which tended to come apart and cause repeated difficulty in some areas of the harness.

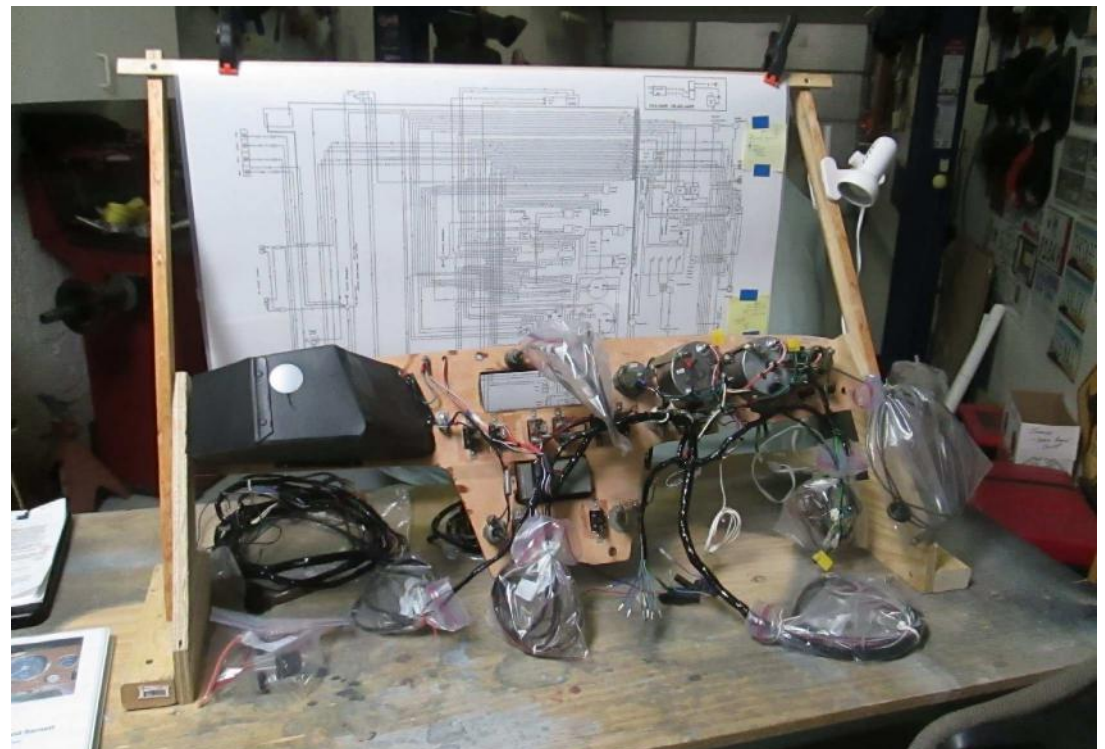
As David had inadvertently raised his hand when it came to electrical, he ended up facing the greatest amount of frustration. Not a very rewarding experience for him and we ended many days more than a bit discouraged.

In the end, we unwound the new harnesses and re-wired everything and tested point-to-point connectivity. This allowed us to test each wire and verify the integrity of each connector. Yes, it took 3-4 times as long as it should have, but we now have something we're certain is wired correctly and, if we do have a problem in the future, debugging will be much simpler.

At this point I began to understand why so many rebuilds and restorations are never completed. Without David's gentle (and sometimes not so gentle) and persistent urgings, I doubt I'd have made it through this part of the project.



David Barnett built a frame to hold the dash and worked this project in his workshop. We took the original Lotus wiring diagram and blew it up and mounted it to a large, 4' X 5' poster board to help track down wires.



Here is the new, finished dash with all of the rebuilt gauges installed and wired up ready to transfer from David's workshop to the Elan.

Gearbox / Transmission / Clutch

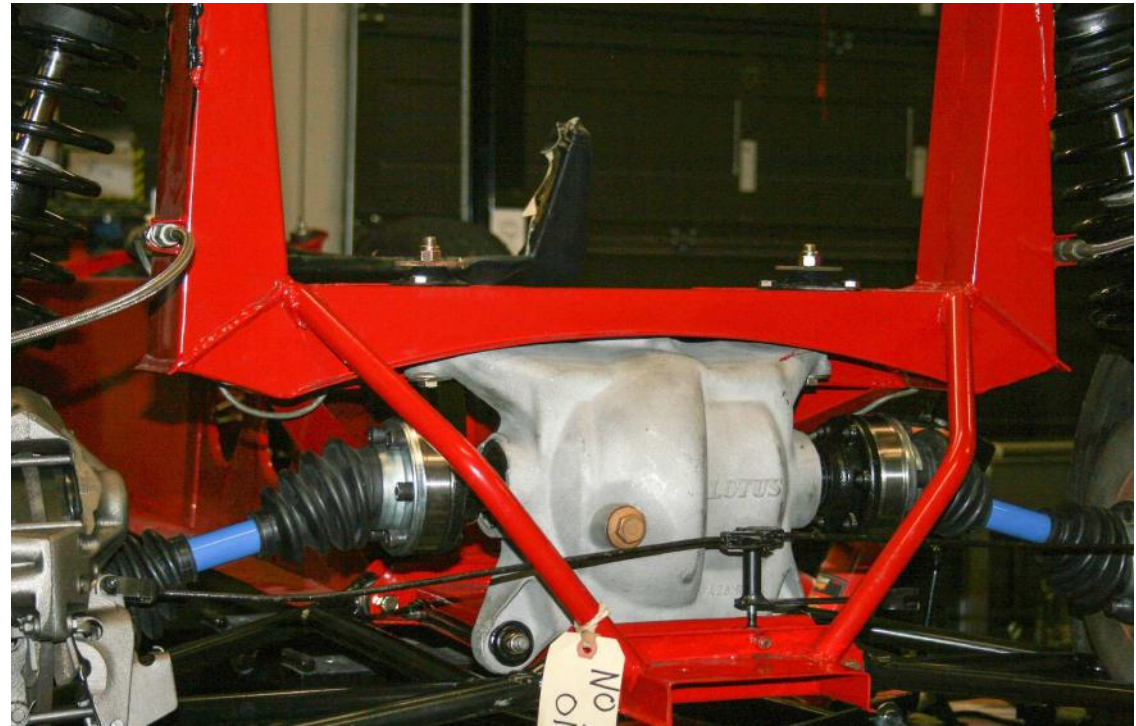
The differential was pretty straightforward with Arizona Differential doing the work. They dismantled and examined everything looking for any damaged gears; there were none. They installed new inner and outer axle bearings, rings and seals as well as new ring and pinion bearing seals. They inspected everything and said it looked to be in “very good shape.” It was great going to a shop that specializes exclusively in differentials. After putting it back in the frame we filled it with the special Redline oil recommended by Brett Engel.

I cleaned the drive shaft and painted it with POR15. We ordered U-joints from Dave Bean but broke one during assembly. It turns out Napa carries the exact size U-joint we needed, so we lost no time waiting for this part.

Cottman Transmission on Cave Creek Road in Phoenix specializes in, you guessed it, transmission repair. The guy in the back-room on the transmission bench was in his mid 60's and happy to see the Elan transmission. We talked before he dismantled it. He was happy to get this sort of a task and seemed genuinely intrigued, and dismissed any ideas I had about this being “complicated” because it was a Lotus.

Stopping back a week later, I spent a half hour going over what he'd done. He'd taken the transmission apart and carefully examined everything. Some gears were, of course, showing some wear. However, not seriously enough to cause him to recommend replacement. He explained that transmission gears are like a family and over time, they begin to work together well. If I were to replace just the one gear showing a bit of extra wear, it would no longer fit as well with the others and I may get whining or worse, it could cause other gears harm. If they're happy and playing well together, let them be. So, in the end, it was all about cleaning each gear completely and reassembling it.

The clutch required nothing. It looked as if it were new. This is not too surprising as the clutch and flywheel on the Elan are oversized for the engine, and they typically get light duty. Mine was no exception.



The finished differential, with the new CV joints attached, awaits new, fresh oil.



Countless times we were glad to have taken so many pictures and made so many notes when dismantling the car. And boy, were we glad we labeled everything.

Months in the Workshop

Most days it was me working in the shop, starting in the morning, 3-4 days per week. A couple of days each week Wayne Viall would show up at around 2:30 PM. We would work together until about 5:30 PM. We made much more progress on the days that Wayne was here to help. While David stopped by frequently later on, most of his projects were completed at his house in his workshop. At the end, with the wiring difficulties, David provided me a needed "kick in the pants," to keep going.

LOOP (Lotus Owners of Phoenix)

Periodically we'd reach a point where a "Saturday work day," with the Phoenix Lotus club seemed appropriate. I'd send an update, a list of tasks for the day, and we'd all gather to try and make a significant amount of progress in one day. It always worked and helped reach key milestones.

Brian Buckland Arrives in Arizona

I've made frequent mention to the value of Brian Buckland's book, "The Rebuilding of a Lotus Elan" already. Brian is the most knowledgeable person in the world about the Lotus Elan. Soon after I began my project I reached Brian by E-mail. Mostly as a fan communicating my appreciation for his work, but with a few small questions, too. I soon learned that he'd planned a trip to the East Coast of the US for a visit. He'd agreed to speak at a LOG event. I asked him if it would be possible to modify his plans and visit us here in Phoenix and perhaps help with my rebuild. With a promise to show him the Grand Canyon during his visit, Brian agreed to come. The week here with Buckland was great. He worked extensively with me and the team on the car. He gave a moving talk one evening to the local Lotus club and other invited guests.



Brian Buckland holds court on a Saturday seminar/work day in my garage with the Lotus Owners of Phoenix group. (Left around to right: Larry Turek, Mike Mah, David Barnett, Wayne Viall, Mauricio Zagorin, Buckland, Jim Meininger, Mark Osterbaur and then Brian Duffee in foreground.)



Buckland (blue shirt) points out key aspects of the re-assembly to Wayne Viall (green shirt) and others in the Phoenix Lotus owners group.

Interior

On the downside, the interior was old, worn, and filthy. Rodents had chewed it up in a variety of places. On the plus side, most all the pieces were still in tact and it was easy to use the originals as templates to build new pieces. The car has its original Colin Chapman engraved steering wheel which was in great shape. I beefed up the slender wheel by covering it with a split heater hose and then stitched on a new leather cover. The original Elan shift knob was still there and the seatbelt buckles were all in fine condition although the belt fabric was old and stiff. We replaced the belts with new material using the original sewing pattern. David Barnett found a reproduction of the foil tabs that went on each seat belt.

The electric windows worked just fine. We bead blasted and painted them with POR15. When first reassembled, they tested perfectly, so we put them back in the car. Once back in, one of the cables jumped the track. So we replaced the pulleys and put in a new cables.

The original soft top was not worth saving. The plastic window was faded and it had some minor tears. We ordered a new one through Dave Bean who got it from Robbins Auto Top in Oxnard, CA. It is top quality and looks great on the car. It came without the snaps installed which, when you think about it, makes sense. With the high risk of getting a snap in the wrong place, I went back to Able Upholstery who got it installed perfectly. The tonneau cover, on the other hand, was completely usable but Able Upholstery also put in a new zipper and reinforced a couple of areas. We took all the old fiber-board pieces and, using them as templates, created new ones, which were then covered with carpet.

Before adding the carpet, the inside of the car was covered with a special sound deadening foam material. The soft, sticky side went down directly to the fiberglass interior. The aluminum foil backing made it easy to form and stay in place. New carpet was glued to the aluminum back.



The original, Colin Chapman engraved steering wheel was in great shape. A heater hose and new leather cover makes it much thicker and like new.



Both seats were rebuilt with new stuffing by Able Upholstery in Phoenix. Several rust spots at the bottom of the seats were treated with POR15. We found new vinyl material for the seats that perfectly matches the original.



POR15 is remarkable rust proof paint, the next best thing to powder coating. POR15 chemically bonds to metal forming a rock-hard, non-porous coating that is guaranteed not to crack, chip or peel. The bad part is it is difficult to work with. If you get it on something – it stays there.

The dash crash pad had a split in the middle but we managed to remove it carefully and recover it with a material that looks identical to the original.

One of the more expensive replacements was the windshield. With the price of the new windshield, shipping costs from the UK and the two special lengths of rubber surround to mount it, the new windshield was over a thousand dollars, before having a professional installer put it in.

The dash was sent to Madera Concepts in Goleta, CA. It came back absolutely gorgeous. The wood looks very close to the original. They matched the original font and applied labels for the various functions on the dash with an important upgrade – they put the labels on before applying multiple applications of the clear coat. This means that the labels won't peel off or fade over time. Why didn't they think of that at the factory the first time?

Madera Concepts did not, however, make me a cover plate for the hole in the dash where the radio goes. I'd sent them one, so I was a bit disappointed they'd missed doing that. Now I had a hole in the dash and the only suggestion Madera had was to have me send the dash back so they could match the wood pattern and make me one.

Fortunately, David Barnett came up with a better solution. David fabricated a small cubby hole out of "cardboardium" covered with fiberglass, lined the inside with a felt-like, water-proof black material used to carpet certain areas of boats. This cubby now conveniently holds glasses, garage door openers and the like. The Elan really needs a feature like this and it looks totally natural to have it there. Absolutely brilliant!

My existing valances which cover the areas below the dash and hide the wires were more than a bit brittle and had some cracks. New ones came from Dave Bean and although expensive, they are far more flexible than the original ones and look the same.



It is easy to see the cracking and worn lettering on the original dash above. Madera Concepts made it all better.

The center console piece was an entirely different matter. A replacement is available, but costs almost \$250 and I couldn't bring myself to order one given how good mine looked. While it looked fine, with only a few small cracks and being a bit brittle, I decided to make it work.

First I repaired the cracks with Plast-aid, which is almost a miracle product for repairing plastic items. I wrote about it in an article for *Motorcycle Consumer News* and raved about its value and flexibility. While the console was technically now "fixed," the plastic remained old and brittle. Soon after putting it back in the car, I leaned on it and a new crack appeared. A big crack. Damn, out it came. This time I completely fiberglass'd the underside of the console which is, I think, only a partial fix to the problem. The plastic may now still crack but by God, it's not going anywhere.

At some point I'll most likely pop for the new console piece, but I'm curious to see how long the original, with my repairs, lasts. We shall see.

Tires / Exhaust / Wheels

Tires: The tires on the car looked almost new – unless you got close. They're 10+ years old with no more than a few hundred miles on them. But the Arizona sun and air have taken their toll. The rubber is hard as a rock. Tires need to be driven. Chemicals inside the compounds rejuvenate the rubber as you drive – at the same time the highway scuffs off its toll. Not driving a tire for months is just as bad as taking a car to the track and sliding through corners. We found new modern replacements that mimicked the original tires precisely. I paid extra to get each one road-force balanced to perfectly match the wheel it was on. It cost extra because to perfectly balance a tire, it occasionally has to be removed and repositioned on the rim. Most shops do not want to go through that effort. However, paying them a few dollars more is well worth the extra money.

Exhaust: The Elan's original headers and exhaust appear just fine. Although the ultimate plan is to replace them with stainless steel headers and a more free-flowing exhaust and muffler, they'll do for now. One hi-value addition was welding the threaded boss for mounting the sensor for the air/fuel ratio meter. This was a key step to incorporating a permanent installation of the MTX-L Digital Air/Fuel Ratio Gauge from Innovate Motorsports. This gauge measures the all-important mixture of air to fuel and displays it on a gauge, which I mounted in the glove box. This is an invaluable tool for determining how well your carburetors are tuned and how well your engine is burning gasoline. Yes, the human ear is good and "how it feels" is important, but this key data point was extremely helpful to us in learning that, early on, we were running too rich. New, leaner metering needles, new seats and floats were installed and the air/fuel ratio moved into a far more acceptable range.

Wheels: All five rims were cleaned, bead blasted to remove all muck and then powder coated. I was able to easily match the silver paint from the bumper to the wheels. I was lucky, I had five good rims to choose from, although four were better than the fifth.

Discount Tire stores in Arizona offer, at an extra cost of course, balancing done on a Hunter Road Force Touch diagnostic balancer made by Hunter Engineering Company. It did wonders on my NSX so we repeated the process with the Elan.



It was hard for the Lotus Club in Phoenix to give up on the idea that there is "something that needs to be done on Larsen's car next weekend." A conversation on dynamic wheel balancing led to another Saturday event. The idea is that for optimal handling, each tire should be pushing down at precisely the same weight and within specs – while the driver is in the car. After a few hours, the Elan is within .02% of perfect. Half a dozen of us diligently stretch an hour's effort into a full morning of work.

Cooling System

Radiator: English weather can be described as mild. It rains a good deal and rarely hits above the high 80's. Chapman, not one to look too far beyond his own requirements, never envisioned the 110 degree days in Arizona or driving on super slabs for hours at high speed. The stock radiator is inadequate to cool the car in Arizona and we rectified that in this rebuild. I took the original radiator to Phoenix Radiator and asked if they could build a new, dual core radiator, expanding the size to fit within the brackets of the original, but losing the side panels which were of no use anyway. They expressed no hesitation and only wanted a week to complete and test it. The result, a new dual core radiator, double the size of the original, and has triple the cooling capacity. Plus, it should, theoretically, mount to the original mounts.

Everything was working to plan until we actually put the engine back in the car. Then we realized the radiator may be too tall. Given its new greater width, it no longer sat all the way down into the space allotted for it. We were on pins and needles as Wayne Viall fabricated new mounting brackets. Once the engine was in place, we finally put the new radiator in with Wayne's brackets. We then slowly lowered the hood into place, holding our breath, to find that we had a good half inch of room to spare. We all breathed a long sigh of relief.

Heater: Once the heater box was out of the car it was pretty easy to take apart and clean up. This was one of the more fun projects as it did not take long and provided a good amount of satisfaction. As one could imagine, the heater box was full of debris. Leaves and twigs that had fallen into it over the years, as well as moisture, had caused a good bit of rust to form and had worn through the paint in sections. David Barnett took the motor home and installed new brushes and cleaned the inside. I bead-blasted the rust from every corner of the box and then painted it with POR15.



Today's technology allowed us to add two high performance fans, sealed to the front with more than enough juice from the Nippondenso alternator to power them. It was easy to reverse them into pusher fans.



This is the heater core from the inside of the heater box. Once all the debris was cleaned out, the core pressure tested just fine, so back in it went. The outside of the heater box was bead blasted then painted with POR15 paint.

Carburetors / Fuel System

Converting from the stock mechanical fuel pump seemed like a no brainer: more reliable, better fuel flow to the carburetors and fewer problems. The issue became finding a “low pressure” fuel pump. The Elan carburetors are happiest with about 2.5 lbs. of pressure. Choices for fuel pumps delivering 20 to 50 lbs. of fuel pressure are everywhere. Under ten lbs., much less under five lbs. were very hard to find. Finally, I found a Carter in-line Pump (Summit racing: CRT-P60504) that promised a maximum pressure of 4 psi and ordered it. The pump was mounted next to the gas tank along with a good fuel filter.

The first few runs to sort out the car, our air/fuel gauge indicated we were running too rich. I immediately suspected the electronic fuel pump (and the new aluminum fuel line we’d used to replace the old plastic one) with supplying too much fuel to the carburetors. I purchased a Holly fuel regulator and fuel pressure gauge. Before installing the regulator, we started with the fuel pressure gauge and it measured a pretty steady 2.8 to 3.0 lbs. of fuel pressure – back at the tank. I was no longer convinced the problem was too much fuel pressure.

Next we removed the carburetors and determined one of the floats was leaking, and decided to replace both floats with new ones. Once they arrived, we installed them and reassembled and tested everything. We were still running rich, even after trial and error with several different float level adjustments – each of which, by the way, involved removing and reinstalling the carburetors. We began to get really good at this. After discussions with Ken Gray at Dave Bean Engineering, he sent us a new set of needles and seats, which we installed, and then reassembled the carbs. Instantaneously, we were right in the ideal range on the air/fuel gauge – if anything, somewhat lean.

The motor felt exceptionally strong and smooth with only a very slight lag just as you got on the gas in 3rd and 4th from a constant speed. It was hardly noticeable and completely disappeared once the air filters were installed. Voilà!



A new, reliable electronic fuel pump and filter are installed in the trunk, replacing the old mechanical pump. We also installed a fuel pressure gauge to get accurate data.



Not many 40+ year old cars still have the original emissions sticker from 1969 on the carburetors.

Reassembly

Once the frame was returned, reassembly began. Buckland's book helped a lot in getting the steps into the right order. Also helpful was an EXCEL spreadsheet I created which ended up listing 174 major component pieces and sub-assemblies (right). Each item was identified by its part name, whether it was new or had been refurbished, what area of the car it belonged, where it was physically located in the garage or elsewhere and finally, when it was due to appear in the reassembly order: early, midway through, or late. This really helped and is something I'd recommend.

Sorting Out

One shouldn't be surprised that it takes a few weeks/months of driving a freshly rebuilt car to get it all sorted out. Not the most fun as you just want to be done! The Elan was no different: A minor electrical issue, then lights not coming up and going down smoothly. An alignment by a professional who really knows what they are doing was next. Timing initially was not spot on. Then the carbs required dialing in. Oil leaks were tracked down. Interior valances didn't want to fit right. Two missing snaps on the soft top. How to fit that damn front bumper piece? These last things seem to take forever.

<i>Description</i>	<i>New/Refurb</i>	<i>Area</i>	<i>Where</i>	<i>Reassemble Order</i>
Front suspension set (right side)	Refurb	Suspension	Lift - right side	Early
Front suspension set (right side)	Refurb	Suspension	Lift - right side	Early
Rear axles & bearings	----	Suspension	Lift - right side	Early
RR Axle inner bearings (2)	New	Suspension	Shelf # 1	Early
Bearing circlips large (4)	New	Suspension	Shelf # 1	Early
Bearing circlips small (1)	New	Suspension	Shelf # 1	Early
Bolts holding disc's to hub	-----	Suspension	Lift - right side	Early
Rubber donut bolts		Suspension	Discard box	NA
Drive shaft boltts	-----	Suspension	Wire rack - Shelf # 8	early
Lower A arm bolts (8)	-----	Suspension	Shelf 3 (in box)	early
Rubber Bump stops	New	Suspension	Shelf 3 (in box)	early
Torsion Bar Bushings	New	Suspension	Shelf 3 (in box)	early
Lotocones (large)	New	Suspension	Shelf 4	early
Rear suspension turret bushing strut	Reburb	Suspension	Shelf 4	early
Emergency brake rods	Reburb	Suspension	Shelf 5	early
Rear Springs	Reburb	Suspension	Shelf 5	Early
Chassis Cross Brace (red)	New	Suspension	Shelf 5	Late
Differential hanging bolts	New	Suspension	Shelf 5	early
45 degree zerks (old)	----	Suspension	Shelf 5	early
Bolts from Rear rotor (3)	-----	Suspension	Shelf 5	NA
Drive shaft bearings - inner (2)	New	Suspension	On lift - right ramp	Early
Shocks, aka dampers (Front)	On order	Suspension	On order	Early
Front springs	On order	Suspension	On order	Early
Differential Torshion Arms	Reburb	Suspension	Wire rack - Shelf # 13	Early
Radiator mounting bolts	----	Radiator	Wire rack - Shelf 2	Middle
Radiator overflow bottle	Cleaned	Radiator	Body Shelving	Middle
Heater core hose clamps	----	Radiator	Body Shelving	Middle
Radiator	New	Radiator	Black Shelves	Middle
Windows with Electric motors/strike plate	Refurb	Body	Avo - body shop	Later
Headlight system check valve	New	Body	David Barnett	Later
Gasket Making and Gasket Sealers	New	Various	Wire Rack - Top Shelf	Various
Rear wishbones (2)	Refurbd	Suspension	On top of tires	Early
CV Joints (2)	New	Suspension	Wire Rack - Shelf 4	Early
Brake discs (4)	Cleaned	Suspension	On lift - left ramp	Early
Lotocones (2)	New	Suspension	Wire Rack - Shelf 1	Early
Lotocone Washers	----	Suspension	Wire Rack - Shelf 1	Early
Rear Drive Shats (2)	----	Suspension	On lift - right ramp	Early
Drive shaft bearings - outer (2)	On order	Suspension	On lift - right ramp	Early
Drive shaft spiders (2)	----	Suspension	On lift - right ramp	Early
Rear emergency brake rods	Refurbd	Suspension	Wire rack - top shelf	Early
Abutment Plates (2)	Refurbd	Suspension	Sitting on chassis	Early
Wheel hubs	Cleaned	Suspension	On lift - left ramp	Early
Shocks, aka dampers (Rear)	On order	Suspension	Black Shelves - bottom	Early
Rear springs	Refurbd	Suspension	Black Shelves - bottom	Early
Rack & Pinion and mounting parts	Refurbd	Suspension	On lift - left ramp	Early
Steering column & wheel	Refurbd	Suspension	In two car garage	Early
Front anti-sway bar	Refurbd	Suspension	Wire rack - top shelf	Early
Rack & pinion bolts (extra)	----	Suspension	Wire rack - Shelf 1	Early
Drive Shaft	Refurbd	Suspension	Wire rack - Shelf 2	Early
Drive Shaft U-Joints	New	Suspension	Wire rack - Shelf 2	Early
Upper differential nuts/washers	----	Suspension	Wire rack - Shelf 2	Early
Rubber bushings for front sway arm	----	Suspension	Wire rack - Shelf 2	Early
New sway bar end bushings	New	Suspension	Wire rack - Shelf 2	Early
Bolts/nuts for emergency brake	-----	Suspension	Wire rack - Shelf 2	Early

This EXCEL spreadsheet had over 175 different items on it. At first used to identify which pieces were going to be refurbished and put back on the car vs. replaced with new, it eventually grew to include WHERE a particular component was located and then, in what order it would go back on the car. This turned out to be a very helpful sheet and was heavily used.

IMPORTANT THANK YOUS

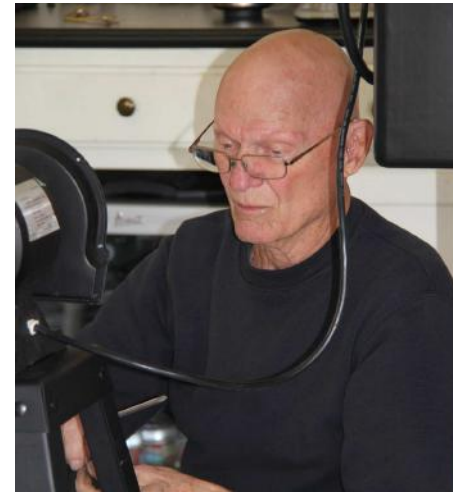
To Jay Leno, Jim Hall, David Barnett and Brian Buckland, thank you! Without you guys, I'd have never started.

To Wayne Viall, Jim Unsworth, Brett Engel and again, David Barnett: your work and selfless assistance on my car during the rebuild was extraordinary. I could never repay or say thank you enough. Without your efforts, it would have never gotten done.

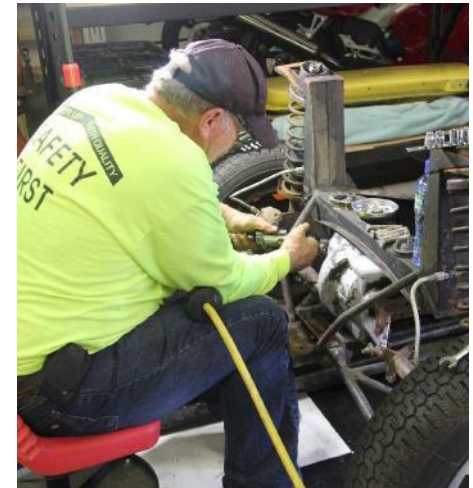
To Clayton Saffell, Larry Turek, Chris Hemminghaus, Tom Innes, Mike Mah, Alain Briot, Jim Meininger, Mark Osterbauer, Mauricio Zagorin and all the guys in the Lotus Owners of Phoenix club: your help, knowledge and enthusiastic encouragement were greatly appreciated.

Ken Gray at Dave Bean Engineering was a wealth of knowledge and timely assistance. It helped me that Ken owns a 1969 Elan S4. Also thanks to Daniel Michael and my brother, Leif Larsen, who pitched in when the body came off and went back on.

The greatest thanks go to my wife, Maggie. She's never once been anything less than 100% supportive of me in everything I do, not the least, my Lotus. As a family, we made some ridiculous sacrifices over the years for this car, including parking our daily commuting cars in a 20-degree below driveway while the non-running Lotus occupied the warm garage along with motorcycles, bikes, parts, tools and junk. She never uttered a word. Not once did she criticize my spending on my Elan, even while trying to put funds away for our daughter's college expenses. When I began the rebuild project, besides encouragement, she provided coffee and sweet treats for all who came to help on our Saturday workdays, often baking them herself. She popped into the garage just before lunch and took sandwich orders and made sure the refrigerator was full of beer. The two luckiest days in my life were meeting her and buying the Lotus – in that order.



David Barnett



Wayne Viall



Jim Unsworth



Brett Engel



*The two luckiest days
in my life were
meeting Maggie and
buying the Lotus - in
that order.*

APPENDIX: Budget (Parts and Labor)

Budget: Spending summary by Area			
Area	Description	Source	Subtotals by Area
Body	Forty (40) invoices: Includes \$9,100 for body, fiberglass and paint. New windshield (\$1,005 w/shipping), dash rebuild by Madera Concepts (\$350), cTonneau cover repair, new soft top through Dave Bean (\$450), new headlamp gaskets, new window pulleys, trunk lock, heater vaiances, new license plate light, rubber pads for clutch and brake, rebuilt crash pad, sealing rubber for edges and powder coating of various key body pieces.	Avo Kullkoian, Dave Bean, Madera Concepts, AZ Powdercoat, others.	\$12,552.16
Brakes	Six (6) invoices: Rebuild brake calipers, new pads, rebuild master cylinder (Phx Brake the first time) and by White Post Restorations (second time), used orginal brake lines, new handbrake cable.	Phoenix Brake Co. IL, and White Post Restoration, PA.	\$ 1,048.99
Carbs	Nine (9) invoices: Carb rebuild kit, new jets and floasts, new gasket everywhere. Does not include labor to rebuild or install of air/fuel gauge from Innovative Motorsports.	Dave Bean, mostly.	\$ 267.68
Chassis	Eight (8)Invoices: Beadblasted, then reinforced by welds in key locations. Jazzed up cross member and added a tow hook and other stuff. Included is new upper differential braketa, new torsion bar bushings, new rack and pinion.	Junior Rios at Fathead Fabrication, Dave Bean	\$ 1,598.46
Clutch	Clutch Slave Cylinder, 7/8 in, T/C 64673347 and Flat Face T/O bearing.	Dave Bean	\$ 169.86
Cooling	Built a new, thicker, dual core, radiator (\$561). Wayne built new mouting brackets. Dave Bean supplied new, powerful fans (\$178) that completely seal the front of the radiator.	Commercial Radiator Service	\$ 739.50
Drive	AZ Differential (\$505). New inner & outer axle bearings (one set redundant), new rings and pinion seals. All gears cleaned and inspected and were in very good shape. Dave Bean supplied 2 new BRG, RR Axle Inners, new U-joints and various clips.	AZ Differential	\$ 720.76
Electrical	Six (6) Invoices: Wiring Harness (3) plus headlamp pigtails. (\$746.49), new speedometer cable, Moss Motors Voltage stabalizer and a massive amount of "donated" labor, most by David Barnett. Cost to rebuild all the gauges (\$468.65) by RS Gauges in this number, too.	British Wiring, Moss Motors, RS Gauges	\$ 1,320.48

Careful records were kept to account for each invoice, parts purchase or labor cost. Of course, no attempt was made to keep track of the labor donated by myself, David Barnett or various members of the Lotus Owners of Phoenix group.

APPENDIX: Budget (Parts and Labor)

Budget: Spending by Area (Cont.)

Engine	Thirty-two (32) Invoices: Includes lower end engine work, not head. New pistons, polishing of crank in Denver, new bearings and re-assembly. Includes help decking the head and rilling out the valves for Jim Unsworth and building a baffle in the pan and installing new ater pump. Includes new racing timing chain from Dave Bean, 12 new cam studs, 20 new Tenaz studs, new heater control valve, thermo switches, all gaskets, electronic fuel pump and filter, Nippon Denso alternator and mounting bracket. Most work by Duffee Motorsports.	Duffee Motorsports. New C P Carillo pistons, rods. Dave Bean, too	\$ 6,507.74
Head	Eleven (11) invoices: All parts and work on the head, includes rebuilding carbs. Mostly Jim Unsworth labor to flow the head and install new valves and inlets, new cam bridge set, new tappet bronze tappet sleeves, 8 new valve cover studs, head and cam gasket kit. Engine and head together, just a bit over \$10,000.	Jim Unsworth, mostly.	\$ 3,500.89
Fuel	Various Carb gaskets and O-rings for re-installing sending unit back to gas tank as well as new aluminum fuel line and electronic fuel pump, filter and gauge.	Dave Bean	\$ 198.64
Gearbox	Eleven (11) invoices: Rebuild transmission, drive train. Mostly cleaning. New parts included a new tailshaft bushing, ARP Flywheel bolt kit, redline shockproof gear oil, new transmission mounts and transmission gasket sets and tail shaft seal.	Cottman Transmission, mostly. Dave Bean for parts.	\$ 1,230.24
Misc.	Five (5) invoices: Glad to keep "misc." items small. Mostly expedited shipping on shocks, dash and brake calipers and a wheel alignment.	Dave Bean	\$ 289.62
Steering	Two (2) invoices: Rebuild Steering wheel column and the piece to couple the steering column to the rack and pinion.	Cottman	\$ 169.95
Suspension	Twenty nine (29) invoices: Replace rubber donuts with CV joint replacements. Part # 576R 0016 from Dave Bean (\$1,676), new Koni shocks front and rear (\$478 rear, \$438 front), new steering rack (\$398), new springs for front (\$65 ea.), new rummber bump stops, new wheel bearings and seals and races from Motion Industries, 2 new lotocone rear mounts, a too many busings to list along with new track rod ends and new bolts and nuts.	Dave Bean, mostly.	\$ 4,230.33
Wheels & Tires	WHEELS: Redo the stock steel wheels. Inspect, repaint, balance. \$75 each?	AZ Powder Coat.	\$ 312.00
Labor	Labor cost for \$50/hr. (All mechanic help)	Various	\$ 5,630.00
Tools	Tools purchased for the project, including press, etc.	Various	\$ 2,050.30
	Sub-total		\$42,537.60

APPENDIX: Tools and Garage Prep

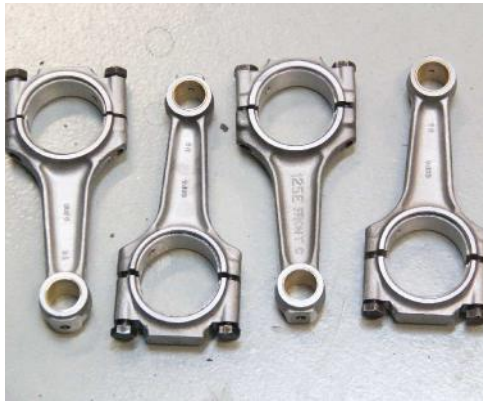
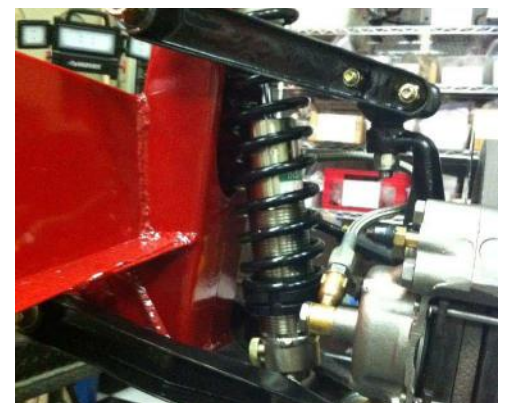
Lotus Rebuild Budget - Prep, Tools & Assc.		
<i>What</i>	<i>Description</i>	<i>Amount</i>
Kubolt VT6362	Air compressor	\$ 568.11
Air Regulator	Air Compressor Parts	\$ 11.00
Water Trap	Water trap, air gauge, shut off valve	\$ 83.53
Retractable Air Hose Reel	Air hose and reel - ceiling mount	\$ 145.80
Elan Manual	From Dave Bean and price sheets. 2/25/2013	\$ 12.03
Brian Buckland Book	with shipping from the UK	\$ 86.00
Lotus Elan Restoration Guide	MRE Books	\$ 24.95
Lotus Elan Owner's Workshop Manual	MRE Books	\$ 29.95
Parts Washer and solvent		\$ 65.00
Various new wrenches		\$ 23.10
Fender Covers and tarps		\$ 21.00
Towell Dispensor	Towells and Towell Dispensor	\$ 76.80
Floor Sliders/Glider wheels	For moving the shelves with parts more easily	\$ 28.66
Grinder Wheels	Wire brush grinder wheels & adapter parts	\$ 22.99
Grinder Stand		\$ 51.00
Wood bench	Heavy Duty Carpenter Bench from Harbor Freight	\$ 152.56
New Sockets	Various new sockets and adapters.	\$ 57.99
Vise	Cheapo/Harbor Freight. Wish I'd bought a Wilton	\$ 65.34
Air Impact Gun, ratchet, cutter, etc.		\$ 87.65
Plastic Bags		\$ 26.00
Sharpies and wooden pencils		\$ 11.64
Husky Light	\$99.97 is without tax	\$ 99.97
12 Ton Shop Press		\$ 129.95
Steel to cover work bench	\$20.00 plus \$20 to cut and bend	\$ 40.00
Infrared Thermometer		\$ 76.48
Vividia Waterproof USB Flexible Inspection Camera		\$ 76.98
Beadblast material (80 grit)	AZ Powdercoat \$27.50 a bag	\$ 82.50
Engine hoise	Borrowed from D. Barnett	\$ -
Beadblaster	Borrowed from Wayne Viall	\$ -
Torque wrench	Ended up buying two	\$ 56.00
Engine mount, holder	Borrowed from David Barnett	\$ -
Farme to hold car body	Brett Engel bought the wood and built it	\$ 100.00
Various pneumatic tools	Mostly Harbor Freight	\$ 75.00
Precision Digital Calipers		\$ 19.95
	TOTAL	\$ 2,407.93

Getting the garage ready and making sure I had the proper tools and documentation cost a good bit, too.

APPENDIX: Repair Invoice Summary

During the rebuild process I came across a folder with 42 repair invoices from 1972 to 1986. A summary of the just under \$5K in repairs is on the right. A photograph of the very first invoice is near the front of the book.

Summary: Lotus Repair Invoices, 1972 - 1986				
<i>Date</i>	<i>Mileage</i>	<i>Where</i>	<i>Description of work</i>	<i>Cost</i>
Nov. 3, 1972	3,747	Munger Imports	Change oil, add brake fluid, adjust idle (Oil Chg N/C)	\$ 6.32
Nov. 14, 1972	4,527	B&B Auto Body & Tire	Balance tires	\$ 7.50
Dec. 8, 1972	4,961	Munger Imports	Install tank heater	\$ 24.54
Jan. 3, 1973	5,827	Munger Imports	Change oil, change filter, repair tire, one other thing	\$ 34.36
Jan. 15, 1973	6,024	Munger Imports	Repair head lamp	\$ 5.37
Mar. 4, 1973		Munger Imports	Rebuild Generator, new brush set.	\$ 5.25
Mar. 6, 1973	9,112	Munger Imports	Oil and filter change, adjust driver door, replace coil wire	\$ 25.60
Mar. 8, 1973		Munger Imports	Remove switch in glove box, check coil & condensor & points. Replace coil, clean battery posts.	\$ 23.14
Apr. 20, 1973	11,666	Munger Imports	Install brake pads	\$ 22.48
Apr. 28, 1973		Munger Imports	Remove headlamps, replace head lamp, replace window on right door.	\$ 11.00
May 15, 1973		Munger Imports	Change oil and filter	\$ 18.47
June 18, 1973		Munger Imports	Remove head, grind valve, adjust valve, install head back on car. Parts on Inv. (2 relays, gasket set, 4 valves, a retainer and 2 studs)	\$ 165.04
July 30, 1973	20,705	Munger Imports	Change oil and filter	\$ 1.00
Aug. 4 1973	20,973	Munger Imports	Replace spark plug	\$ 3.80
Aug. 27, 1973		Munger Imports	Install bush in dist., tighten timing chain	\$ 5.00
Aug. 30, 1973	21,380	Munger Imports	Complete lube job	\$ 4.50
Sept. 4, 1973	21,471	Munger Imports	Check rear end	\$ 2.36
Sept. 5, 1973	21,506	Munger Imports	Install 4 roto-flex donuts, install axle seals new hose and hose clamps, top up anti-freeze.	\$ 51.35
Oct. 2, 1973		Munger Imports	Check for gas leaks	\$ 2.00
Oct. 18, 1973		Munger Imports	Repair window	\$ 8.00
Feb. 18, 1974	21,846	Louis Auto (Wisc.)	Check oil pressure, R&R engine & regasket, repair ignition lock, repair w/s washers, adjust jets, repair exhaust system hanger, tighten coupling pinch bolt, repair tire.	\$ 175.55
Apr. 3, 1974	22,755	Louis Auto (Wisc.)	Check for oil leak, reseal cam cover, check oil pressure (30 PSI 1200 RMP), Repair signal light ground wire	\$ 3.12
Apr. 24, 1974	23,449	Louis Auto (Wisc.)	Install copper washers top cam cover in place of O Rings	\$ 2.91
Apr. 14, 1975	30,837	Munger Imports	Install CD system, change oil & filter, lube job, check front suspension	\$ 30.69
June 3, 1975	31,339	Munger Imports	Remove cly head, remove front cover, repair water pump, replace cly head, time cam shafts	\$ 164.26
June 27, 1975		Munger Imports	Replace Ignition switch	\$ 22.22
June 30, 1975		Munger Imports	Tighten fan belt, replace clamps on gas tank inlet, install snap	\$ 30.26
July 19, 1975		Munger Imports	Replace brake light switch, remove generator and check	\$ 28.01
July 25, 1975		Munger Imports	Remove generator, adjust voltage regulator, repair radiator, change oil and filter	\$ 51.85
April 10, 1976	33,380	Munger Imports	Check ignition and right rear tail light, check plugs and tune, check radiator leak, ck brake ticking sound. New coil, coil wire and wire ends, oil filter.	\$ 102.16
Apr. 16, 1976	33,387	Munger Imports	check generator and regulator.	\$ 84.22
Apr. 30, 1976		Town & Country Imports	Repair Clutch line, repair wiring	\$ 36.00
May 24, 1976		Crown Auto Stores	Install new front shocks (purchased elsewhere)	\$ 24.00
Jun. 2, 1976		Town & Country Imports	Tighten timing chain, install rotor, address electrical problem	\$ 18.20
Aug. 1, 1976		Town & Country Imports	RO#4028 (\$339.79) RO#4097 (\$447.38)	\$ 787.17
Aug. 6, 1976		Town & Country Imports	Change oil and filter, change spark plugs, change spark plug wires.	\$ 23.45
Jul. 27, 1976	33,389	Town & Country Imports	R+R Head Gasket, install head set, cam sealer	\$ 107.59
Oct. 27, 1976		Town & Country Imports	Change oil and filter, low beam lights, thermostat	\$ 41.03
May 12, 1977		Import Service Centre	Replace rear shocks, all brake pads, install mud guards and chrome	\$ 122.39
June 30, 1978		Lind Bros Motors, Waterloo, IA	R&R inboard drive shaft, install new rotoflex coupling, R&R silencer, fabricate muffler	\$ 401.69
Mar. 13, 1980	33,389	Lind Bros Motors	New pressure plate on clutch, new front springs, oil and filter, change anti-freeze, new spark plugs, connect temp sensor to radiator, pressure spray under carriage, repair throttle linkage.	\$ 795.63
Nov. 5, 1985		Quality Coaches (Mpls)	Replace regulator, charge battery, adjust valves, replace V.C. gasket, R&R generator, weld generator bracket, replace front shocks, replace left side motor mount, remove rear suspension to replace rear shocks, machine rear rotors and replace brake pads	\$ 729.75
Jul. 10, 1992		Frank Monise Motors	Lube steering column, check instruments, adjust clutch	\$ 100.00



Summary

Few people manage to keep the dream car of their youth for over 40 years and into middle age. I have been remarkably fortunate and extremely lucky. It could have been hit or wrecked— mostly likely in my "young and dumb" phase. It could have been worked on by careless grease monkey-types who would have damaged it in fundamental ways. Or the most likely scenario could have occurred; the realities of life could intervened and forced a sale of this wildly impractical possession at a weak moment. But magically, none of that happened.



And now, here it is, almost 42 years to the day that I first was able to say, "*That's my car.*" And it is still mine! But now I've managed to give her the respect and attention which is her due. With about a thousand miles since the rebuild, the engine pulls stronger than when new and it handles every bit as well as I remember. I've been able to address every single component of what makes up this car, from chassis and engine down to every nut, bolt, bushing and cotter pin. And I did it myself. Yes, I had a lot of help, but nothing was done that I wasn't personally involved in and approved. And than feels really, really good.





