Contents

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Introduction

I grew up with Volkswagens. The more I worked with them the more I came to appreciate their rugged simplicity. It took me several years to realize they had a sense of humor.

Their humor is a subtle thing, reflected in the fact that Volkswagens are not simple at all. The apparent simplicity of the early-model air-cooled Volkswagens is actually a reflection of superbly sophisticated engineering in which nearly every part of the vehicle serves more than one purpose. Learning to appreciate these subtle sophistications is an engineering Rite of Passage.

For forty years I worked with these friendly machines, learning from them as I learned to take care of them. And then an odd thing happened.

I got old.

I've worked as a commercial fisherman, spent time in the Navy, raised a fine crop of kids, built a lot of Volkswagen engines... and one day I noticed my mane of Surfer-God hair had turned into a grizzled frizz. I'd gotten old and hadn't even noticed! It was a hell of a good joke :-)

My Volkswagens had gotten old too.

Getting old isn't a problem, it's the natural order of things. But it did embody some changes. You slow down a little. And you need longer arms to read the paper... little changes. Looking back, I saw I'd been making such changes all along, and making changes to my Volkswagens, too.

All Volkswagen manuals speak of young machines, fresh from the factory, raring to go. None of the manuals mention the problems of aging, such as what to do when certain 'lifetime' parts wear out or when those first signs of rust appear -- nor any warning about where they are most likely to appear first. In the manuals, the Volkswagen is forever young. The problems of aging were simply not addressed.

Down through the years, as these unforseen problems arose I discussed them with my Volkswagens. (They'll talk to you. The trick is learning to understand what they say :-) Often times the best solution was not readily apparent and had to be worked out on the test stand or in the computer. But the goal was always the same, not just a proper repair but an improvement to the basic design, the correction of a flaw revealed by forty years of use.

Nor do any of those manuals discuss the societal problems our 1930's-era

Volkswagens must face in the 1990's and beyond, such as emission-controls and greater highway speeds. As the years piled up my Volkswagens and I dealt with this type of problem in the same methodical, thoughtful manner. I wasn't interested in a quick-fix nor maintaining a museum piece. To deal with modern-day problems I applied modern-day engineering, adapting my Volkswagens to the realities of modern-day driving. I've nothing against museum pieces -- in a museum -- but my Volkswagens are going to be running strong and clean well into the next century, taking me places I need to go. That calls for safe, reliable, economical transportation, a ride that isn't a burden on our environment nor a pariah in my community. You don't get that with quick fixes.

Today, my 1965 bus gets better mileage than when it was new and stops better, too. Thanks to a modern carburetor and modern ignition system, it's emissions are a scant tenth of that allowed by law. The hydraulic valves are not only quieter, they are more efficient and require no adjustment. And the full-flow oil filtration system insures the present engine will serve twice as long as the original powerplant. Today, my 1965 bus is quiet and clean and safe, a good friend when there is traveling to do -- and I do quite a bit.

We didn't arrive here as the result of some massive project but through a graceful progression of improvements. As the problems of aging were encountered, they were resolved. But where I've merely gotten older, my Volkswagens have gotten better.

Then another odd thing happened.

I discovered a lot of Volkswagen owners didn't know their Volkswagens had gotten old!

I thought everyone knew why Volkswagens caught fire so easily, since the problem -- and the cure -- was defined back in 1958. Or why the rear jacking-point on the bus is the first place to look for rust -- and how to prevent it. Or that everyone understood the benefits to be derived by replacing the 1920's-era ignition system with the more durable, more efficient electronic systems that are the standard of the 1990's.

Could it be that people simply didn't know about such things? Could it be that other folks hadn't noticed their Volkswagens had gotten old? That yesterday's manuals didn't speak to the problems of today?

It did seem odd. There are a number of magazines devoted to air- cooled Volkswagens, millions of which remain on the world's roads. Yet Volkswagen owners seemed oblivious to problems that had been slowly bubbling to the top over the last forty years.

As it turned out, none of the magazines seemed interested in the realities of owning an antique vehicle. According to their surveys, Volkswagens were for kids, often their first car and seldom kept more than a year or two. To stay in business the magazines focused on Having Fun. If they spoke of mechanical procedures at all, the task was always Quick & Easy, lots of sizzle but often no steak at all. And everything was topped off with a bit of cheesecake for the kiddies.

But while the magazines focused on quick & easy fun, Volkswagens kept catching on fire. And rusting out. And overheating.

So I began telling people about the realities of driving a thirty year old vehicle, offering my experience to the Internet. And Volkswagen owners around the world proved the magazines were wrong. People WERE interested in learning how to keep their bugs from catching fire and how to keep them running cool and how to graft 1990's technology onto their 1930's engines. As I told people how to accomplish these things, they found my comments of sufficient value to collect them into an easily accessible archive that proved surprisingly popular.

This CD contains a collection of those messages, some of which appear in the form of short articles. I apologize for the poor writing and often unique spelling :-) The messages were not written with publication in mind but as an informal vehicle for communicating technical information from me to you. If you discover some howling technical error I would appreciate your taking the time to point it out -- bum dope is worse than no information at all. But as to the typos, misspellings and grammatical faux pas, I hope you'll just grit your teeth and drive on -- I'm a better mechanic than a writer and the second edition, should there ever be such a thing, will surely be better than the first.

-Bob Hoover

Note from the Editor

That's an overly grand word since I did very little editing. I mostly compiled, I guess that's the best word for it.

The format of this publication may seem a little strange if you aren't familiar with the Internet, particularly with mailing lists. None of Bob's articles here were intended for publication, they are merely a small part of the dialog that goes on 365 days per year among the net's VW community--compiled by popular demand.

If you have Internet access, do stop by the web page at www.type2.com--from there all other things are revealed. If you have questions about or rebuttals to these articles, it is best to post them to the appropriate mailing list so they can run the gauntlet of public opinion. Nowhere on this CD can Bob Hoover's email address be found, but he does post to the vintagebus list regularly and I think he even reads it sometimes.

In many cases these articles are replies to other people's email messages, public or private. Sometimes a bit of the other message is quoted for context; where this is the case, the quote appears in bold italic.

The Sermons archive was started in 1995 by Richard Kurtz, who I would like to thank here.

The "trip report" is not an unusual phemonenon on automotive & motorcycle lists, but frankly nobody does it like we do--and within the rarified atmosphere of VW trip reports, Bob Hoover is the undisputed master. I place the Grendel saga with the most important fiction I have read (except that it isn't fiction, and it was written in real-time under the greatest duress--but the pacing is so perfect and the drama is so haunting that it leaves me fatigued every time I read it, and it talks with me every time I climb under my buses).

Anyway, the point is that a good trip report is part & parcel of what we do, what Bob does, and there is no real distinction between a trip report and a technical article. This is what makes the Bentley and Fisher and Berg books sadly deficient. =^)

Because of the nature of the mailing list medium, these articles are often difficult to categorize. I gave it a fair shot but you'll get the most out of the Sermons if you use Acrobat's search feature rather than trying to guess where I've put something.

In many places sources are mentioned; JC Whitney, Universal, American

Scientific, and so forth. If you use the Acrobat search feature you can probably turn up the address of the company, maybe the phone number, but these days the best thing to do is to look for the company's web site. Places like JC Whitney and McMaster-Carr have exploited web technology nicely and everybody is better off for it. Especially those formerly sedentary electrons who now have to work for a living.

--Ken Hooper

Sources

BODY & CHASSIS

’68 Backup Lights

Allan,

Not sure if this will help. I’ve got a 67 and a 68, both sedans; wiring your convertible may be different. And yes, the Bentley book that supposedly covers 1966 thru 1969 models makes scant mention of back–up lights, leaving you to discover what bulb is used (66–67 is different from 68, etc), how it is wired and so on.

(But then they also think 1mm = .39" [see page 5–30])

On my 68 the backup light is actuated by a switch mounted on the nose cone of the transmission. It is a normally–open switch, closed when you select reverse gear.

Power for the backup lights is tapped off the coil through a fused lead, the fuse mounted on the right side of the blower housing in a small clip. Check the fuse as a first step in tracking down the problem (assuming any of the above matches your vehicle). And no, Bentley makes no mention of the fuses value; try a 5 amp; maybe eight, no more.

This should be a hot lead whenever the ignition is on, so check that also (use your static timing light; it makes a fine continuity tester).

One of your tools should be a test lead about 15 feet long (ie, long enough to reach from the front to the rear of the vehicle. With power to the backup light circuit, crawl under the vehicle with your static timing light and determine which of the connections on the backup light switch is hot; that’s the lead from the fused circuit. (It would be smart to disable your ignition before crawling under the vehicle with the key on; stranger things have happened. [Just pull the center lead out of the distributor. And remember to put it back.]) If neither lead is hot then the problem my lie between the fuse and the switch. Check that out or substitute your test lead.

If power is reaching the backup light switch but the lights fail to work (I’ll assume you’ve already checked the lamps), disconnect the lead going to the lamps and connect one end of your fifteen foot test lead to the wire you just disconnected. Crawl out from under and connect the other end of the test lead to 12vdc.

If the lamps light, the problem is in the switch. If they fail to light, the problem may lie in the wiring between the switch and the rear light fixture.

Dig around on either side of the engine compartment and locate the wiring coming from the tail light fixture. The driver's side should have a four–pole connector, passenger side has three–pole. The black/blue lead should be the lead to the backup light. Using a test lead, confirm which wire goes where by disconnecting them from the connector block and applying power. The lamp should light. (Or rather, A Lamp should light; you may be looking at the wrong lead.)

The backup light is grounded through the tail light fixture attachment studs, which are fastened to the fender with nuts. If you have a rust problem the fixture may not be making a good ground; dim stop lights or a flaky turn signal would be a good symptom of this. (This is a good reason for brazing–up and re– drilling the tail light holes in the rear fender when you do a paint job. The braze provides a rust–free surface for electrical contact.) You can do a temporary fix by making up a 16 gauge jumper from one of the fixture studs to a good electrical ground on the body. (Use one of the bumper mounting bolts.)

Failure of the grommet around the tail light wiring, where it passes through the underside of the rear finder, is one of the common causes of rusting INSIDE the tail light. The rear tires keep the grommet bathed with whatever they throw up off the road. Clean up the rust then seal the grommet with RTV for a temporary fix.

Common problems with the backup light circuit are the switch, then poor grounding, then broken leads, often where the hot lead dives through the breast tin on the right side of the engine. For some reason, the upside–down position of the backup lamp seems to cause more problems with grounding. The other lamps are installed horizontally and seldom show ground faults.
A problem I've seen more on 66 (6v) and 67 (12v) is age–hardened electrical connectors. VW used the cheapest grade of brass connectors; they'll often come apart in your hand (better grades use a plating of tin over the brass). The odd thing is, I've only seen that problem on those two model years. In any case, it's a good idea to keep a supply of spade connectors on hand. Throw away the little plastic collar (if you buy that kind) and use heat–shrink tubing for insulation. Always crimp AND solder your connectors to insure a gas–tight connection. (Read the book. Automotive electrical systems are classed in the Harsh Environment group; you need all the protection you can get.) Failure to solder crimped connectors leads to eventual failure due to corrosion. You may use multiple layers of heat–shrink tubing to protect the connection against vibration, just be sure to slip them onto the wire before installing the connector, and slip them on in the reverse–sequence you want to use them (ie, shortest piece last).

‘73 Hammerhead Pan

As a general rule, the wiser course is to avoid the later bugs with the hammerhead pan. Rust in the footwell and door pillar areas, combined with asymmetric front suspension loads, causes distortion (usually twisting) of the hammerhead, leading to alignment and handling problems.

The early pan with its more robust torsion bar front suspension does not have these problems.

Of course, a lot depends on the final price and your transportation needs, but the early bug chassis is a life–time sort of thing, you can keep it alive virtually forever. The later chassis is fragile by comparison.

If your interest is in a Forever Car, stick to the early chassis. Indeed, given the fact an early bug can save you up to a quarter of a million dollars in personal transportation expense over the course of your working life, you might consider using some of your budgeted bug–buying money to travel southern California where early bugs are still available for <$1000 and buy one there.

Aerodynamics

The thought of a bus being 'aerodynamic' tends to make some folks jump up & down, wave their arms and make strange noises. To them, aerodynamic means a car that looks like a pumpkin seed. Wrong. They're getting the definition of 'streamlined' mixed up with 'aerodynamics,' which deals with how solids interact with gases. If we were were talking boats we might call it 'fluid-dynamics' but the truth is you use the same formulas, changing only a few of the factors. To a physicist, gases and liquids are both 'fluids'.

A brick can be aerodynamically defined. The definition has to do with how much drag a shape produces at a given speed. If you streamline a shape, it will have less drag. I think the drag co-efficient of a brick is about .95, mebbe more. Bricks work best at jobs where they can just lay there and look at you. Flying a brick is a task reserved for foolish young Air Force pilots, who are usually in the reserves.

To establish a standard defining how well streamlined an object may be, you compare the drag of the flat-plate profile of the object to the actual object, with the drag of the flat plate — whatever amount of drag it may be — chalked up on the board as '1.00'. Then you run the same test with the real object.

A Volkswagen bus turns out to be pretty well streamlined, at least up to 28 miles per hour, the speed at which the original work was done. The early bus had a drag co-efficient of about .30, compared to its flat-plate area, meaning the bus has less than a third of the drag of a flat plate that exactly matches the cross-sectional profile of the bus. Adding the overhang above the windscreen screwed all that up of course, bumping the drag up to .32

Even so, a drag co-efficient of .32 is pretty good. Or, as an aerodynamicist would say, pretty slick :-)

Given enough wing, you could fly a bus. Assuming you had enough engine. And a big enough fuel tank. And a foolish young Air Force pilot to drive the thing. Of course, it would be a terrible thing to do, what with all those folks on the ground craneing their necks and pointing up at the sky when the old bus thundered overhead. On the other hand, if you stick a husky 2200cc Type I engine on the nose of a Piper Cub you can fly around the world an no one would even notice. Truth is, a lot of folks have done just that.

Air Scoops

I found that air-scoops provide a slight over-pressure in the engine compartment.

This doesn't have anything to do with engine cooling.

The engine's blower is a pump, perfectly capable of sucking in all the air it wants. A slight overpressure in the engine compartment might make its work easier but the scoops also scoop up other stuff, such as rain, leaves and what-not.

I installed air scoops on my '65 because my oil cooler is mounted horizontally on the engine compartment floor in the corner opposite the battery. The overpressure provided by the scoops is enough to promote a good air-flow through the oil cooler, enough to do the job at normal speeds and loads. When climbing hills or going fast or hauling a heavy load, a electric fan is needed to push enough air through the oil cooler.

Might as well leave them on. You'll just have to find something to fill up the holes. :-)

Anti-Theft Devices

The title is mis–leading. You can't prevent your vehicle from being stolen any more than you can prevent a bank from being robbed. If someone wants to steal your vehicle, they will do so. Locking devices and alarms are more of an inconceniece to you and your neighbors than to thieves. The well organized thief, and there are corporate–sized gangs specializing in stealing cars for export, defeats such devices with ease, using electronic decoders for the one and explosive–powered shears for the other. (Despite their power source, explosive–powered shears are very quiet, having a well muffled exhaust, no louder than a heavy cough.)

The best deterrant is to introduce unknown factors into the thief's equation. And since they are going to steal the thing anyway, don't waste your resources on systems already proven ineffective.

My idea of a good anti–theft system is one that provides for a graduated response. As the first stage, use something that calls attention to the vehicle and the thief, such as pumping oil into the manifold and opening up the vacuum line to the distributor. The car lays down a huge trail of white smoke, the engine balks and the thief usually bails out to look for easier pickings. These effects are easily accomplished with off the shelf components and may be applied to both carburetted and fuel injected engines. For the forgetful, the system should turn on an unmistakable warning light when armed. To add a bit of whimsy, you might put a toggle switch near the warning light. Not a working one, of course. The working switch should be concealed, perhaps a push–switch behind a door panel, a completely invisible switch. The dummy switch will serve to distract the thief, giving them something to do while the vehicle is lurching to a stop in the middle of the freeway, surrounded by a cloud of white smoke.

The ultimate anti–theft weapon is to detonate a smoke grenade or tear–gas cannister INSIDE the vehicle after triggering a 'count–down' beeper. The increasing tempo of the beeper has a remarkable effect on anyone unfamiliar with it, plus it gives the forgetful owner plenty of time to toggle the reset.

Both of these systems would has their own power source, using data from the engine only for triggering information. The system becomes armed whenever the ignition is turned off. Hot–wiring the car — by–passing the regular ignition — does not render the system safe since it starts its count–down whenever the engine is started by any means.

I admit the use of tear gas or smoke is a radical method. The material in a smoke grenade is a colloidal compound. It clings to anything it touches and may never be completely removed from some plastics, fabric and leather. It will also color the thief fluorescent red, yellow, purple or whatever, depending on the color of the band around the grenade canister. The tear gas isn't much better. It clings to fabrics and dissipates far more slowly than depicted on TV cop shows. But it also renders the vehicle valueless to the thieves.

If you're a chemist you might consider a system that sprays a ninhydrine compound on the thief, such as used by banks and messenger services. It permanently stains the skin and is often still evident when the thief is brought to trial.

Smoke and tear–gas grenades are normally classed as pyrotechnic or explosive devices and their possession is illegal in some states. Given the current lack of justice in the American legal system, using such 'violent' devices to protect your property from theft, a 'non–violent' crime, you may find yourself in more trouble than the car thief, whos lawyer will probably argue that his tramatized client, who now glows fluorescent yellow even in the dark, should be compensated for the ridicule he/she/it has suffered from his/her/its peers as a result of the cruel and unusual punishment you've inflicted.

Personally, I believe fluorescence in defense of Volkswagens is not a crime and will defend my vehicles to the last erg of my ingenuity.

Bob

PS —— ummm…. I wouldn't stand too close to my bus if I were you. I found these war surplus ejection seats at an auction and, well…

Auto Body 101

I've been working on Grendel's noze, tying to straighten out the results of at least three collisions. The dents are coming out fairly well — I'll probably need a few gallons of Bondo to smooth things up, which is barely a quarter of the Bondo I excavated to get down to bare metal. Progress :-)

But the rust around the windscreens is far worse than I expected. After removing the seals & glass several large holes were evident. Today I went after the inner lip with a flapper-wheel. The metal vanished in a powdery cloud of rust. And revealed some interesting details about the anatomy of the metalwerk around splittie windscreens.

The nose-skin stops at the windscreen, just abaft the kick-up where the wiper shafts come through. The windscreen sheet-metal overlaps the nose-skin in front and butts up against the dashboard sheet-metal to the rear. The matching lip on the dashboard is bent upwards (you can see this by inspecting it from the inside) to match the lip on the windscreen sheet-metal. The two lips are then spot-welded together about every two inches to form the flange that captures the rubber seal.

But where the windscreen sheet-metal overlaps the nose-skin, there were only five spot-welds in twenty inches, making this a virtually open joint. Of course, it's out of sight, tucked up in the attic under the dash.

Unfortunately, the radius of the nose-skin and the windscreen sheet-metal are different — they are not an especially tight fit. And the curve of the nose-skin serves to collect and hold any condensation that may form under the dash.

This joint is going to rust whether you have good seals or not. And if you have bad seals it will rust that much faster.

You can get at the inboard edge of this poorly welded seam with a wand-type applicator and probably get some Waxol or other body-panel sealant into the space but the odds are, the seam is already rusty — it's just a matter of time before you'll have to replace it.

I'm replacing a lot of sheet-metal on Grendel — rocker panels, jacking points, wheel wells, most of the floor(s), all of the rear body below the hatch, lower portions of the cargo-bay doors, lower portion of the front door sills... and the lower portion of both windscreens. I ordered replacement panels from Mill Supply, JC Whitney, two local (socal) sources and Das Bulli Haus but I've found the quality generally very poor regardless of the source. Consequently, I've been making most of the panels myself. I'd planned to use .050" stock to rebuild the windscreen sheet-metal but after seeing the extent of the rust, I cut it back a bit farther and am using a bar of .125 x .75 stock to rebuild the lower portion of the recess, using .090" stock to fabricate the lip. Before welding in the lower portion of the recess I'll passivate the rusted lip of the nose skin. After welding, I'll try to seal the space with Waxol (or similar).

I found similar water-traps in the design of the rear jacking points and two of the frame cross-members. The rear jacking points have several opening facing forward that can scoop in anything thrown up by the front wheels. The joke here is that the openings are larger than the drain — the space can collect objects larger than it can get rid of, meaning it will eventually become blocked. Once blocked, the space forms a perfect water-trap. The cross-member has the same design flaw — holes where stuff can get into the U-section cross-member are larger than the drain. All four of mine (two rear jacking points and two U-section cross-members) were solid with silt & gravel, as were both rocker panels — there wasn't much metal left. Might be worth your while to take a look.

Auxiliary Fuel Tanks

I've been spending a lot of time laying under Grendel, looking at her ceiling through the holes rusted in her floor. (A hole you can step through is a BIG hole. Good Condition. Remarkably little rust.)

Down in Baja you're never more than a hundred miles or so from a gas station and given the fuel economy of a bus or bug the only precaution you need to take is to carry a couple of jerry cans for those times when the Pemex station is out of gas. But the trip to Inuvik includes a couple of gas-less stretches long enough to require you to carry additional fuel. And if I run the engine in order to power a shortwave transmitter I'll be even farther behind the 8-ball.

An early VW bus doesn't offer a lot of places to mount a jerry can. I can lash a couple to the roof rack but an auxiliary fuel tank would be a better way to haul additional fuel. Unfortunately, I've never seen an auxiliary fuel tank on a bus that I would care to ride in.

Laying under Grendel, I realized the space outboard of the longitudinal frame members is fairly well protected. The space is about 4.5 inches deep at the frame member and about 14.5 inches to the inner panel of the sill, which forms another longitudinal frame member about 2 inches deep. Overall length of the unobstructed space is a little less than four feet. If you crank the hypotenuse of that triangle at about ten inches from the longitudinal frame member you have a space that could hold about 12 gallons of fuel.

The purpose of this posting is to ask if anyone knows of this space being used for auxiliary fuel tanks, and to invite comments on auxiliary fuel tanks in general.

Front Belly Pan

I don't have this pan and I wondered how necessary it is (I'm sure it was put there for a reason)...

The front belly-pan protects the gear shift, emergency brake, drag link, Pitman arm, pedal cluster cross-shaft and the swing-arm pivot. Water, dirt and debris thrown onto these lubricated parts accelerates their wear. But the most dramatic thing you'll notice when running with the belly pan installed is that your bus will be warmer (!) That is because the belly pan also protects the uninsulated portion of the heater-duct.

One reason most people throw away the belly pan is because the small bolts (6mm) tend to rust into their captive nuts, causing the bolt to shear when you try to remove it. Since it's fairly difficult to drill-out and re-tap these captive nuts (or threaded bores, in several cases), the front belly pan is eventually discarded. Another reason for abandoning the belly-pan is due to collision damage. The front bolts are fitted to the rather fragile double-walled structure just behind and below the bumper. It doesn't take much of a ding to distort this structure. The best fix I've found for this is to use a hole-saw or plasma cutter to make some work-openings in the rear of this double-walled structure, allowing you to straighten out the dings with a spoon. If you make the work-openings just above the fasteners for the belly-pan, you can get at the nut-plates.

Before trying to track down a belly-pan, crawl under your bus and check the threads. They're probably rusted and you may find a couple of broken bolts. If you do any drilling or thread-chasing while laying under the bus, be sure to wear a face shield. (I got a bit of a ribbing from one of the guys on the Inuvik run when he spotted the safety goggles I carry in my tool kit. I didn't mind. Ouch of Prevention :-)

After you've gotten all of the threaded bores to accept a bolt, here's a cute trick to keep them from rusting. Take a big tube of silicon caulk and pump a generous glob of the stuff right up thru the threaded bore, then install a bolt, liberally dosed with anti-sieze. Now go away and do something else. (A couple of the threaded bores are on a flanged cross-member, giving you access to the top-side. Use the same trick with the caulk but apply it directly to the top of the threaded bore.)

When the silicon caulk cures, it will form a waterproof cap on TOP of the threaded bore. The bolt will come out without any problem — silicon caulk isn't all that strong — and you will be left with a neat WATERPROOFED fastener for your belly-pan.

This is a pretty messy procedure. Have your bolts ready to install before you start pumping the caulk, and do just one hole at a time — the caulk tries to run back out the hole. Once the caulk cures you can peel off any that gets in your way.

Even though the cap of cured caulk will keep water out of the threaded bores it's still a good idea to install the bolts with anti-sieze. I also use big flat washers and a lock washer. You can buy replacement bolts of longer size at most well equipped FLAPS.

Broken Throttle Cable

Not to detract from David's accout of overcoming a broken accelerator cable, but there are a couple of tricks that can get you home, or at least off the freeway should your cable break.

If you advance the idle adjustment screw to about 1,500 rpm you can make about 30 mph. You gotta eat a little clutch to do it, but it will get you off the freeway.

Bailing wire or stainless steel safety wire can be used as a wildly dangerous substitute for an accelerator cable (BT,DT). The problem is, you can't get the stuff straight enough; all those lazy bends bind in the tube going through the tunnel. Push your foot down, engine roars. Lift your foot (as when bearing down on three Mexican women who decided to cross the highway at that particular instant) AND NOTHING HAPPENS! The throttle stays open, you keep doing 90mph, and the women keep sauntering along. (Hello sagebrush, goodbye road.)

The trick? A bungee cord. And grease. Two wraps around the fuel pump then wire the bungee cord to the throttle arm. Grease the dickens outa that sucker before you push it into the tunnel.

The problem? Your foot's going to get awfully tired fighting that bungee cord. And it ain't doing the carb much good, either.

Here's the drill: Fan belt, clutch cable, throttle wire, six feet of rubber fuel line, all in one package. Inside the package is an adjustable wrench big enough to handle the generator nut, a pair of vise grips, two screwdrivers (big & little). The 'package' is a piece of sailcloth about one yard wide by two yards long. Tie it up with about ten feet of light line. Tie it up tight; makes a bundle about as large as a big thermos. Lash it to the roll cage with bungee cords.

I've seen some rigs, the guys don't even carry a regular tool kit. They've got their tools distributed all over the rig, tools and spare parts taped, lashed or wired right beside where they'll be needed. Doesn't make much sense in a daily driver but comes in at the genius level when seconds count. (I remember one guy who appeared to be WEARING his tool kit. DNF'd)

Broken Throttle Cable II

I was remiss in failing to mention that the over–all, hands–down winner in Why The Throttle Wire Breaks is us. We usually kink the cable trying to put the engine back in. Then we straighten it out, hope for the best.

The throttle cable is a high–carbon steel wire; a 'music' wire. Once kinked, you can never get it perfectly straight. Once kinked, the kink will rub against the tubing wall or the blower housing or some damn thing until it wears itself in two.

So if you kink one, replace it. You can always carry the kinky one for a spare, which is somehow apropos for this list :–)

Other forms of failure are at the ferrel where it's secured to the barrel nut on the carb. Here again, the problem is Operator Error, usually from holding it improperly while we tighten the barrel nut.

Other failures occur at the accelerator pedal, with either the hook or thee eye wearing through. If it's the hook on the cable, no sweat; replace the cable and be on your way. But it it's the eye in the accelerator pedal, you have some interesting times ahead of you. One fix is to grab it with your vise grips then tape the vise grips to the pedal (!) (This is fast. It's also infuriating to discover your foot is now an inch higher than it should be. And the accelerator pedal has just gained two pounds of mass, making for some very interesting shifts as you fly low though the weeds.)

When was the last time anyone greased their accelerator pedal? (Don't look at ME! I never grease the filthy thing! Musta been Joel. Prolly used some of that Friday Grease.)

The above caused me to recall that a lot of really good drivers wear special shoes with thin leather soles. (I'm more of the Combat Boot persuasion.)

Door Hinges

The screws fastening the door hinges are normally removed with an impact driver. Be persistant, use lots of Liquid Wrench and take several days for the task if necessary. When reinstalling the hinges, chase the threads with a tap — the impact will have distorted them. New screws are available from most well-stocked FLAPS and some VW dealers. If you can't find them locally, give a shout via the list or check the archives, we've had this problem in the past in some areas of the country and have always managed to resolve it. The screw-plate is free inside of the door pillar on some models and positioning it can be a bear, but it is a do-able thing, as the archives show.

Once the door is off the vehicle you have the perfect opportunity to rebuild the hinge pins. The best fix is to have them bushed and to replace the carbon steel pin with one of stainless steel. It is usually hinge-pin wear that causes the misalignment you've noticed even on show cars, since adjusting the position of the hinges effects only the x-y relationship. Worn hinge-pins make it impossible to align a door without shimming — and shimming doesn't speak to the root problem. One of the VW-specific magazines has a pictorial how-to on hinge-pin replacement.

The inexpensive hinges used on Volkswagens, and the way they are exposed to the weather, dictates the need for frequent lubrication. Back in the good old days when there was a VW dealer on every corner and service was inexpensive, each time the dealer gave you a lube job he also lubricated from 12 to 27 other points on the vehicle, depending on type. Door hinges were at the top of the list. The drive-thru lube-bays that have sprang up in recent years do not provide the quality of service needed to maintain a Volkswagen, leaving the task up to you. Unfortunately, I've met VW owners that didn't even know it was a good idea to oil their hinges, and had never done so for as much as ten years. Little wonder we see a lot of sagging doors.

Drag Coefficient

Although any mention of streamlining and Volkswagen buses is liable to produce a grin, there's a basic misunderstanding here that I would like to try and clear up.

How well a thing is streamlined is determined by how much drag it creates as it moves through the air at a given speed. Indeed, 'streamline' is the opposite of 'drag' in that we refer to how well something is streamlined as its 'drag coefficient'. 'A Given Speed' is a part of the trickery so keep your eye on it. Even the term 'Air' is not without its confusion factor since drag is relative to the density of the air-mass in which that coefficient is determined. To establish a base-line we always use a 'standard atmosphere', meaning the air is exaclty 59 degrees Fahrenheit and the air pressure is precisely 29.92 inches of mercury. The combination of pressure and temperature defines a certain air density. Thinner air, less drag; thicker air, more drag.

As you can see, drag is a relative thing, and when it comes to 'drag coefficient' the thing it is relative to is the profile of the object versus the object itself.

Just as an example, let's start with a brick (!). If you look at a brick head-on you see a rectangle about 2 inches high by 3 inches wide. Head-on, you can't tell how long the thing is, nor if its nose and tail have any taper. All you can see is the cross-section of its profile and that shape is what you take as your base-line. You start by making a flat plate having exactly that profile but zero thickness, or as close to it as you can get —lets say we make our profile out of sheet steel a sixteenth of an inch thick. If we attach that flat plate to a pivot and put it into a wind tunnel, blowing air against the pivoted flat plate will allow us to determine its drag (under those conditions) simply by measuring the deflection of the plate at the pivot point.

Now streamline your brick. Keep the rectangular profile exactly the same but mold a gently rounded nose on one end while building a neatly tapered cone on the other — turn your brick into a teardrop, or as near to a tear-drop shape as you can get without altering the rectangular profile.

Ready for the big surprise? When you hang your tear-dropped shaped brick in the wind tunnel you will discover its drag is about ONE-TENTH that of the flat steel plate having exactly the same profile! Dividing the drag-number for the streamlined shape into the drag-number for the flat-plate shape is what gives us our 'coefficient' of drag. In this case it would be about 0.10.

You can spend a lot of time refining the nose and tail shape of your brick but you'll find that you'll never get the drag coefficient below 0.10. Indeed, you'll probably never achieve that mystical number because that's about as good a streamline as you can achieve with even the most perfectly shaped object.

Now put the brick aside and lets go look at a Volkswagen bus. Again, lets stand out in front of the thing and determine its frontal profile — it's 'flat-plate' area. The drag of the flat-plate area — at a given speed —becomes one factor in our equation. We then measure the drag of the bus and plug in that number as the other factor. Divide the one into the other and you have the coefficient of drag for the bus.

Ready for your next surprise? The drag co-efficient for a splitie is about .28! That is to say, the VW bus is a pretty slick little brick :-)

Alright, stop laughing — the trickery in the above numbers is that the drag of the bus was measured at something like 30 miles per hour or its equivalent in meters per second, which is some kind of a standard. Still, .28 is not too shabby for a brick.

The ratio between the length and width of a thing is called its 'Fineness Ratio' and up to a certain point, the longer it is, the lower its coefficient of drag. But some of the drag comes from the air sliding along the surface of the thing so there is a point of diminishing returns in the fineness-ratio trick — make it too long (or drive it too fast) and drag is bound to go up.

What's all this mean?

Not much, really. Without a tail-cone and more slope to the nose, the Volkswagen bus is about as 'smooth' as it can get, aerodynamically speaking. And while .28 is pretty good it reflects only the coefficient of drag — the actual drag itself is quite large. In order to lower the gross or actual drag yet retain the interior volume you would have to use a shape such as found on, for example, the Toyota Previa wagon or similar.

But it's far to say that despite their boxy shape early Volkswagen buses are remarkably well streamlined.

Drilling Glass

Drilling a SMALL hole in glass can be a bit tricky (amateur astronomers drill large holes in glass all the time).

Try using a piece of hard brass tubing for your ‘drill’. (Inquire at a hobby supply store; they carry an assortment of sizes.) Using modeling clay, build a volcano-looking dam around the drill site, sloped according to the angle of the glass you’re working on. (This won’t work if the glass is in a vertical position.) Fill the crater of the volcano with a mixture of oil and carborundum abrasive. I use #80, the coarse stuff, because I’ve got a lot of it. (Try valve grinding compound if you don’t have raw carborundum abrasive.) Chuck the tubing into a low-speed drill motor. Drill the hole.

During the drilling, raise the bit now and then to keep the carborundum in circulation. It cuts surprisingly fast.

After drilling the hole use finer grits of abrasive and a wooden or felt hobb to champher the edges; if you don’t, they will chip. If the hole was drilled as a stress relief for a progressing crack you can expect the crack to stop when it arrives at hole. (Fingers crossed, rabbit’s foot in hand.)

Filling the hole with an RTV compound will prevent embarrasing questions the next time it rains. (‘Why... yes, there DOES appear to be a hole in my windshield!’)

(I’ve never done a windshield but I’ve installed fittings on windows cut from flat glass.)

Fiberglas Ducting

When upgrading to a recircurlating heating system, you recommended that I mount the recirculating blower behind the rear seat of my bug and use formed fiberglass ducting. How are such ducts formed and made?

How to Make Fiberglas Ducting

This type of ducting is not suitable for hot air, such as the output of the heat exchangers. You can produce high-temperature ducting but it takes special resins and must usually be oven-cured. The procedure described below is suitable for temperatures up to about 140 degrees Fahrenheit.

The Problem:

You want to install return-air ducting from the cabin to the inlet of the heat-exchangers inorder to convert the Volkswagen's single-pass, non-recirculating cabin heating system into a multiple-pass, recirculating system. That calls for some form of ducting from the cabin to the inlets of the heat exchangers. The method advocated by the people who sell kits of parts to accomplish the recirculation mod. pierce the firewall with a rather large hole to which they mount the blower, often inside the passenger compartment. Placing the blower under the rear seat provides for a safer, quieter and more efficient installation since it draws in — and re-heats —the coldest air in the cabin (ie, that near the deck) and the blower's noise is somewhat muffled by its location. Plus, an under-seat location is inherently safer than chopping a hole in the firewall.

Unfortunately, if the blower is located under the seat you will need to duct the cabin air under the vehicle and back to the engine compartment, meaning the duct must pass through the space occupied by the transmission. It also means the duct will be exposed to road-salts and cold temperatures. At first glance, there is not enough room to install duct-work in the area above the tranny — there is a bit of room but it is not large enough for the commonly available aluminum or fabric ducting. Even if there was enough room you could not use the more common form of round, expandable aluminum ducting without insulating and protecting it from corrosion.

The Answer:

The answer is to make your ducts fit the space available, which means they must have a rectangular cross-section and conform to the contours of the chassis in the area through which they pass.

This is an easier task than it may appear, thanks to the nature of closed-cell styrofoam — the rough, crunchy stuff they use for Christmas decorations, wreath foundations and so forth.

The nature of styrofoam — foamed styrene — is that it dissolves readily in naptha or gasoline but does dissolve readily in epoxy resin... although it does dissolve to some degee. (Polyester resin turns styrofoam to soup, dissolving it almost as readily as does gasoline.) Another characteristic of styrofoam is that it is very easy to shape. You can cut it with a knife and form neat curves with a touch of coarse sandpaper, grinding the foam into any shape you wish. The resulting surface is extremely porous — it will soak up tons of resin. But if the shaped foam is sealed with plastic food-wrap or cellophane tape, it will not absorb any resin at all. Indeed, the sealed surface — which forms the interior of your duct — can be made extremely smooth if wrapped with the heavier gauge of cellophane tape as is used for sealing boxes and the like.

To make a section of fiberglas ducting you simply shape a styrofoam core, seal it with several wrappings of cellophane tape then lay-up two layers of fiberglas fabric over the sealed core, saturating the fabric with resin. After the resin has cured, to remove the core you pierce the seal and pour a gasoline into the foam. The foam will dissolve into a sticky oil — liquid styrene. You'll be left with a tube made of fiberglas. The tape may then be pulled out of the cured fiberglas tube.

At least, that's the theory :-)

If you wish to try this method you will have to find your materials locally and run some experiments to insure you have the proper type of foam (ie, see if it dissolves in gasoline), resin and fabric. Frankly, if you are not familiar with laminates this probably is not the project to begin with. But the use of fiberglas laminates has become so ubiquitous you should be able to obtain information, materials and even some hand's-on experience in their use in virtually every part of the United States.

Putting Theory into Practice.

On the whole, fiberglas is pretty simple. You can train yourself in its use — you don't even need fiberglas for your experiments, an old bed-sheet will do just fine.

The really difficult part of this modification is forming the foam cores that will become the ducts. You must figure out where you want the return-air to re-enter the engine compartment — the most logical places are on either side of the engine, just forward of the cylinder heads, but there are other options open to you. If you're willing (and able) to modify your heat-exhangers, there's really no reason to use the existing inlets. You can run the ducting under and around the engine compartment, allowing you to seal the outlets from the blower housing and the normal inlets to the heat-exchangers. But such a modification is akin to running the four-minute mile. Using the existing inlets is more like being able to walk a mile, that is, something nearly anyone can do.

To form the cores you will have to work under the vehicle, cutting and shaping the foam to follow the contours of the body-work. For proper air-flow you'll need to maintain a cross-section of about eighteen square inches, and the ducting will have to branch in order to provide air to both heat exchangers. The need for the branch virtually dictates the need to make the ducting in sections, and that in turn dictates the need for joints which will of course have to be air tight.

The most commonly available styrofoam comes in 'boards' an inch thick, a foot wide and two-feet long. You'll find it at variety stores, hobby shops, crafts shops and the like. Since your ducting will have to be three to four inches wide by two inches deep, you'll need to stack up slices of foam to achieve the required depth. Foam cores do not have to be very strong — you can stack-up planks using a few dots of plastic-resin glue, securing the pieces in place with wooden toothpicks until the glue hardens. But you can't use common white glue, which dries rather than hardens. Weldwood 'Plastic Resin' glue is a commonly available wood-working glue that hardens through chemical change — common white glue is a water-based vinyl paste that must dry out to form a bond. When dobbed between layers of styrofoam, white glue thinks it's still in the bottle — it refuses to dry and thus forms no bond with the foam. Weldwood 'Plastic Resin' glue is an early form of epoxy that comes in powdered form and uses water as an activator. Simply mix it up in small batches as you need it. It has a working life of about four hours and cures in about twenty-four.

In laying out your cores the most common practice is to do the complete layout using only a single thickness of foam, building it up to the required depth once you've worked out the best location for the ducting and laid it all out. Once you've built-up the core to the required depth, all corners must be removed, rounded into neat shoulders having a radius of about one inch. This insures the fiberglas will wrap smoothly.

In laying out and shaping the cores for the ducting you must plan for the transitions where the duct will attach to the blower and to the engine compartment. Rectangular to circular transitions are easily accomplished using styrofoam cores. Simply glue on the needed extra pieces and sand them to shape. The transitions thru the breast-tin into the engine compartment will typically be transitioning down, that is starting out with a fairly large rectangular section and transitioning to a circular section of smaller diameter. The section nearest the blower should have a larger cross-section to insure minimum losses. The typical blower provides only a fraction the output of the engine-driven blower. But while the air-flow is less, the temperature rise is more, and recirculation insures a net gain over the existing system.

You will also need to plan on how to support the finished ducting, making provision for metal mounting tabs and the location of fasteners to secure the ducting to the body work.

When you've formed a complete set of cores you can remove them from the vehicle and do the lay-ups at your convenience in the shop. Because of the irregular shape of the cores you'll find wrapping them with fiberglas to be the most practical method. To accomplish this, cut the fiberglas into strips about six inches wide and wind the fabric around the cores at an angle of about forty-five degrees, the top layer being laid — and wound — in the opposite direction and angle to the bottom layer, giving a bias of ninety degrees between the two layers. Toothpicks will serve to hold the windings in place while the fabric is saturated with resin but be prepared for some dissolution of the core around the toothpick, since it will pierce the sealing tape. This is rarely a problem when using epoxy resins but can cause difficulties if you use the more commonly available polyester resin.

Handling the irregularly shaped cores is always a challenge when making this type of ducting. A number of cardboard boxes, their ends appropriately notched and sealed with plastic or tape are typically used as 'fixtures' in this type of fabrication.

Be sure your mounting tabs are accurately located. The core will usually remain visible thru the sealing tape once the fiberglas is saturated with resin. A marking pen that does not dissolve the core can be used to mark the location of the tabs. Your cardboard-box 'fixtures' should be designed to position the cores with the tab-side up, allowing you to install the tabs after the windings are laid-up. The most convenient form of mounting tab is a strip of sheet-metal about an inch wide and two inches longer than the width of the ducting at that point, the extra length allowing a one-inch tab on either side of the duct. To insure a good bond to the fiberglas punch a series of holes in the central portion of the metal strip and bond it to the two layers of fabric with an additional length-wise layer about four inches long. Due to the light weight of the finished ducting you will need only a few mounting tabs, none of which need be especially strong.

Once the ducting is fabricated and secured in place, it will become a permanent part of the vehicle. At that time the ducting should be insulated with paint-on high-density urethane foam (ie, the heavy two-part liquid that foams in place. If not familar with it, visit a hobby shop). The foam insulation produces a slick surface that may be painted or sealed with resin.

High temperature RTV is used to seal the ducting to the blower and where the ducting enters the engine compartment. Aluminum ducting similar to the stock Volkswagen heater-ducting (ie, from the blower-housing to the heat-exchanger) is used to connect the fabricated ducting to the heat exchangers. This section of ducting inside the engine compartment should also be insulated. Standard heater-duct sleeves, as used with the Type I engine, provide a handy means of fabricating the heater-duct connector in the engine compartment bulkhead.

Volkswagen used a single-pass, or open-loop system of cabin heat because they derived their heat from two of the exhaust manifolds of the engine's four cylinders (and from all four on the later buses). Such a system is safe with regard to carbon monoxide poisoning since fresh air is heated, used once, then allowed to escape from the cabin. Unfortunately, with the single-pass design the amount of waste heat available from only two cylinders is not sufficient to provide a comfortable level of cabin heat during cold weather, and even four cylinders has proved deficient when trying to heat the cabin of a bus.

The principle of recirculation, which merely means passing the SAME air thru the heat exchangers until the cabin reaches a comfortable temperature, is used on all modern vehicles, albeit deriving the heat from an inherently carbon-monoxide-free source. However, the heat-exchangers used on Volkswagen engines have proven to be extremely safe, allowing the recirculation principle to be used so long as reasonable care and intelligence is shown in the modification.

I first mentioned this type of heating-system modification in an article posted to the list in April, 1995. (see 'Stale Air Heating'). Since that time a number of people have installed recirculation systems, most using the kit of parts available from J.C.Whitney, or fabricating their own system using a bilge blower and commercially available ducting. Results have generally good although several have complained of blower noise, ducts coming loose and other relatively minor problems unrelated to the principle involved.

Since posting the original article, which mentioned the use of fiberglas ducting, several people have asked how to fabricate such ducts. I sent them instructions similar to this. Recently, however, I received a flurry of such requests including two in the same day, which I feel justifies making this a general post. The length of these instructions will give you some idea why they were not included in the original article :-)

Fovever Poptop

The basic problem with the fiberglas tops I‘ve seen on VW campers appears to be degredation of the resin due to exposure to ultraviolet light, a common problem with polyster resins.

If the composite part is to withstand constant exposure to sunlight, as would be the case with pop–tops — or airplane wings — the top surface must provide a near–perfect barrier to ultraviolet radiation. While there are a number of UV inhibitors that may be added to the resin, the only proven barrier I‘m familiar with is aluminum.

Adding aluminum in powdered form to the gel coat provides a nearly perfect UV barrier. Unfortunately, it‘s rather difficult to work with in hand lay–ups and repairs.

The aluminum need not be suspended in resin, it may be mixed with regular paint or varnish. For fabric covered aircraft, powdered aluminum is mixed with cellulose or butyrate dope. Several coats provide a nice sanding surface with the aluminum powder actng as a lightweight filler. The final color coats are applied over the aluminum.

Since urethane varnish and enamel will adhere to a well–sanded fiberglas structure, the procedures above could be used to refurbish a pop–top. The aluminum filler layers would protect the resin from further degredation and a top–coat of urethane enamel, which contains its own UV inhibitors, would provide the slick ‘wet–look‘ finish that does such a good job of cutting down solar insolation.

Powdered aluminum is available from most good paint stores. It is used on canvas (boats) as well as aircraft and may be found at some marine supply outlets.

Hanging by the Nose

I would like to space the nose mounted spare wheel away from the front to allow rain to run down behind it instead of collecting and rusting the panel. Some people tell me (and this makes sense) that if I do this the weight of the wheel will cause the panel to buckle when I go over a bump as it is so thin. So I want to know if it is possible to strengthen the panel in any way to allow the wheel to be set about half an inch forward so it is not touching the front. Would a plate inside work ? Angle iron ? What implications are there for crash protection?

Phillip,

The nose-skin of the Transporter was not designed as a load-carrying structure. The panel has no internal support. Even though Volkswagen offered a mounting plate for the spare tire, many dealers refused to install them since they often resulted in buckling and local failure of the sheet metal panel at the fasteners.

There was an after-market tire mount that used three internal struts, coupling the mass of the spare tire to either the package tray or the dashboard, and to the lower body panel in the vicinity of the headlight bulges. This was for splitties and I never saw one installed but I understand it worked quite well. I believe it was made by an Italian company.

The principle of transfering the load of the spare tire to a more substantial structure is valid but as you can see by inspection, not easily accomplished without a lot of work.

The same problem presents itself when you try to use a brush-bumper or kangaroo bars. If you hang the thing entirely upon the exisitng bumper mount you end up with an excessively long lever-arm — rather than protecting you, the thing actually contributes to the damage should you go bump in the night.

Professionally installed brush-bumpers add a strut to each of the A-pillars and another between them, running under the dash. The brush-bumper is then welded firmly to the re-enforced A-pillars. I saw a picture of a bus that encounted a termite mound in Africa with one of these brush-bumpers. The doors were a bit askew but the bus survived substantally undamaged.

The Volkswagen bumper is not designed with strength in mind. You can improve it in that regard without too much trouble. The best compromise appears to be massively re-enforced attachments with a heavy-guage tube between them. This is largely concealed inside the bumper. You may then attach your spare tire carried to this re-enforced bumper, positioning the spare with the lower edge a bit below the lower edge of the bumper. This keeps the mass low and tends to transfer any impact into the re-enforced bumper mounts rather than folding the whole thing back into the cockpit. I've seen this mounting arrangement with the tire slanting forward, using the spare tire itself as part of the energy-absorbing system.

Heater–Cable Replacement

Go to the friendly and knowledgable local VW shop. Buy the right heater cable.

Back your VW up onto some ramps, or just back it up to a curb or off a sloped driveway or something. The point is to get a little space under it's butt end so you can reach the heater boxes.

(optional) Throw something to lie down on under the back of the car. This is important if it's cold outside, 'cause laying down on freezing pavement sucks.

Get into the car and pull the rubber boot off the handbrake. Check out the left heater lever, and how it fits onto the assembly with that nut and those friction pads.

Remove it. You may want to slide the driver's seat off it's rails and take it out of the car to give yourself more room.

Unplug the cable fron the lever. I'm working entirely from memory here, and don't really remember how they fit together. I'm thinking that there's this bit that is straight, and then curves to make a right angle, and then curves again to point in the same direction as the original bit.. So there's a mostly straight ferrule on the cable end, except for this small peice of it that's offset, and the offset piece fits through a hole in the lever. I assure you that it'll be obvious when you're looking at it.

Take a good hard look at the hardware that's in the little baggie with the new cable, and take a good hard look under the car at the one side with the good control cable. You want to duplicate the old setup, but add the new hardware, basically. I'll leave that up to your mechanical aptitude.

Get back into your beloved VeeDub, grab the old cable by the ferrule, and pull. Notice that the cable's Y–shaped, that it's really two cables that share one ferrule at the front end.

Pull the new cable out of its baggie, and check out the lengths of the cables. One part is obviously longer than the other, right? Now look at the tubes that you just pulled the old cable out of.. One of those is also a tad longer. Remember this for a step…

Lube the cable in the slime of your choice. I used regular moly grease 'cause that was what was lying around. Get it good and slimy.

Put the cables in the tubes. One of the cable ends is longer; so is one of the tubes. You've been remembering this since step 8. Put the longer cable end into the longer tube. With luck, it'll just slide right in.

If you're unlucky, like I was, there's a blockage in the tube somewhere. If there is a blockage, clear it. I used a whole bunch of WD–40 and one of the old cables to clear it. I bent a little diamond shape into one end of the wire, and stuck the other end in my drill. Spun it up, stuck it in, and had a very small, very high–RPM Roto–Rooter. It was a thing of beauty.

Stick the front end back together. Basically the reverse of taking it apart; put the cable ferrule throught the lever, stick the lever on with the friction pads, and tighten it all up again. You want the lever in the down position for step 12..

Get under your Volksie again, and think back to how the cable looked as it was hooked to the lever. You want the cable ferrule through the cylindrical plug, the cylindrical plug in the round bit that connects to the heater box lever, and the bolt holding it all together.. And make it work. It'll look fairly obvious, I expect.

That was basically it. Turn on the car, and work the levers, and be happy at the air flowing in the right places at the right times.

Heat System Tune-Up

I read your article and it seems more than some of us can do at this point, however for regular heat during winter do you reccomend forced heat? I have heard there are some on the market but have found none so far.

I don't know which of my nearly 200 articles you've read although I can guess it was one having to do with the onset of winter and the poor heating in early buses. Also, your definition of 'forced heat' is not clear. I've writing several articles advocating the conversion of the present open-loop (one-pass) heating to closed-loop (recirculating) heating, as is used on all modern cars. But perhaps I can help in another, less expensive way.

For a quick winter fix, if you have an old bus try plumbing BOTH heat exchangers to the central duct — there is a 'Y' built-in for this purpose. Use flexible aluminum tubing, as for heater ducting (the ducting will see over 200 degrees). You can cut up an ironing board pad or hot water heater insulation wrap to insulate the new duct. Up front, pop off your interior panels and stuff the space behind with dacron (polyester) quilt stuffing —you can get a big bag of it at K-mart or similar stores. Look in the sewing section. Back in the cockpit, make sure you have no air leaks around the penetrations through the floor Under the cockpit, insulate the heater duct and make sure your belly pan is in place. If your belly pan is missing, fabricate something to serve in its place — you want to deep water & air from chilling that section of the heater duct.

Back in the cargo bay or passenger compartment, lay down at least three layers of cardboard then cover it with plastic then cover the plastic with a final layer of cardboard. Replace the top layer of cardboard whenever it needs it.

What these mods do is force all of the engine's heat to the front of the vehicle — you can melt ice off the windscreen in short order with both heat-exchangers on line. Really :-) The quilt stuffing and cardboard are just insulation. They will help retain whatever warmth you can develop inside the vehicle. You'll find additional details in my article on insulating the bus.

If you live in a really cold climate you're going to have to shop for a gasoline heater. The interior volume of the bus is simply too large for the two heat exchangers to keep it comfortable without at least an inch of high-density urethane insulation between you and the metal skin. And that means roof, walls and floor.

Horn

Problem: Horn don't work. Fuse is okay.

Volkswagen uses a different circuit theory for their horns. The horn is hot all the time, insulated from the chassis by the isolator/bracket. The wire that goes to the steering box is hot, as is the horn.

Test the horn. With the hot lead hot, use a jumper to ground the other terminal. The horn should sound. If not, you have a bad horn. I'm very sorry for you if this is the case because there is no cure. A horn is a necessity of life, without it you are going to die.

Pull the horn button, check the wire. (Horn should sound when you ground the wire.) If not, the problem is in the button or the wire.

Make up a continuity testor having a wire long enough to reach from under the steering gear box to the steering wheel hub. Test the wire that runs through the steering column. If it shows 'open' you'll have to replace it. (see below) It won't be shorted or the horn would sound continuously. If it proves good, use your static timing light and the wire you've used for continuity testing to cobble up a test light that includes the horn button and wire. Test the function of the horn button. If it proves good, and since you've already tested the horn, the problem is either in the terminals on the wire going to the steering gear box or you have gone deaf between the first and third tests and the horn is driving your neighbors up the wall and the cops will soon arrive to blow your young ass away since you are obiviuously a drug-crazed hippie doper as proven by that crazy old van you drive.

(The horn button may be corroded, or the entire steering column might somehow be isolated from the frame of the vehicle [Wildly improbable]. I kinda like the deaf thing. In California if you're deaf they let you carry a white ear and park in loading zones. If anyone says anything, just show them the ear and walk away.)

If everything checks out except the wire, the trick to replacing it is to first get it out of there. I'll leave you to figure out that part. To replace it, you should use a 'fish', a piece of very stiff steel wire with a loop on one end. Push it completely through the steering column, tape the new wire to it and draw it back. Or pull it through, your option.

When you make a new terminal for the horn button wire, solder as well as crimp the fitting and seal it carefully with heat-shrink tubing. You'll end up with a better fitting than VW ever imagined and it will be the last thing to fail on the vehicle, probably fifty or a hundred years from now.

Your horn is a legal requirement in all 50 states, Puerto Rico, American Samoa, Guam, the Ukraine and the parts of California that start with the letter ‘S’.

If you wish to run an air horn, send me a private post with your address so I can move if you’re too close.

Horn Wire

In your 'Grendel, Sunday III' lecture you mentioned replacing the horn wire. John Muir says 'This wire is hell to replace' or something like that but you made sound super easy. Care to expand on that?

Replacing the horn wire in the steering column IS fairly easy. John may have been referring to dealing with a wire broken at both top & bottom. You must remove the old wire and 'fishing' for it can be a real chore. But once the wire is out, pulling a new one through the column is a simple task.

If you'll look at the hole on the bottom of the steering column you'll notice it's smaller than the opening at the top. If you probe up inside the shaft from the bottom you'll also discover a lip of some sort.

To replace the horn wire, you pull the new wire through using a length of bailng wire. Stretch the wire first to make it reasonable straight then feed it through FROM THE BOTTOM. If you feed it from the top you'll have to hunt for the smaller–diameter opening. If your wire becomes bent during the hunt, you'll have to start over with a straighter wire. But coming up from the bottom is a simple push–through, once you're past the invisible lip.

Back top–side, bend over a six–inch length of your puller wire. Strip back about an inche of the wire you want to pull–though and put the stripped portion through the bend in the puller–wire, bending the stripped wire back onto itself. Use a pair of pliers to flatten the bend in the puller wire to take a tighter grip on the stripped wire. This bend must be small enough to fit through the bottom opening.

Now wrap the whole thing with vinyl electrical tape, starting at the top, so your spiral overlaps in the proper direction. Run the tape right on down the puller wire covering the entire bent–over portion and continuing about an inch beyond. Press the tape tight with your fingers when you're finished wrapping. Now start it down into the steering column, it should be stiff enough for you to push the puller–wire all the way in. Then go back to the underside and gently pull on the puller–wire. You'll feel it when it finds the lip but the vinyl tape will let it slip past. The tape may catch on the edges of the small opening. If it does, pull the wire up to the top again using the electrical wire you are pulling through, squeeze the tape tighter and try again. It should go through quite easily.

It really isn't that tough a job, taking less time to do it than to write this. And I type about a hundred words a minute :–) Typially, replacing a horn wire should take about fifteen minutes. I probably took a little longer than that on Sunday because I had to repair the electrical terminal on the horn button.

The job can turn in to a nightmare due to simple errors, such as wrapping the tape from bottom to top. That exposes the tape–edge to the lip inside the steering column and is liable to peel the tape off, solidly jamming the column with a plug of wire and tape. Or, you an spend hours poking the wire down from the top, trying to get it to go through the smaller lower hole.

If both ends of the old wire are accessible the job is even easier. Just solder your new wire to the old, put a little waterless handcleaner on the junction to serve as a water–soluable lubricant, and pull the new wire through. Takes maybe five minutes.

The general tone of your message made it clear that you thought I was blowing smoke up your ass. I'm not. I'm glad you've found much to admire in John's book. So have I. Unfortunately, some of the methods he advocates are damaging or dangerous, and many are grossly incorrect, an opinion I've expressed in detail in other postings, some of which are among the 'sermons' archived elsewhere. If you find time to read them I'll be happy to expand on points with which you disagree.

I've made this a general post since horn problems are fairly common. I think you'll find the above procedure to be as easy as I say but if you encounter a particular problem replacing a horn wire please let me know and we can deal with it privately.

Hush Bus

Having been designed as a utility vehicle, noise suppression was not a consideration in the original Volkswagen Transporter.

Sound is nothing more than another form of energy. Energy can be absorbed or converted to other forms. Energy may also be focused and amplified, which is usually what happens with most Volkswagen buses — the sound-energy produced by the power-train, suspension and tires is being dumped into the passenger compartment. You can change that.

A major source of noise is the blower on upright engines. Operating at about 1.6x the engine's speed, the blower generates an enormous amount of noise and aims it directly into the vehicle's body-work. You can effect a marked attenuation of the noise produced by the blower simply by doing what Volkswagen did to the later model buses, which was to install a firewall between the fuel tank and the engine compartment and to pad the resonating surfaces of the engine compartment with sound-absorbant material. Indeed, even with later-model buses chances are you can make it quieter simply by using the better sound-absorbant materials that are available today.

The main hazard associated with adding a sound-absorbing blanket to the engine compartment is allowing the stuff to get sucked into the blower. Volkswagen used metal frames to contain and support its sound-absorbing blankets. If you want to retro-fit a sound-blanket to your early-model bus it would be wise to copy the mounting procedure used by Volkswagen. Just remember that the frame should not be allowed to resonate — you could end up making the noise worse :-)

Another hazard associated with sound-blankets is fire. Volkswagen used non-flammable pads of fiberglas. Modern-day sound-absorbant materials are usually based on urethane foam and while not especially flammable, when consumed by fire they give off noxious gases that are potentially lethal.

The outboard gear-reduction units on early buses are another major source of noise. Thanks to the spring-plates and torsion bars, the noise from the spur-cut gears is conducted directly into the floor of the cargo bay, which resonates extremely well at certain frequencies. The best method of suppression for this type of noise is to build a sound barrier directly on the cargo-bay floor, such as urethane padding covered by carpeting. Unfortunately, the cargo-bay floor is a welded structure. Any moisture that gets into the cargo-bay eventually reaches the floor and if the floor is fitted with any sort of padding, will usually stay there until it rusts its own drain holes. Before attempting to add a sound barrier to the floor of the cargo bay it would be wise to examine it for rust and to deal with any found, going so far as to add additional coats of anti-corrosion paint.

In early buses the major source of noise was the power-train. With all that noise coming from the engine and suspension there was little benefit to be derived from quieting down the body panels. In later-model buses, having taken steps to reduce the noise from the power-train, additional effort was devoted to reducing the noise transmitted by the roof, nose and door panels. Here again, these same principles may be applied to early-model buses. Some of the most practical techniques have already been discussed with regard to thermal insulation, most forms of which also make excellent sound barriers.

Anyone who has taken a peek above their headliner or inside of their doors has discovered that time has taken its toll. Whatever insulation, be it sound or thermal, was originally installed has usually come adrift, meaning your vehicle is louder today than when it rolled off the assembly line. Creating a sound-barrier in your engine compartment and on the cargo-bay floor will do nothing for the sound-energy transmitted into the side-panels and roof, from which the sound resonates quite well. To render your bus as quiet as possible you will have to devote equal attention to the roof, side-panels and doors.

Perhaps the funniest aspect of complaints of a noisy ride is to discover the stock rubber engine- and tranny-mounts have been replaced with rigid urethane or in extreme cases, with solid steel (!) Compared to rubber, urethane mounts are virtually transparent to noise, even the muted whirr of the needle-bearings in your cluster-gears can be clearly heard. Urethane mounts are designed for the high-g loads encounted in off-road racing. They have no practical purpose on a vehicle driven on pavement.

Sermonette

In modern vehicles the most common method of achieving a quiet passenger compartment is to isolate the noise-source, typically with some form of rubber or other elastomer. The noise is still there but it is kept outside, unheard by the passengers. Because of features inherent in the design of the Volkswagen Transporter, specifically with regard to the suspension system, effective acoustic isolation of the power-train is impossible. The bottom line is that it's impossible to turn a 1965 Microbus into a Silver Ghost, where at sixty miles an hour the loudest noise is the ticking of the clock. The good news is that without too much effort your bus, early or late, can be made a lot quieter than it presently is.

(Just between you and me, I've always wondered if Rolls-Royce didn't use hellaciously loud clocks :-)

Keeping Warm in a VW Bus

This article will explore three basic requirements that must be met to insure your bus provides a comfortable habitation during both winter cold and summer heat. The requirements are adequate insulation, proper ventilation, and heating.

Heat rises. Warm the interior of your Volkswagen bus and that heat will naturally rise toward the roof... and go right through it. Because heat rises and because the roof is so large, maintaining a comfortable interior temperature when camping in your bus can be an expensive and even dangerous proposition. Expensive because the lost heat must be replaced by burning fuel, dangerous because Carbon Monoxide, one of the by-products of burning that fuel, is a silent, cumulative poison.

Keeping warm in a Volkswagen bus, even in below-freezing weather, is a do-able thing but it isn't something the stock bus or camper was designed for. To keep warm you must keep the heat in and the cold out. You do this by insulating the bus. The windows can't be insulated directly but they can be covered thermal barriers and with insulating blankets.

The most practical insulation for space-shuttle fuel tanks, aircraft cabins and Volkswagen buses is urethane foam sprayed directly onto the surface to be insulated. For Volkswagen buses, you can spray-on about two inches of foam on the interior of the roof (and as much as you want on the exterior) and about one inch on all the vertical surfaces. Any more than that and the foam will interfere with the fit of the interior trim panels, upholstery and headliner. The doors may be literally filled with foam after making allowance for the latch and window mechanisms. The interior trim is of course removed before the foam is sprayed on, all areas where you don't want the foam to stick being masked-off. Recessed areas that can't be sprayed directly are filled with non-sprayable foam, the stuff available in hardware stores. The 'canned' foam is installed first, allowed to harden and then trimmed. The masking is applied and then the spray-foam is applied to the interior of the vehicle, usually in one over-all application. Once it expands and cures, the masking is removed, the foam trimmed as needed and the interior trim, upholstery and headliner reinstalled.

Insulating blankets use a combination of materials to take advantage of reflection and insolation. Polyurethane foam sandwiched between aluminized mylar creates a remarkably effective heat barrier if the blanket is secured to the structure so as to prevent air flow around the blanket. Snaps, Velcro, or magnetic strips are used to secure the blankets. The use of such blankets obviously obstructs the view through the glass and should not be used while the vehicle is in motion. To provide a 'clear-view' insulated window you will have to use multiple panes of glass or plastic with a dry inert gas between them. Fitting Lexan panels over the interior of the windscreen using an RTV compound is one method that has been used on vehicles in Antarctica.

When the object is to maintain a steep temperature differential in an enclosed space you will find you'll have to deal with every possible heat-flow path, and that means every metal fitting that can conduct heat from inside the space must be provided with some form of thermal insulation, or the fitting must be isolated, the conductive path broken.

To achieve an adequate level of insulation it isn't necessary to resort to the extreme measures taken in say a space craft, but the fundamental principles must be understood and the basic rules observed. Failure to do so can see you spend a lot of money for insulation and still end up with a bus that's too hot in the summer and too cold in the winter.

Perhaps the most unfortunate failing in preparing a vehicle for cold weather use is the failure to provide for adequate ventilation. If the occupants of an insulated space are to remain comfortable the air within that space must be continually exchanged, not only to insure adequate oxygen but to remove moisture. Humans generate about 70 watts of heat per hour, along with nearly half a pint of moisture. Exchanging cabin air for exterior air is the most obvious method of getting rid of the moisture while providing adequate oxygen but of course the exterior air will be cold. If it is a great deal colder than the quanta of heat in the air it is replacing, some form of supplimental heating must be provided.

A neat point here, and one often overlooked, is that people generate quite a lot of heat. In a well insulated enclosure the heat of the occupant(s) is often enough to send the temperature soaring to uncomfortable levels. Introduction of outside air is used to regulate the interior temperature.

Ventilation in the typical non-pop-top camper is very poor. The interior air should be removed from a LOW point of the inorder to rid the space of heavy gases such as carbon monoxide or hydrocarbon esters. Incoming air should be introduced through a tempering system, such as a length of uninsulated aluminum pipe. The cold exterior air will cause much of the interior moisture to condense on the surface of the tempering pipe where it may be drained away, at the same time the exterior air will pick up heat from the interior. If additional heating is need it should be applied to the incoming air-stream near the delivery end of the tempering system so as not to defeat the condensation effect. Removal of the interior air is best accomplished with a small variable-speed fan located well away from the interior space and isolated so its operation can not be heard. There are a number of muffin-type fans that are suitable and a number of places on the vehicle where they can be installed. The controls should be clearly marked and fitted with an indicator showing when the fan is operating. With a bit of thought it should be possible to have the fan respond to a thermostat, making its operation automatic once it is manually actuated.

When heating an enclosed, insulated space, and when the heat is generated by combustion, the heater must be provided with its own air supply and exhaust. The interior space must be heated by convection or radiation.

The typical camper or RV space heater uses bottled gasseous fuels. Such fuels are convenient but expensive in terms of BTUs. As a general rule, the amount of heat available from a given fuel is equal to the weight of the carbon in the fuel, less any residue. By comparison, a gallon of kerosene represents more potential heat energy than a gallon of propane or even a gallon of gasoline. In the same vein, you'll see that charcoal is an emminently practical fuel given the right conditions.

The typical camper or RV space heater is a packaged system, the camper or RV designed to accomodate the 'package'. When forced to install such a packaged system into a vehicle not designed to accept it, the compromises may outweigh the advantage of convenience and ready availability. The system I've described here treats the Volkswagen bus as a unique entity, without regard to such packaged systems. Indeed, I have viewed the bus as the 'package' and described systems that accomodate rather than compromise its uniqness. I realize few of you can take full advantage of my point of view but the fundamental principles and ultimate goal still apply.

A Few Notes, and a Bit of Blue Sky

An unexpected but entirely welcome benefit of spray-on foam insualtion is its sound deadening qualities. A well insulated bus is amazingly quiet. If the engine compartment and transmission area of the under-body are insulated as well as the roof, sides and doors, the cockpit area of the typical bus becomes as quiet as a luxury sedan.

Volkswagen buses used as campers often suffer from interior rust, primarily from condensation above the headliner and behind the trim panels, but also as a result of spilled water and urine, the latter being extremely corrosive.

The most commonly available high-efficiency 'heat blanket' is the aluminized pads used to cover ironing boards. People with pop-top style campers might find a few ironing board covers, suitably tailored and secured with Velcro, can extend the use of their camper well into the snowy season.

Aluminzed mylar window film works in both directions. It reduces the amount of heat that can enter your van during the summer and the amount that can leave it during the winter. The stuff is a thermal barrier, restricting the natural hot-to-cold flow of heat. The combination of silvered windows and insulated curtains makes an effective, low-cost thermal barrier.

Each dollar spent insulating the roof of your bus is probably equal in effectiveness to each $100 spent insulating the floor and walls.

If properly insulated, the heat from two people is enough to keep the interior of a VW bus at a cozy temperature down to about 30 degrees Fahrenheit (about -1 C.) For an overnight camp-out in the snow, the old-fashioned footwarmer — oven-heated bricks — works surprisingly well as an auxiliary heater. You'll need a metal-lined ice chest, such as an older-model Coleman to carry the hot bricks, and they are heavy as hell, but they give up their heat slowly and will keep even an uninsulated bus fairly comfortable through a long winters night. When camping in the wild, rocks heated in your campfire serve the same purpose. No need to carry them with you of course, although when you get to your next campsite you'll want to be sure you only try heating DRY rocks.

The most powerful heat-source in your Volkswagen is the engine. The most practical system of heating the vehicle when stopped would be some form of waste heat storage and recovery. One method of achieving this is to use waste heat to heat a brine of eutectic salts stored in heavily insulated containers such as a pair of 3" diameter stainless steel pipes attached to the frame. Such brines can be heated to nearly 1,000 degrees Fahrenheit. The heat may be recovered with the vehicle at rest through a variety of means, a pressurized water system probably being the most practical. By the same token, such a heat source would work very well with an evaporative refrigeration system. Perhaps one day we will see such systems.

Lotsa Light!

So there you are, purring across the desert in the cool of the night and there's a funny sound from the engine room and the purr gets a little quieter and that damned red light comes on. You just lost the fan belt.

No big deal; you got a spare. And the lug wrench is the same size as the fan pulley nut and you've even got a screwdriver to keep the pulley from turning while you take off the nut. But the flashlight has those Civil War surplus batteries and gives you one last good-bye glow, like a tiny red worm and dies. You're fresh outta light.

Doing it in the Dark

If you got a bug, changing your fan belt in the dark isn't too bad. You've got your flashers going of course, and they throw a little light into the engine room. But let's hope you don't drop anything, you'll be pushing your bug back and forth, playing patty-cake with the ground hoping all those stories you've heard about night-time desert creepy-crawlies aren't true. (They're true.)

But you have a neat little trouble light in your kit. It's your static timing light. Connect it up, change the fan belt and you're on your way.

Sure is nice to have the right tools when you need them, eh? What? You say it's back at the house. I don't think that's a very good idea, do you? Why don't you keep it in the door pocket with your fuses. Whatdaya mean, 'What fuses!'

Reality Check

Most good cars provide a light under the hood, another in the trunk, one in the glove box, a couple under the dash, one by the ash tray... Good cars provide good lighting; they assume you'll drive at night now and then. Cheap cars don't do that, assuming you'll stay home glued to the tube when the sun goes down. The Volkswagen is a cheap car (or usta be!). The only lights you get are the ones required by law.

My 1973 Datsun has a little light under the hood, positioned so you can check the oil. It's a very smart kind of light. (Only after praising the Datsun people for their thoughtfulness did I learn that such a light was a legal requirement in some countries where 1973 Datsuns were sold.)

Letting in the Light

I've got four lights in the engine compartment of my 1965 bus, two in the engine compartments of the Ghia and sedan, two on the baja.

On the Ghia and bugs I put one of the lights on a bracket pop-riveted to the blower housing, positioned so as to illuminate the distributor and that side of the carb. The other light is mounted on the base of the generator tower so I can see the dip stick and the timing marks on the pulley.

The light fixtures I used are high quality new-surplus items manufactured by Grimes, the aviation people. They are solid nickel-plated brass jobbies that cost a couple of bucks each. Pretty small; Grimes calls them 'panel lights'. They use the commonly available #1816 12vdc lamp. (That's the GE number; it cross-references to others that will fit.) The lamp is small, about like a flashlight bulb. If you want more light than it provides there is a halogen replacement.

> [Editor's Note: Bob posted the following addendum about ten days later—surely American Science and Surplus carries a similar fixture though?
>
> "I'm sorry to hear the Grimes light is no longer available. It is extremely well made. I will keep an eye out for something similar, make a public posting if I turn up anything (I get lots of new/surplus catalogs)."]

I got the light fixtures from American Science & Surplus (3605 Howard St., Skokie, IL 60076. (708) 982-0870) The part number for the lights is #10572. Cost was about two bucks.

Screwing Them On (or up, your choice)

When mounting the lights on the engines I made up brackets from sheet steel or aluminum. On the bus, I used aluminum angle stock and mounted the lights on the overhead of the engine compartment. In all cases I gave the lights their own fused circuit, installing the fuse and the light switch on a small panel tucked up out of the way. The panel is aluminum, shaped to fit, installed with either screws or pop-rivets.

Since I was running an auxiliary circuit I figured I might as well run a good one, going directly to the battery with a 10 gauge wire. This is easily done in the bus and Ghia, where the battery is in the engine compartment. On the ’68 sedan I snuck the wire under the body, fastening it securely at several points and protected inside of black polyethylene tubing, the stuff they use for drip irrigation systems. On the ’67 baja I pulled the wire through the body channel with the other wiring.

Why such a big wire? For the cigarette lighter. Or rather, for the cigarette lighter socket. (I smoke a pipe; kinda hard to get going with a cigarette lighter.) The socket is fused with a 25 amp circuit breaker. I use it to power a 12vdc air compressor or a trouble light or a camping lantern or a ham radio or... or whatever you might want to plug into a cigarette lighter socket. I guess the thing would even work as a cigarette lighter, although mine comes with a big red plastic plug to keep out the dirt. (Baja-dust is special stuff, capable of penetrating six inches of steel plate.)

No one ever notices the auxiliary lights, unless they see them on at night. The lamps are hooded; the light shines where you’re looking, not in your eyes, and on the bus each of the four fixtures is behind a rib or strut. The wiring is wrapped in looms and the looms secured with aircraft-type wiring clamps, secured to the chassis with stainless steel sheet metal screws. The switches and panels are out of the way; you have to look for them to see them. No chrome, no colorful curly wires; everything is built for the long haul and so far, has worked exactly as intended.

Sermonette

I plan to keep my Volkswagens until I fall apart. And until then, I plan to keep doing what I like to do, which is to head for places well off the beaten track. The lights and the auxiliary power outlet make things safer and more convenient, and enhance the usefulness of my vehicles. Installing them took a bit of work but if properly done it’s a one-time thing, good for the life of the vehicle. Such things are worthy improvements for early Volkswagens.

Paint

I'm not a car painter, although I've painted quite a few cars. Lots of airplanes, too. My interest in applying paint is to preserve and protect the vehicle. Its finished appearance runs a distant second although when properly applied my work doesn't look all that different from what you'll see in a new-car show-room.

A good paint job by a professional car painter costs several thousand dollars. His only interest is in making it look good, which he does. The typical pro can win prizes. But he only uses paint that contributes toward the 'appearance-goal,' if you want two-part epoxy primer, and nine coats in the wheel wells and different colored primers for different parts of the car, the pro will do it... for a price.

The cost of a good paint job is enough to justify buying a low-pressure, high-volume gun and tackling the job yourself. LPHV isn't nearly as difficult to learn as the older method and actually does a better job in less time, plus you can always sell the equipment when you're done and recover part of the expense. The real problem is finding a place to do the painting.

HVLP systems (works either way :-) have very little over-spray, almost everything that comes out of the gun ends up on the vehicle. You can do a fair job even without a spray booth, assuming no wind, few bugs and warm weather. If you don't have those conditions but do have the space, a one-time spray booth made of plastic sheeting is a practical alternative. Just make sure it doesn't collapse onto your freshly painted vehicle.

The real secret of a nice paint job is the preparation, and to do a really good job you must strip the vehicle of all doors, windows, hatches and hood. You should expect the vehicle to be in this state for three or four days, long enough to shoot, cure and sand several coats of primer. The final finish will reflect every error and omission but it will also reflect the several hours of sanding needed to flat the primer coats..

The nicest thing about doing your own painting is that you know the finished product won't rust. That assumes you've eliminated any existing rust and then used several coats of two-part epoxy primer, the first coat being the type with the anti-corrosion stuff in it. Oddly enough, such a paint job has the ability to look better over time. Just make sure the color coat is heavy enought to withstand being rubbed out.

Such a paint job will never win any prizes but with freshly painted wheels, new window rubber and re-installation of well-polished chrome fittings, the results aren't half bad, certainly better than you'll get at one of the quickie paint shops. Plus you have the security of knowing the belly got more than its share of primer; that the rust was dealt with and that the final shape isn't the result of a hundred pounds of bondo and a mile of fiberglas.

Restrain the Battery

Wanna keep your battery from flying all over the place when you hit the unpaved stretch between San Felipe and LA Bay Junction?

Use shock cords.

Forget those metal frame thingees. Even the best of them eventually corrodes. Shock cords are cheap and you've always got a couple or you can borrow one, asked or or not, or even lash the puppy down with rope if the shock cord breaks. Use two. It's rare to have them both break at the same time.

Your battery should be sitting in a shallow neoprene tray with its own drain. If you don't have one, pick one up at a junk yard; look in a Datsun. The tray is big enough to hold a Type 27 battery. This is also the quick — and permanent — fix for rusty bug-belly (after replacing the pan, please).

Can't find the neoprene tray? So make one. Outta wood. Pine and plywood work fine. To seal it, heat up some common canning wax in a double boiler and just paint it on. Stick the bush in it the wax when you're done; it'll be there the next time you need it. And even if you've got a neoprene tray, paint a coat of wax on the bottom. On the OUTSIDE bottom. (I'll tell ya why in a minute.)

Battery acid doesn't make much headway against wax, nor against wood. If you assemble the wooden tray without nails (use Weldwood Plastic Resin glue, not that cheap crap in the bottle) there won't be anything to react with the acid, even should the wax get rubbed off. Don't like bare wood? So paint it. Or give it nine hand-rubbed coats of urethane varnish (almost as good as wax at defeating acid). And THEN give it a coat of wax. (Trust me; wax is the stuff to use here.)

And while you won't believe it, the waxed tray won't slip around on you, assuming you've got a couple of bungee cords holding it down. (I won't tell you how I came up with the idea of waxing my battery box, but if you're ever at Ponto I'm the old guy with the hand-carved board.) To give the bungee cords a place to grab a-hold, I made up some little fittings out of sheet metal, riveted them to the chassis. An aircraft eye-bolt would have been sexier but I didn't have any short ones. Whatever you use, give them a coat of wax after you paint them.

Every couple of years, scrape the wax off and lay on another coat. The only other stuff that works as well is pure asphaltium, and it's messy as hell.

Roof Racks

The roof rack on my 65 bus garners a lot of comment at SOTO meets, usually about how ugly it is. Or where they can get one like it. (Go figure.) The rack is as long as the vehicle and nearly as wide. It is supported on eight legs, fastened to the drip rail with a tricky little bolted clip incorporating a brass shoe that allows the drip rail to continue railing drips yet prevents rust at the point of contact. The rack is made from electrical conduit and weighs about forty pounds.

I built it mostly for carrying sheets of plywood, installing a four skateboard wheels on the rear edge to facilitate loading. It has handled loads as heavy as a thousand pounds (no sharp turns, please) and as clumsy as the nose clip from another bus.

There are a few tricks to fabricating things this large from thin–walled tubing; it helps if you've made a fuselage or two. All welding was done with gas (little tiny torch). Cost of the material was about $30; welding time was a couple of days, working off & on, using coat hangers, bailing wire and even some welding rod. I used only two jigs — simple wooden things to maintain alignment while tack–welding. Layout was on a concrete slab. I don't recall exactly when I made it; several years ago. It has proven to be very useful, especially during jaunts to the desert, when a temporary floor of aluminum panels allows you to always drive in the shade (!). Because of its light weight and ease of mounting, taking it on & off is a one–man job, although I've not found a handy place to store it and usually leave it mounted. I haven't noticed any reduction in speed on the highway, nor increased fuel consumption although logic tells me there should be some of each. It does generate a bit of wind noise at anything above 70 mph.

The only commercially built racks of similar size were outrageously heavy (>100 lb) and rather poorly welded, which convinced me to build my own. I've a similar albeit smaller rack on my 67 baja, mounted directly to the roof, through to a support structure on the interior. I've never tested it for weight–carrying capacity but it has held four large adults, a heavy tripod and a 35mm movie camera & battery pack, although never at highway speed. It too develops some wind noise, a curious whistle that begins at 92 mph but dies away as you approach Mach .170 [standard atmosphere assumed].

Neither rack was designed with a permanent floor but both will accept plywood or aluminum panels, as dictated by the load to be carried. The rack on the baja has numerous welded fittings to accept a variety of antennas, lights, etc. Three lights (sides & rear) are permanently mounted, as is one VHF antenna. Extending from the rear of the rack is a permanent sunshade made of riveted aluminum that serves to shield the rear window and provide a mounting point for two small solar panels, sufficient to keep the batteries topped.

The rack has been on the baja since 1981. I've no idea what it weighs; I'd guess fifteen or twenty pounds. It has six supporting legs, all rather heavy. Empty, the baja weighs about 300 lbs less than a standard sedan, thanks to lots of noise and complete lack of amenities. It was built to haul two passengers and a heavy load of cargo off pavement at speed, and it does.

Rustabustacus

...PO said it was a California bus. There's none of the usual rust (for this region) in the wheel-wells and rocker panels but when I was repairing the door latch I found the inside bottom of the door was completely eaten away by rust.

I've taken the time to write you a somewhat lengthy reply because your message describes an increasingly common problem.

As you've discovered, a bus from a warm, dry climate is perfectly capable of rusting from the inside out almost as readily as from annual applications of road salt. Before getting into how to deal with the rust let me bore you with some background on the problem.

Like all modern vehicles, Volkswagens are assembled by spot-welding. Spot-welds are seldom placed closer than an inch or so apart. Between the spot welds, the metal is simply pressed together, held there by the spot-welds on either side. This process is very similar to a row of rivets and provides excellent structural strength but such seams are NOT water-tight. The only way to get sealer into spot-welded seams is to submerge the chassis in a tank of the stuff. Volkswagen didn't do that. There are also weldable anti-corrosion compounds which can be painted onto the seams before they are spot-welded but Volkswagen didn't do that either. Early air-cooled Volkswagen bodies are assembled from panels and pieces made of relatively thin (ie, .032") low-carbon steel sheet — stuff that loves to rust. During the assembly process those panels were given no anti-corrosion protection of any kind.

What Volkswagen did was to apply seam-sealer over SOME of the seams and to then spray-paint over the sealer. You can find a couple examples of such sealed seams in your engine compartment. There are other examples but the ones in the engine compartment are the easiest to examine.

The door skins on the front doors and the hatch are not even spot-welded, they are simply bent around the inner door structure and hammered flat. After assembly they spritz a little paint on the interior of such structures but that's the limit of their protection. The exterior is protected with several coats of primer and paint but on the inside, all you have is that bit of over-spray. You can confirm this for yourself by pulling any of the other interior door panels and examining the junction between the inner and outer panels. You'll usually find some rust even if the vehicle has spent all of its life in Arizona.

The most serious aspect of this problem is that, as with the doors, the design of the Volkswagen Transporter includes a number of water-traps — portions of the structure which by their design, do NOT allow water to drain away. All of the doors include water-traps where the panels are joined but so too does the roof where it fastens to the bulkheads and the bulkheads where they are fastened to the floor. You'll need to pull more of your interior panels to examine these areas but it's time well spent.

You may think your bus is water-tight, and it may in fact be tighter than most, but ALL buses collect moisture on their interior, from their passengers if from no other source. Every human produces about a quarter-pint of moisture per hour simply by breathing.

When the atmosphere inside a bus is warmer than the outside, the moisture on the inside will condense against the colder surfaces of glass and bodywork. You've seen this for yourself — that mist on the windscreen is condensate. What you can't see is the same process taking place inside the doors, above the headliner and behind the upholstery panels.

When condensation occurs on a panel that contains or leads-to a water-trap — which includes virtually ALL of the panels of a Volkswagen Transporter — the condensate finds its way into the water-trap and remains there until it can evaporate. In the meantime, it causes rust. Unfortunately, if like most of us you keep your windows and doors closed when the vehicle is not in use, the water can not get out of the vehicle. It will evaporate during the heat of the day only to condense somewhere else during the cool of the night.

As to the water-traps themselves, they can take many forms. The non-welded, unsealed joint between the inner frame of the doors and the door panel forms what I call a 'cranny-trap' — a seam or crack where two pieces of metal are simple pressed together. However the water may arrive at a cranny-trap, it is held there by capillary action, meaning you'll find rusted cranny-traps even at the top of some structures. But most water-traps are simple gravity pools — places where water collects due to gravity but which do not have a drain. If you'll examine the geometry of the cargo-bay doors along their lower edges you will see they form a gravity pool because of the shape of the lip, as well as a cranny-trap because of the unsealed seam on the inner surface.

The most common form of gravity pool is the frames around your windows. The slope of the frame is INWARD, toward the glass. Age and capillary action is sufficient to allow water to collect under the seal around the windscreen, while opening and closing the side windows guarantees water will be trapped under the seal. The bad news is that any moisture that finds its way under the seal tends to stay there. The best proof of this is the number of Volkswagens with rust around the windscreen and other windows.

The metal under the seals is usually very well painted but paint alone can not provide protection against rust if the paint is constantly immersed in water, which is the case under your window seals... and behind many of your door seals. Given enough time and a few corrosive contaminants, plenty of which are present anywhere around a motor vehicle, water becomes an extremely effective solvent... given enough time. And that's really what we're talking about here —time.

The design and fabrication of your early air-cooled Volkswagen met or exceeded the standards of its day. But Volkswagens were cheaply built machines, never intended to survive thirty years or more. Indeed, the odds are your bus started to rust even BEFORE it was built. If you work on enough Volkswagens you come to expect evidence of rusting on the body-panels even under the base-coat of primer. That means the body-panel had some rust on it when the vehicle was assembled, acquired somewhere between the stamping mill and the assembly line.

Assembly of the body panels into a vehicle and painting the resulting structure slows the rusting process but because of the presence of unsealed seams and other water traps, the rusting will continue, albeit at a slower rate. Now add thirty years to the equation.

The point here is that the rusting problems you described in your message are, unfortunately, perfectly normal, even for a vehicle from a warm, dry climate. You should not view the previous owner as either liar or villain — he probably didn't know about the unsealed seams and numerous water-traps. Nor can we lay too much blame on Volkswagen for the poor design. Veedubs were cheap rides, cheaply built with only casual attention to corrosion protection. No one expected them to outlive their owners.

But the bottom line is that Volkswagens have an inherent problem with rust so lets try to do something about it.

The body of your bus is made up of a system of panels supported on ribs or frames. The doors are an example of a panel & frame while the roof and bulkheads use ribs to support the panels. The horizontal pieces you'll see on the bulkhead opposite the cargo-bay doors are commonly referred to as stringers and defined by their cross-sectional shape. The stringers used on VW buses include 'hat' sections, 'zee' sections (inside the door sill) and 'L' sections (between the roof and the bulkheads. All of the stringers make excellent water traps.

Panel & frame construction results in a double-walled structure and while the doors are the best example of this, the windscreen and all other windows use this form of construction, meaning you have double-walled structures around all of your windows. The key point here is that NONE of those double-walled structures have ANY corrosion protection on the inside. They are rusty and the process of corrosion is going on even while you read this message.

Common sense will tell you that the proper way to deal with an unsealed seam is to seal it. The problem is what to do about the rust that is presently in the seam. I can't give you a pat answer for this. Corrosion causes the metal to expand. In extreme cases of rusty seams your only option will be to cut out the rusty seam and weld in new metal. Your windscreen is perhaps the most common example of this type of repair. But if the rust is relatively light and the seam has not started to spread you may be able to arrest the progress of the rust through the use of chemicals such as phosphoric acid which can convert the active red rust into the relatively benign black rust. This is not a cure but it is often the most practical fix.

When using a chemical 'rust-getter' the procedure is to flood the seam with the chemical... and keep on flooding it until all signs of reaction have ceased. The chemical is then neutralized according to its user-instructions after which the seam is sealed. This procedure is often called 'passivation' or 'conversion' but I'll tell you right now, it is not a permanent fix. The rust is still there. It may not become a problem for another twenty years but it will eventually recur.

The standard seam-sealer, the brushable rubbery stuff, is virtually worthless when dealing with seams that are already rusty. After treating the rusty seams as mentioned above, the best sealant is one of the systems based on wax dissolved in alcohol. This stuff has a molecule that is small enough to get right into the passivated seam, preventing migration of moisture that may still be present within the seam. At the same time, this type of sealant will form a very effective seal over the seam.

The alcohol-wax procedure is especially advantageous because the solution is thin enough to be sprayed. This becomes invaluable when trying to deal with those pesky OVERHEAD seams, such as above the windows. A spray-able sealer also allows you to use tubing or skinny little wands to reach inside the double-walled structures and squirt the sealer exactly where it's needed. The waxy sealants have another advantage — they can accommodate the normal thermal expansion the body-work experiences. With other forms of sealant, applying the stuff on a hot sunny day is a virtually guarantee it will pop off during the first frosty night. With wax, you'll have to hit minus forty before the stuff does any cracking.

J. C. Whitney (and others) sell alcohol-wax type sealers and the equipment you'll need to properly apply the stuff. The applicator costs about forty dollars and the chemicals —enough to do perhaps a dozen buses — another twenty or so. If you have a syphon-gun and know what you're about, you can buy just the chemicals but the wands and special nozzles that come with the applicator kit will allow you to reach areas impossible to treat with a syphon-gun alone.

Dealing with gravity-pools is more straight-forward but gravity-pools — places where liquid water can collect —have some unique problems. Take for example the bulkhead opposite the cargo-bay doors. Moisture, either from condensate or leaks from the windows, will flow down this bulkhead UNDER the interior upholstery panel and collect on the deck. It can not flow away because the ribs supporting the bulkhead dam the water into pools. Immediately adjacent to the pools is the spot-welded seam between the cargo-bay floor and the bulkhead... which is why this area is one of the first to rust through. Sealing that particular spot-welded seam is one of the first things you want to do, as is sealing the welds between the bulkhead and all of the ribs and stringers. But the real cure is to eliminate the water.

Eliminating water that leaks into the vehicle is a common-sense procedure — you deal with the leaks. Eliminating water produced by condensation is a bit more difficult. To eliminate condensation you must insulate the bulkhead. If there is no temperature differential, there will be no condensation. Gluing various forms of insulation to the bulkhead is the usual fix but it is a bad one, since most forms of insulation are porous. The stuff slows the process of condensation because it slows the flow of air but does not prevent it. In effect, you simply transfer the rusting process from the area near where the water collects to the entire surface of the panel, since the insulation works both ways — once there is moisture BEHIND the insulation, it will tend to stay there.

The only truly effective form of insulation I've found is urethane foam applied DIRECTLY to the bulkhead. There are commercially available kits that allow you to spray the foam onto the bulkhead or ceiling. One such kit is called 'Spray N'Fill' and is available from Insta-Foam Products, 1500 Cedarwood Drive, Joilet, Illinois 60435-3187. This product was available from Harbor Freight in 1995. The stuff is expensive.

Self-expanding urethane foam is produced by mixing two oily liquids. When mixed together, a chemical reaction occurs that releases both a gas and a catalyst that causes the urethane to solidify. But due to the gas, the urethane solidifies in the form of a crunchy, plastic foam.

Hobby shops and some paint stores sell foam-in-place liquids. Some types allow about twenty minutes between mixing and foaming, meaning you can mix the stuff and PAINT it on the bulkhead or ceiling. But you have to be quick. And chances are you won't be able to re-use the paint brush. But this method does offer the advantage of being able to mix the stuff up in small amounts.

Most hardware stores offer some form of urethane foam in a can. Designed to seal cracks around doors and windows in houses, in old Volkswagens the problem is getting it to stay where you want it. One method that worked for me was to fasten a sheet of thin aluminum to adjacent ribs and squirt the foam behind it. After the foam had cured, I unscrewed the panel, which was about a foot wide, moved it up the ribs and repeated the procedure. To prevent the foam from sticking to the form, I painted the aluminum with hot paraffin. But this method is fraught with hazards. For one thing, the urethane foam will continue to expand long after the form is removed. After discovering this (and sanding down the protruding foam) I left the form in place for a full week. Even so, there was still some bulging from the centermost section of foam.

Or you might consider the ‘cow-pie’ method. Tear off a sheet of waxed paper about a foot square, squirt a pile of foam in the middle of the sheet and stick it where you want it to go. Thinned out to about three-quarters of an inch by massaging the stuff through the waxed paper, the foam will expand into a cow-pie about three inches thick in the middle. The next day simply peel off the waxed paper. This was how I insulated the roof of my 1965 Microbus before the trip to the Arctic Ocean.

The cow-pie method works rather well but is slow, expensive and messy. And urethane foam is NOT completely waterproof. I was careful to apply it only on well-painted surfaces since any moisture trapped UNDER the foam would eventually appear as rust.

The major draw-back of the cow-pie method is the lack of uniformity, not only of placement but of density. The center of the cow-pie, which cures the slowest, ends up with large, relatively inefficient cells, graduating to small, efficient cells nearest the edges. As to placement, cow-pie application is more art than science. You’ll end up with cow-pies all over the place but not quite touching, since it’s impossible to judge the exact amount of expansion that will occur. To get a uniform surface you must cut down the bulges at the center of the cured cow-pies and apply additional cow-pies to fill-in any gaps. And of course, the residue from sanding or cutting ends up all over the place, especially down your collar.

The bottom line regarding insulation is how well it works. I’ve found the urethane foam to be a pretty good solution to the rust problem. The foam also makes the bus quieter and caused a dramatic improvement in the heating system. With regard to urethane foam as a thermal insulator, the best evidence I can offer is the fact the huge external fuel tank for the space shuttle is insulated with a sprayed-on layer of high-density urethane foam less than two inches thick. We’re talking liquid oxygen and hydrogen here, folks. Pretty cool stuff.

The floor of your vehicle remains a major problem area since that is where the moisture will ultimately collect. You can't prevent this process. The best procedure here is to assume the floor is going to get wet and that you're going to have periodically dry it. When you clean out your vehicle to dry the floor you should inspect the paint-work for any signs of rusting and deal with it as needed.

Unfortunately, the problem of water-traps is not restricted to the passenger compartment. Your frame and exterior bodywork includes a number of double-walled structures in which dirt and water can collect. The most obvious are the rocker panels and jacking-points. The lower forward apron — that portion of the body just behind the front bumper —is another double-walled section that is prone to rust. Each of these areas will benefit greatly by having their interior sprayed with an anti-corrosion sealer.

Even your suspension system contains a number of potential water traps. It is not uncommon to hear of vehicles sent to the crusher because rust destroyed the frame sections supporting the front axle, or even of the torsion tubes themselves.

Sermonette

Cars are bio-degradable. They start to rust the day they're built... or even before. So long as automobiles are made of steel, rust will be their most fundamental problem. In the late 1930's and early '40's Henry Ford experimented with body panels of plastic and others of stainless steel. His goal was to come up with an auto-body that did not require paint but the basic problem was rust — if there was no rust, there would be no need for paint other than as a decorative finish, for which he could charge a premium.

("You can have it in any color you want, so long as you want stainless steel..." :-)

Your bus is rusty now and it's going to get worse — and ultimately die of the rust alone, if you don't do something about it. There are some things we can do to slow the process or to make it more manageable but like they say, rust never sleeps. The best defense against such an enemy is constant vigilance.

Rusted Tranny Mounts

If you live in the rust belt and are interested in an early bus (ie, pre-'72), the tranny horns and cradle should be high on your list when you inspect the vehicle.

As with the sedan, the two 'horns' onto which the transmission carrier is bolted are welded to the torsion bar housing. The entire weight of the engine and transmission are carried by the horns and the nose of the tranny, which also bolts to the torsion bar housing.

To accomodate the greater weight of the bus and the additional torque developed by the outboard gear boxes, the rear-ward ends of the tranny horns were fastened to a U-shaped cradle welded to the frame just aft of where it kicks-up to provide clearance for the axles and rear suspension. The resulting structure is not as stiff as it should be since the upper portion of the resulting load-cell is closed only by the sheet metal that forms the floor of the fuel tank niche and the deck area abaft of the main cargo bay. This load-cell is often distorted by any collision-impact due to the lever moment of the frame members extending to the rear of the load-cell and to which the bumper is attached.

The structural weakness of this area was well known by Volkswagen. Starting in 1968, the Transporter gained a rear cross-member bolted between the frame rails aft of the engine and to which the engine was attached but this was at best only partially effective. In 1972 VW introduced an entirely different chassis design.

On early buses one reason to inspect this area closely is because the tranny horns are open on the bottom just aft of the torsion bar housing but closed on the bottom at the rear, forming traps for corrosive salts.

You can add considerable strength to this area at little effort simply by welding plates across the open parts of the tranny horns and by closing the U-shaped structure of the cradle. A strut of 1" diameter x .120" wall-thickness tubing should be used to close the top of the load cell. I've seen square tubing used here as well, mounted with one corner down, allowing a complete weld without having to cut access holes in the sheet metal. A fabricated U-shaped 'hat' section of about .090" thickness would also serve, so long as it was plug-welded to the sheet metal.

Repair or replacement of the tranny horns and cradle is not difficult but requires careful attention to alignment. Closing the open sections and the addition of gussets should be part of any repair since it would be unwise to depend entirely on butt-welds for the integrity of the repair.

If you are considering installation of the IRS modification you may wish to strengthen this area as described above, not because the IRS mod increases the stress on the load-cell but simply because the original design of the load-cell was deficient to begin with.

Rusty Beetle Floor Pans

Your mother–in–law just stepped through the floor on the passenger side. You take this to mean it's time to replace those rusty floor pans. Installing new floor panels is a fairly difficult chore, not in the work itself but in making sure you end up with a straight chassis when you're done. The floor panels make a significant contribution to the strength and rigidity of the belly pan, which is why they figure high on the list at vehicle inspection time. Unfortunately, rusted floor pans is usually a symptom of more serious problems; if the floor pans have rusted through, there's a good chance you've got rust in other areas as well.

Scope of the Job

The problem: You got rust. The fix: Cut out the rusty parts and weld in new panels. The Zinger: The whole thing might be rusted out!

So start by removing all of the rust and making an accurate survey of the damage. The easy way to do it is to pull the body, remove the corkboard insulation, sandblast everything back to good metal.

Removing the Body

Disconnect everything (engine is already out, wrapped up and stored away), take off the fenders, unbolt the body and lift it off. It weighs less than a full–dress Harley but you're still going to need three husky friends or a little tiny hoist and a sling.

But before pulling the body you need to figure out where you're going to store it; figure it will be off for a month. (heeheehee!) Okay, three months.

But before you can do that, you'd better take a close look at the body. Is it rusty too? Then you gotta fix it before you can pull it off. The body is floppy as hell without the chassis; if it's rusted you'll never get it lined up again once you pull it off. These repairs can be sorta crude since the object is to insure the body's structural integrity, not its appearance.

Okay, so the body is straight and you're ready to unbolt it. But before you do that, you'd better take a careful look at your belly pan, because if it's really rotten it's liable to fall apart when you remove the body. And without the body, you will have lost the only jigging tool that will allow you to keep your repairs aligned; you'll end up with a twisted chassis. So you may have to do some structural repairs to the chassis, especially in the area of the side rails. Okay, the body is straight and the chassis is… straight enough. Pull off the body. (I'll leave you to figure out how to get out all those rusted bolts. And while you're doing it, keep repeating to yourself: "Anti–seize compound. I will never assemble a body to a chassis without Anti–seize compound!)

When the body came off it revealed a whole assortment of gaskets you've never seen before. You can't reuse them. Oh, you'd like to, and some of them may look okay, but one of the classic Gotchas! is that the body has to be torqued down on new, full– depth gaskets to insure proper alignment. (Relax; body gaskets are still available. But get a set before you take anything apart.)

Dealing with the Belly Pan

("How we going to flip this sucker over?")

Now you've got this neat looking go–cart in your garage. You can put the steering wheel back on, slap on a seat and have a hell of a fine time; your power–to–weight ratio just shot up there with a Shelby Cobra. But if you've got a swing–axle, you can't pull the tranny (Perfect Opportunity!) without rigging up some sort of dolly under the belly pan because pulling a swing–arm tranny also pulls your rear wheels! (AAgghhhh! Why didn't he tell me that FIRST?) Okay, calm down. So leave the tranny. But drain it. And bag it. Tight. Three layers of heavy plastic. Lotsa duct tape. You're going to be sandblasting your belly pan and that sand is going to go EVERYWHERE. (This also applies to your brakes. And your front suspension.)

The Big Trick is how to work on the BOTTOM of the belly pan. They've got flipper jigs for this: You bolt them to the wheels, add a lever arm, and tip the vehicle over on its side by raising the lever arm with an engine hoist. Or those three husky friends who helped you pull the body. In fact, you can leave the body on and still flip it over; the curved side rails support the body clear of the floor. Flipper rigs are made in Canada. They cost about $500 (spring, 1995 prices). Or you can do something else.

Most shops use a fork lift for positioning the belly pan for sand blasting. Others use a ceiling hoist. Others use a derrick. Others use three husky friends. You decide which method works best for you. A derrick is two A–frames with a bar between them; go look at a kid's swing–set; make the same thing only bigger/wider/taller out of steel pipe or wood. A hoist is a winch on something higher than the floor; a ceiling beam or a tripod. A tripod is three pieces of heavy pipe lashed together.

You're not dealing with the Titanic here but there's enough weight to turn you into a road–kill pancake. If you're not familiar with hoists, winches and moving thousand pound loads, you'd be smart to get help.

Sandblasting

Sandblasting is the most economical way to remove rust. You need at least a 3 hp compressor and a pressure–type sandblasting rig that holds a hundred pounds of sand, minimum. You're also going to need some protective gear because the sand comes out of the nozzle at about a thousand miles an hour, bounces off things and makes you bleed. And you need an air–mask, like for a diver but on land. It gets its air either from the big compressor through a reducer, or from a separate low–pressure, high volume compressor, which is the best way to go. (Some air compressors can kill you with their fumes.) And it helps if you have three husky friends hanging around to position things for you, refill the tank, and so forth. Figure on spending four hours getting your chassis clean.

You can rent all this stuff. Or maybe find a mobile sandblaster who will come to your shop and do the job. Or you can tow your chassis to a shop and let them blast it there. But one thing you can't do is a proper job using a spray–paint compressor and a one–quart sandblasting gun from Sears; it's going to take several hundred pounds of sand to do the job right. And the little rigs are just tooooo sloooowwww, as in weeks.

Painting

Sandblasted metal rusts so fast you can see it form. Seriously. You want to have your anti–corrosive primer ready to mix and shoot when you start blasting, and be prepared to apply it the minute you're done. This is a precautionary paint job, intended to protect rather than serve; you'll do the whole thing over again later. But if you don't do it now, you're going to have do the sandblasting all over again(!).

Okay, yeah; there is another way. Some guys do all the metal work and THEN the sandblasting, fixing anything the sandblasting reveals. That only works if the rust isn't too bad. I do it my way because with a really rusty chassis the sandblasting reveals problems you never even dreamed of, problems too serious to repair before the Rust Monster returns. When you sandblast and then prime, you can spread your metal work over however long it takes; the chassis won't get any worse. When you're all done you clean up your welds, maybe do a little local sandblasting, and lay on your For Real coats of anti–corrosive primer. (The epoxy stuff is best; the Navy uses it at sea and it really works.)

Repair Work

Now you know what has to be done, but you probably don't know how to do it.

Back about a thousand words ago you should have ordered the replacement panels you knew you were going to need, such as the floor pans. But sandblasting has probably revealed other problems, some for which there are no replacement parts available. Deal with these things first. You want to pay particular attention to the front axle attachment points. (Front suspension for you Fearsome Strut people) And to the rear torsion tube and the tranny horns. Rusted through? Cut it out and replace it, using parts locally fabricated from an identical thickness of mild steel sheet, tube or plate; or find a junker that has a good section you can transplant. This last is tricky because you must insure perfect alignment. If you're a virgin, think about it before making the leap; you may do more harm than good.

Those little mig machines have turned everyone into wizard weldors. (Well, maybe not everyone.) Big rusty hole? Clean away the corroded metal, tack in a patch about the right size, use your torch and a judicious selection of hammers to forge the part for a perfect fit. Scribe it; mark the exact shape you want. Grind off the tack weld and cut/grind/file the patch until it exactly fits the hole. Chamfer the edges. Fix it in the hole with wedges/clamps/whatever. Tack weld. Finish–weld both sides. Grind the welds and fix any holidays. Do it right and the repair will be as strong as the native metal. Finish it right and the repair will be indistinguishable from the native metal. There's a little bit more to it than that. (Okay, there's a whole lot more to it than that.) Metal is malleable stuff; it's willing to work with you. You can acquire the skills you'll need but don't expect it to happen over night.

Replacing the Floor Pans

Cut away the rusted metal. Use the replacement panel as a pattern. Don't use a torch, unless its one of those teenie–tiny plasma–arc thingees. A regular gas torch will need a lot of grinding for clean–up. Use a stab saw, or a cut–off wheel, or an air–chisel, or even a saber saw; you want a nice, clean edge, well back in uncorroded native metal. And if that falls outside of the overlap you'll have to do a local patch before you can do the floor pans. Insure an overlap of at least an inch. Remove all paint where you're going to weld. Align the replacement panel and tack it into position, taking the time to insure as perfect a fit as possible. If you're doing an early bug, the floor panel may have the seat rails already attached. Make sure the replacement panel goes in so the seat is straight. (Having the seat a few degrees off will drive you crazy on a long trip.) If your new floor pans don't have the seat rails or attachments, you'll have to cut the old ones off the old floor pans. Use a spot–drill; make a neat job of it. Position them with clecos or pk's before tacking them down.

When you're satisfied with the fit, and have it tacked down every two inches or so, flip the chassis over and do the same thing on the bottom. This puppy is going to try and move around from thermal expansion, once you start welding. And it WILL. All you can do is go with the flow, running only a few inches of bead at a time, working from end to end, side to side and top to bottom, trying to even things out. Keep your hammers handy, and your three husky friends; they can lean on things to close the gap while you run the bead. There are a lot of tricks that every tin bender knows that will produce a flat, undistorted repair. If things look like they are getting out of hand, seek help.

Commercial Work

If you take your bug to a body shop they'll slap a pair of pans in it in a couple of hours. A good shop might even throw a coat of paint on the welds. If you say you want the pans replaced, they will replace the pans. Period. If your front axle is about to drop off they might tell you about it but that's the limit of their liability. Or, they can tell you the gravastatious is rusted to the point of asfulizing the thingamabob, but they'll fix it for another hundred bucks. There is no enforceable 'Standard of Good Workmanship' (and probably no enforcement, period) unless you come equipped with lotsa money and a team of lawyers. The only thing you can do is put your trust in the people doing the work. (Okay, yeah; there are both standards and enforcement procedures. But with a population of 30,000,000 [all of whom own cars] California has exactly two (two — count 'em) people to investigate automotive–repair complaints filed with the California Office of Consumer Affairs. So on the one hand we have the laws, on the other we have reality. I'm talking reality here.)

The bottom line is, no matter the level of your skills, if you do the work yourself you will know exactly what was done; you put your trust in yourself. And when you get right down to it, that's not too bad a deal.

(No, they're not all rascals. But enough. The sad part is that the other shops know who the rascals are and don't do anything to clean their own house; they get tarred with the same brush.)

Fiberglass Floor Pans

It sounds like a good idea, and if you live in the rust belt it may be the smartest thing since beer in cans, but the problem is subtle: To insure adequate strength and corrosion resistance you must form a perfect metal–to–epoxy bond on the underside of the belly pan as well as the top.

The quick fix, and one I've see in the magazines, is to cut away the old pan, pop–rivet the new one into place and slather a few layers of fiberglass over the joint. FROM THE TOP. But if you've failed to deal with the rust, all you've done is buy a little time. (And sell a few magazines, which was probably the goal.)

The proper composite repair calls for bonding the fiberglass panel on both surfaces, top and bottom, overlapping the native metal by about four inches and using an epoxy formulated for metal bonding. (Ciba–Geigy (Shell) has some stuff; so do others.) The trick here is making the lower bond. You need to use multiple lay–ups with peel ply, or use air bags, or flip the chassis over. And if you can do that, you might as well do a proper welded repair.

Sexy Metal Work

In a private message to a fellow subscriber blessed with rusty pans I expounded at some length on the joys of hand–flanged seams and other tin bender tricks that only took me thirty years to master. (Gee! Whatta swell guy!) The point is, there are better ways to do the repairs above, and autobody men will use them if time and money permits. But the methods above will work well enough in most cases and you don't have to be born with a wrench in your mouth.

Rusty seams

Your bug or bus is stitched together by spot-welds. It would be stronger and less prone to rust if continuous welds were used but when dealing with sheet metal, a continuous bead causes the light panels to distort.

To keep spot-welded seams from rusting, which they are prone to do, a bead of caulking is smeared on the inner edges while lead, bondo or paint is used to seal the outer edges. If the seam was free of rust at the time it was assembled, so long as the sealant remains intact the seam won't rust. But it's not uncommon to find rust under the paint on Volkswagens and that includes rusty seams. The stuff has been there since the vehicle was assembled, just waiting for a chance to spread.

There are different kinds of rust. A few ions of sodium from sea air or road salt will act as a catalyst, drawing in the moisture needed to start the rusting process. And once started salt-induced rusting will continue until the sodium is neutralized or removed — sealing in the rust won't help. This means a good first step for dealing with rust is to add water (!). Hopefully, the water will carry away the salt, giving you a chance to deal with the rust.

One of the handiest methods of dealing with rust is use a phosphoric acid compound that will convert the ferrous oxide to ferric phosphate. Black iron oxide is a more stable form of rust. Once sealed with paint a phosphated surface is usually stable, the rust will not progress. (I'm always getting the ferrous/ferric thing mixed up. A bit of help from the chemically adept would be appreciated.)

When dealing with a rusty seam often times your only recourse is to use chemicals but the most successful method is to remove the rust, weld the seam closed and go on from there.

Bondo is polyester resin — plastic — mixed with fillers. The most common filler is sand although materials as diverse as talc, sawdust and glass beads are also used. Because of the fillers, bondo is permiable — it isn't waterproof. Before using bondo to fill a seam or smooth a repair, the bare metal surface should be treated with a phosphoric acid solution. Failure to observe this precaution often leads to the formation of rust under the bondo. In time, the rust will cause the bondo to crack and admit more moisture and you'll be back here you started. The fillers reduce the strength of polyester resin. Use the thinnest possible layer.

The typical vehicle rusts almost as fast from the inside out as from the outside in. Once water gets into a vehicle it's surprisingly difficult to get it all out. And while most car owners are careful to deal with minor rust on the exterior of their vehicle, few place the same importance on those rusty spots lurking under the floor mat. If you have a rusty seam you should immediately check the other side of the seam. In many cases, this is the source of the moisture that has caused the rust.

Most car owners spend a lot of time making the visible portions of their vehicle pretty but when it comes to rust protection the invisible portions, such as the under-side, are of equal importance. Anything that can hold moisture next to the metal will promote rust and quickly, too. Pressure washing the under-side of your bug or bus can add decades to its life. And just as you should immediately deal with any stone chips on the body work, so too should you care for the fender wells and frame members.

Sermonette

It is the nature of cars to self-destruct due to rust; cars are bio-degradeable. We can stave off the process by sealing the metal from the air using layers of paint, and protect the paint with layers of wax. But if we’re serious about caring for our vehicles we must devote equal time to the interior and under-side. The best rust treatment is prevention.

Rusty Windscreen

Regarding your windscreen seals, your short-term options are the use of composites — fiberglas. But since proper execution of either composite or welded metal repair depends on preparation, you're looking at about the same number of man-hours, the only savings will be not having to hire a weldor a weldor.

Preparation involves removal of the package tray, which involves disconnecting and removing our speedometer cable. Start with that; insure the cable is free and CAN be removed. There is a rubber sleeve on the inner end of the spindle that sometimes becomes so clogged with oily dirty that it makes it impossible to easily remove the cable. Key word: Easily. You can get it out but you may have to work at it.

Once the speedo cable is free, disconnect it from the speedo head, pull it out, coil it up and store it in a bag. It takes only a small amount of grit on the cable to ruin it.

With the speedo cable out of the way the package tray is a no-brainer... except you'll have to loosen the steering wheel shaft from the bottom of the speedo head housing, and. Just do what is necessary to have the package tray on the bench. Then go around and unbolt your wipers. Be sure not to lose any of the hardware because it is rare stuff. The object of removing the package tray was the removal of the wipers, which must be removed so we deal with any rust we find in the windscreen area.

Back inside the car, remove your wiper switch from the dash but leave all of the wires attached. Find the hot wire from the fuse block to the wiper motor and remove it. Then tag it. Masking tape and a magic marker is the handiest tool for marking your wiring.

Unbolt the single 10mm bolt securing the wiper motor to the frame of the vehicle and work the wiper arms out of their grommets and the wiper motor/arms out of the car.

Now is the time to protect everything. Use heavy gauge plastic sheeting. Not drop-cloth stuff but the 3- or 5-mil vapor barrier used in construction. You may also use meat paper, heavy brown paper or multiple layers of newspaper but the plastic is the best choice since it will withstand sandblasting. (SANDBLASTING? [Calm down, I'll get to that in a minute.])

Did I mention removal of the carpet/floor mat? Ummmm... I probably should of mentioned that.

The object of doing all this is to insure the repair of your leaky windshield doesn't leave the bus in worse condition than before. The only way to be sure you've removed all of the rust is to go after it with abrasives, and sand-blasting is the most cost effective method of abrasive rust removal. Don't even think about chemicals at this point, we are dealing with a purely mechanical problem.

You will want to insert a couple of small sheet metal screws in the door pillars on the latching-side of your front doors, right up near the lower edge of the headliner. Run a strand of bailing wire from the screw to the overhead vent and down to the other screw. Rig a plastic curtain from the wire; use duct tape and ingeniuity; the object is to seal off the rear of the vehicle from the cockpit.

Remove your sun-visors. If you leave them in, bag them and tape them to the overhead, but it's best to remove them. After the sand-blasting you will probably drive the vehicle home. If you fail to remember all the places where the sand-blasting residue has settled you'll go blind about a block from the house. If you do the sand-blasting at home and forget about the visors, you'll usually remember when you are doing the painting, about a millisecond after you bump the sand-laden visor.

Away from the vehicle, you should have positioned your metal-prepping supplies, your paint and your composite materials. If you are not familiar with the use of composites on steel structures, this is not the place to learn.

You should also have your replacement windshield seals on-hand preferrably in a pan of warm water containing some glycerine.

Go ahead and cut out the glass. Since you aren't making a business of auto-glass removal, don't bother with the special knife, although it does make things easier. Use the sharpest knife you have or a single-edged razor if you like to bleed. You can sharpen a knife as sharp as a razor if you put your mind to it; just keep graduating up the scale of abrasives and do the final stropping on leather. Keeping the blade wet with glycerine during the cutting makes an amazing difference in how easily the knife slips, often right off the window and into your hand. Be cool.

The object is to cut the seal away from both the glass and the metal. Slide your knife/razor/what-ever along the glass with the blade virtually parallel to the pane, penetrate the rubber and commence drawing the blade downward. You're going to be surprised at how tough that old, cracked rubber will be. Start in one of the upper corners and cut down, then do the other corner, then do the top. That's usually enough to allow the glass to be pressed out of the seal. Treat it gently and stow it carefully.

With the glass removed the seal will peel away from the bus, often taking some of the bus with it. I've described preparations for a worse-case scenario but with a bit of luck your windows won't be that bad.

If your bus is more than ten years old and still has the factory seals, the metal is going to be rusty underneath. Seals are inexpensive and aren't too difficult to replace but for some reason it's a chore no one bothers to tackle until the rain fills up their shoes, ruins the wiper motor and rots out the cockpit floor. Go figure.

The big question is: 'How much rust do I have?' and the only answer is to pull the seals and find out. The worse-case is to discover the flange rusted away and holes in the body-work.

Whatever amount of rust you have, get rid of it. Totally. Back to bare metal and an inch or two to either side. Sandblasting is the best way but I'll leave you to make your own mistakes. Immediately after sandblasting, prep the metal with a phosphoric acid solution. An auto-paint supplier will put you on the right track. Follow the instructions. Use repeated applications. Keep the surface saturated until ready to neutralize; paper towels and strips of clean rags will help when dealing with the overhead panels; use plastic and duct tape to keep things in position.

The phosphoric acid solution will alter the compostion of the infinite surface left by the sandblasting, a surface that would otherwise rust faster than a politician can lie and which if left untreated could make the situation even worse than it was.

Once the surface is treated it must be neutralized. Once neutralized it must be dried. If working in damp or cold weather, provide some means of drying the surface quickly. A hair dryer will work, a heat-shrink gun will work better. A lot of guys use propane powered radiant heaters, very handy things for warming rubber seals... if you're careful.

Cleaned, prepped and neutralized, you may then prime the surface for painting if it does not need major repair. Or prime it anyway, planning to do a fiberglas repair — you want the surface either in-work or protected.

The rust is usually found only on the lower flange, more toward the outboard corner than the centerline. The usual repair is to weld in a new flange locally fabricated from metal of suitable thickness. The welding will of course entrail some grinding and the work may be extensive if the wiper cut-outs are involved, but if you tackle it a bit at a time a welded repair is not all that difficult and is always the best choice; Volkswagens are made of steel, not fiberglas.

If you wish to use fiberglas for the repair you should have some experience with composities and with the unique problems of bonding composites to steel structures. In most cases the fiberglas repair will result in a new, rust-proof flange only to produce rust under some other portion of the repair a few years later. Repair of an improperly done composite repair is more difficult than doing a welded repair.

The best composite repair is to build a mold of the shape you wish to produce using rigid urethane foam. You can glue the foam to the dashboard then sand it to shape. This will put gravity on your side as you do the lay-ups and fills. Covering the urethane with heat-smoothed plastic sandwich wrap will impart a glass-smooth surface to the finished lay-up.

The lay-up should progress in two steps, first laying up two or three layers of fine twill-woven six-ounce fabric saturated with a suitable epoxy resin. Surface with peel-ply and allow to cure. Strip off the peel-ply. trim for height, lay in a build-up of saturated chopped cotton fiber to form the fillet then do the finish lay-up with two or three layers, the first layer being the widest, the other(s) narrower. The stepped layers will be easier to blend in to the contour. If properly done, the repaired flange will have exactly the same contour as the metal flange it replaced but will be stronger and impervious to rust.

Once the lay-up has cured, grind to finished size and blend the layers into the contours of the nose. Prime and paint.

Installation of the windows is covered in the various manuals. The basic idea is to lay the window on something that leaves the edges free so as to allow the seal to be fitted to the glass. Once satisfied with the fit, embed a piece of strong twine into the channel that will fit over the flange, crossing the ends of the twine at the bottom-middle-inner surface of the seal. The glass and seal are then set into the opening with the flange fitted into the channel of the seal. The twine and lots of lubricant is then used to force the seal over the flange by someone inside of the vehicle while a second person presses on the pane from the outside. And if you think this sounds tough, a pro would have the glass installed in five minutes or less working entirely on his own.

The real problem with doing your windshield is that you are doing two different jobs, body work and glass installation. And you'll probably be under the gun to do it as quickly as possible so you can get the bus back on the road. And cheaply, too. This combination usually results in a crappy job.

Here are some tricks you may wish to consider: You can drive the bus without the package tray and steering column re-enforcing plate. You may also drive without the speedometer being connected. That means you could do those tasks well ahead of the windscreen replacement.

There are other forms of windscreen seals including a type that pops in from the outside and is locked into place by inserting a rubber tube into an easily accessible groove on the outer face of the shield. Peel the tube out of the groove and the glass comes away in your hands. Using something like this would allow you to do a flange repair on a piece-meal basis, re-inserting the window between sessions. This also applies to the final paint; a temporary seal allowing you to drive the vehicle while still wearing its primer coats, removing the glass for sanding and additional painting as time allows.

Operating without windshield wipers is not legal in most states, but most state laws do not specifically say the wiper must be OPERATING, only that the vehicle must be ‘equipped’ with them. Treating your windscreen with Glass-X or other dispersant will allow you to drive in the rain without the use of your wipers; you can leave them out until all of the body-work repair associated with the windscreen is completed.

As with most things, prevention is less expensive than repairing. Windshield seals are about twelve bucks each from J.C.Whitney (Oct 1995). If kept clean and treated with a protectant, your rubber seals will remain tight for up to ten years, longer if the the vehicle is garaged. At the first sign of aging the seals should be replaced, dealing with any rust found in the process. In this way things never get too bad and the cost is spread out in manageable ten-year bites.

Auxiliary Fuel Tanks — Redux

Part of my preparation for the Inuvik run was to design, fabricate and install a pair of 15 gallon saddle tanks for my 1965 Microbus. I also replaced my stock 10.7 gallon fuel tank with one from a 1972 breadloaf, upping my total fuel capacity to about 45 gallons.

One of the objectives of the Kansas City trip was to see how well the tanks performed. Generally, they did very well. They did not leak, which was the first consideration, and they allowed me to drive all day without refueling.

The only problems I encountered with the new tanks were due to poor design on my part. Initially, I laid out a rectangular tank and had the material bent to that pattern. But when I began assembling the tanks I realized the space into which the tanks were meant to fit is not a perfect rectangle due to the kink in the frame of the bus back near the rear jacking point. This forced me to modify the shape of the tanks, cutting a wedge-shaped gore in each tank about 1-1/2" wide by 14" long, and to modify the end panel and one internal baffle accordingly. This modification must take into account the left/right nature of the tanks. Other than that error, fabrication was straight-forward and relatively easy, thanks to the use of a plasma-arc torch that sliced the sixteen gauge steel with remarkable ease and accuracy.

A lesser problem was encountered when using the tanks. With the tanks full, in some attitudes I could get a burp of gasoline out of the fuel tank vents. Apparently I did not provide sufficient head in the anti-siphon loop of vent-line tubing. This should be easy to rectify since the 3/8" aluminum vent lines, two per tank, are secured with push-on rubber tubing.

An annoyance was the amount of time I had to spend with my thumb against the fuel transfer button. Transfer takes place at the rate of half a gallon a minute meaning I had to keep my thumb on the button a total of an hour each day. I'll replace the push button with a toggle switch, plus add a blinking light to remind me the thing is on.

Getting the last gallon of fuel out of the saddle tanks called for the nose of the bus to be higher than the rear of the tanks and, ideally, for the passenger side to be lower than the driver's side. These conditions could usually be found simply by running nearer the shoulder while ascending a slope but in Kansas I had to use the kerbing at a rest stop to achieve the proper attitude. The pump makes a different sound running dry.

In most cases I never completely emptied the fuel tanks since my longest day's run on the Kansas City trip — 810 miles — did not consume all of the fuel on board. I ended that day with the main tank three-quarters full —

about two hundred miles of driving — and an estimated seven gallons in the saddle tanks, of which at least five was transferrable. When ‘empty’ each saddle tank actually contains about a gallon of fuel trapped below the level of the transfer port due to the geometry of the tank and fitting.

Two vents per tank are needed because the tops of the tanks are perfectly flat and the tanks contain three internal baffles. The vents go to opposite upper corners of the tanks insuring there will be no air trapped during filling.

The fuel tanks were fabricated from 16 gauge hot-rolled steel. Each tank is fastened to the chassis of the vehicle at eight points using 1/4" bolts through welded fittings. Each tank is provided with an inlet 1-1/2" in diameter. The inlets of the tanks are common with a welded T-pipe leading to the filler neck, which is a modified aircraft fuel tank fitting. The common plumbing is connected with Neoprene hose with two clamps at each joint.

The fuel transfer pump is a commonly available Facet electric fuel pump. A fuel filter having a replaceable element is installed between the pump and the saddle tanks. Both the pump and the filter are installed within the cage of the vehicle’s frame and are protected with shields. The outlet of the transfer pump is plumbed to one of the two vents on the late-model fuel tank. The second vent serves its normal purpose, vented via an anti-siphon loop installed above the level of the tank in the left louver-well of the engine compartment, exiting below the vehicle through a grommeted hole in the left rear fender well.

After welding, the tanks were pressure-tested to 15psi using special seals and fittings fabricated for that purpose. Fifteen pounds per square inch is far more than any rectangular fuel tank will ever be subjected to in normal service. The purpose of such an extreme test was to verify the structural integrity of the internal baffles, the upper flanges of which are secured to the tops of the tanks by rosette welds through the tank top. At that pressure a number of minor leaks were revealed. In each case the bead was ground down and the leak rewelded although the leaks were so small they would of been sealed when the tanks were sloshed.

After pressure testing the interior of the tanks was etched with acid, the etchant neutralized and the interiors sealed with sloshing compound.

The tanks are inset between the body sill and frame with their tops against the three traverse frame members between the jacking points. The traverse frame members are approximately two inches wide by fourteen inches long giving a contact area of 87 square inches. Because of their robust construction and interior baffles, the tanks are strong enough to support the weight of the vehicle.

The raw material for the fuel tanks cost about $60, the shearing and bending, done at a shop experienced with fuel tank fabrication, cost $140. I did all of the welding, fabrication and assembly using exhaust pipe tubing for the inlet fittings, welding the necessary T- and L- fittings. Vent lines in the tank are 7/16" diameter mild steel tubing. Outlets are 1/4" NPT on welding flanges fabricated here in the shop. Total weight of tanks and fittings is about 83 pounds.

While the real purpose of the tanks is yet to be tested I found the ability to fill up in the morning and drive all day to be a convenience. With the stock tank I could seldom go more than 200 miles before the needle would nudge the big ‘E’. Even with the larger 15 gallon tank from the ’72 breadloaf my unrefueled range would have been no more than 400 carefully driven miles. Now, I wait until the gauge sez half-full then lean on the button for eight or nine minutes, bringing the gauge back to three-quarters. To keep track of the transfers, I move a nail from one slot in the dash to another. When I’ve moved the nail four times I’ve transfered between twenty and twenty-five gallons of fuel — and have been driving all day. If I keep the speed under 50 mph I have an unrefueled range of about 1,200 miles.

Sandblasting

Kris,

Repeat after me: (It helps if you face south. No! East! Face east. Ah, hell, face any way you want.)

"Oh God, please make my dick drop off if I ever even THINK of doing this again."

And He will hear you, for God loves each and every Volkswagen. (But as for for you…)

Looks 'orrible, eh? Did I tell you about the time I towed the '67 home with the battery bouncing along underneath by the cables? No? Well, remind me one day.

Okay, sandblasting is a Think Big kind of thing, as in Industrial Grade. Unless your rich aunt just died, forget about setting up to do it yourself (didn't I post something about sandblasting? Or was that Federal office buildings?). You need a Big air compressor, as in five horsepower, 20 cfm, 150 psi. You need a pressure–fed abrasive tank and the hose and the nozzle and about a thousand pounds of sand and three guys to move things around for you because you are trapped inside a space suit sweating like you've never sweated before, peering out at life through a foggy little window while wearing rubber gloves, each of which now contains at least a pint of your bodily fluids along with a cup of grit. You ain't never going to be the man you wuz once you start fooling with sand blasting.

So shop around. And expect to pay. You know those ads in the back of Popular Mechanics that say 'Learn Electronics at Home!' or "Be Your Own Boss!" Can you EVER remember one that said "Learn Sandblasting in your spare time!" No, you can't, can you. Cuz you gotta be NUTS to be a sandblaster. But they aren't so crazy as to do it for free. There's a local welding shop that will blast a bug chassis for $100 if the thing is delivered on a trailer. They dangle it from a fork lift, flip it around. But they only do it when work is slow. Also check rental outfits; some are crazy enough to rent big compressors (they tow like a trailer) with a built–in sandblasting rig. And some sandblasters are mobile; they'll come to you. Get the yellow pages, start checking.

How about this: Cut out the pans and do the new ones. Crawl all over the chassis cutting and repairing. ('You are definitely gonna learn to weld, Boy!') Ditto for the body. When it is reasonable straight/complete, pull the body, get a VW tow–bar and take the chassis to the sandblaster place. Pull the wheels and bag everything you don't want totally destroyed. Have your painting stuff all laid out back at the house. Tow it home and get a coat of anti–corrosive primer on it before the sun sets. If you think it's rusty now, you ain't seen nothing! That puppy is going to do some World–Class rusting it has been sandblasted. (Sandblasting increases the surface area by a factor of at least 10. The more the surface, the faster the chemical reaction.)

The body is a different problem because the damn thing is so remarkably fragile. But it's possible to do a body–off restoration without resorting to sandblasting the body through a combination of cut & replace, chemicals, disk sanders and elbow grease.

I've Been There, Did That not only with veedubs but with a 1940 Plymouth pickup and a number of other rare/restorable machines. Which is why I HATE that Gee Whiz, Quick & Easy attitude taken by the VW–specific magazines. It is horribly misleading, a serious disservice to veedub owners.

But before we talk about sandblasting, tell me about the brakes. I've still got you two–blocked in the garage with your wheels glued to the deck. And the steering wheel; what happened with that? Here I am, groping around in the dark while you're out there having all that fun!

(Are you sure I haven't posted something about sandblasting? Sure has a familiar ring. But then, I've spent a lot of time sandblasting. [It makes you go deaf. Didn't I mention that? Or the part about no babies?])

I'm working on a couple of sermons, a little different from the others.

One bit of advice: Slow down. Rust is tricky, it will hide things from you. Scrape, brush, poke and then think about it before you reach for the Sawzall. Once it's cut, it's outta there. And the thing is liable to collapse in the middle.

Steering Wheel

Pry up the button in the middle of the steering wheel (little button on early, big on late, whole damn center pad thingee on latest).

Disconnect the wire. (It's hot; pull the battery or disconnect the hot lead at the horn.)

USING A PULLER, remove the steering wheel.

One of those little bar–type pullers works fine but you'll need metric bolts to match the threaded holes in the steering wheel. No threaded holes? Then you'll have to make them. Or use a bearing separator..

A bearing separator is a flat plate with a hole in it, split down the middle, fitted with nuts and bolts to fasten the plate together around a shaft. The inner edges of the hole are usually rather sharp to fit between gears in a gear stack, or under a bearing on a shaft. It will work pulling the steering wheel on an early bus but I don't know if it will do for a bug because of the bezel and turn–signal; I've never used one that way. I prefer to drill, tap and use a regular steering wheel puller.

The steering wheel hub is made of an aluminum alloy, not all that strong; it won't take a fine thread. Drill two holes, one on each side of the hub right up against the wall of the horn–ring well. Use a #7 bit (13/64" if you ain't got a full set of drills) Figure out how deep you can go; you want it as deep as you can without messing up the underside of the wheel. Mark your bit with masking tape as a depth gauge; drill a straight hole. Thread it 1/4–20. Use both plug and bottoming taps if you've got them; you want as many threads as you can get. Keep them straight to the bore and well formed; use a lubricant and back your tap out and clean it frequently, running it back in as gently as you can (it will make the threads oversize if you run it in & out too much). Flush the threaded bore clean when you're done; get all the chips out. Don't use compressed air, the crap will fly all over the shop and you're liable to get a chip in your eye.

The puller you want to use is usually called a Steering Wheel Puller. The body of the puller is a metal bar, usually about 1" square by four or five inches long. Each end of the puller bar will have a slot about 5/16" wide to accept the puller bolts. The center will have a big husky bolt with some sort of bearing on the end that goes against the steering wheel shaft; the nut will turn against the bearing; the steering wheel will remain motionless. Select a pair of Grade 3 or better 1/4"x20tpi bolts (Your puller may have come with some. If so, use a tap to match; use the puller bolts; they will be Grade 5 or better. If you don't have high–strength bolts, don't worry; but if it doesn't come free easily, consider getting some). Thread one of the bolts into one of your newly threaded holes, as deep as it will go. Put a stack of washers on the bolt first. Then position the puller and thread–in the second bolt, with an equal stack of washers. Take up the slack by hand; insure everything is straight and properly placed before using a wrench. If one bolt is a bit high, raise the other to match; you must have an EVEN pull. (Push the wire down into the hole; you can fish it out later.)

This is one time where heat and/or hammering will work against you. But if it seems to be really hung up, try tapping on the center–bolt of the puller. Use a small hammer, light taps. Often times, if you soak the splines with Liquid Wrench, tap a little on the center–bolt when the thing is under tension, it pops loose. I had one, left out in the weather x–many years, took for ever to come loose. But it did.

The problem is, the hub is an aluminum alloy (probably Kirkzite or some damn European thing) but the splined shaft is steel; they LOVE to stick together. Be patient; trust your tools. The thing has had forty years of married life, don't be upset if it takes a couple of days to process the divorce.

If you've had to go out and buy a puller, don't feel badly about it. Pullers are a factor in a mechanics life; you'll need the thing again. But even for a single job, it pays to get a good one. Don't buy the first thing you see; shop around; there's a lot of crap out there nowadays and a bad puller can ruin the steering wheel shaft (take care of those threads). I'm using my dad's puller; my grandsons will use it when I'm gone. It has my dad's name on one side, mine on the other. One day it will have other names; it is a well made tool that probably cost all of a dollar in the late 1930's. There are other such things around the shop, each carefully cared for but used when needed; they aren't curios. (And neither am I; all good mechanics have good tools, many with a history, carefully kept.)

Harbor Freight has something that will probably do the job for $13 (p/n 00638–4AGA); look it up in their catalog, keep it in mind as you shop locally; order it if you can't find anything locally. Patience pays a nice dividend.

The Haynes book is better at telling you how–to than the Bentley. (Indeed, the Haynes manual [their #159] is better at most things than the Bentley book(s) [Haynes uses one manual to cover all models, 1954 thru 1979; definitely a good buy when compared to the cost of the Bentley manuals it replaces]). Although when it comes down to it, neither one of them is worth a damn if you don't have some experience with things like pullers and tapping threaded holes. (Of course, if they spelled out everything the manual wouldn't fit in a truck!)

Tune Up Your Lights

What is the deal with these light bulbs. Half the time I think they're burned out, but when I go to change them, the second I touch one it pops on. Has anyone given any thought as to how to keep these things in there tight.

Derrick,

Most VW light sockets use springs to provide tension for the electrical contact with the lamp. I don't know if this is true for your '72 Kombi but thirty year old springs are the cause of poor electrical contact with a lot of early buses.

Another common problem with antique Volkswagens is that the electrical contacts become oxidized, offer a very high resistance.

There are two common methods of dealing with these problems. The first is to make yourself a burnishing stick. The other is to re-solder your bulbs, even new ones.

A burnishing stick is a high-tech device consisting of a short length of dowel-rod about half an inch in diameter with a matching pad of fine carborundum paper glued to the end. You want really fine paper for this —#600 is about right. And a good bond — you don't want the thing coming off. I make them by putting a dot of epoxy cement on the back of the paper, proping the dowel upright in the pool of epoxy and leaving it. Overnight is good. When I think of it again, I trim away the paper then grind the fillet of epoxy flush to the diameter of the dowel with a file. You end up with a stick with a pad of carborundum paper glued on the end.

To use the thing, poke it in the socket and twist it around a few times. Like I said, it's a pretty high-tech device. And that's just the Standard Model.

For the DeLux Model you use rubber cement and a section of old inner tube. You glue the paper to the inner tube then use a 1/2" diameter hollow punch to punch out little biscuits of rubber-backed emery paper, using epoxy or rubber cement to fasten the biscuit to your dowel rod.

Now you have a Compliant Burnisher, which does a nice job of polishing the convex surface of the electrical sockets.

Soldering your bulbs is attacking the problem from the other direction.

Look at the bottom of an automotive light-bulb. See that dot of gray metal?

That's solder. Solder is an alloy of tin and lead. It is very soft. Brass, such as an electrical contact, is harder than solder. If you press a brass contact against a solder contact the solder will flatten out.

Oxidization will occur when ever oxygen can get at something. For electrical contacts you want a gas-tight junction. If the soldered contact flattens out the tension will be lessened and both the soldered contact and the brass contact will become oxidized over time.

But the basic problem with tail-lights and so forth is usually the slow decline of spring tension. To partially offset that decline we can make the soldered contact a little bit higher. Soldering also flushes away the oxidized surface, leaving you with a bright, low resistance contact. You can't burnish a soldered contact — it's too soft. You just wipe away the solder. That gives you a clean surface but also a lower one — you end up making the problem worse.

So get out your soldering iron and add a drop of solder to the contact(s) on the lamp. Do the ground, too (that dot of solder up near the bulb). Can't hurt.

Hard to hold and solder at the same time, eh? So use a lump of modeling clay. Plug the glass bulb into the clay. Now the bulb will stand up and you can do the soldering.

Finally, the third most common problem with your lights isn't a lighting problem at all, it's a grounding problem. This is most often evident in relation to early bus tail-light fixtures but it applies to all of your exterior lights.

Find the grounding circuit. Renew it, making up new leads as necessary, with new connectors. Crimp AND solder all connectors. Burnish any spade lugs. Adding additional ground leads is a good idea. If you have a lead that is grounded to the body with a screw or bolt, burnish the area of contact and re-assemble the thing using internally toothed washers and a dab of copper-based anti-sieze compound. The copper insures a good electrical contact while the grease protects the bare metal from corrosion.

And I mean find ALL of the grounding circuits — including the braided grounding strap from your tranny to the frame. Poor grounding is the cause of a host of electrical problems and the fault is usually found at the grounding strap. A new grounding strap is cheap insurance. Most ham radio operators who work mobile have two or three grounding straps, plus a good copper ground from the alternator to the battery. (In my bus I run a #6 grounding lead from the battery to the cockpit, giving my headlights a better chance to do their job.)

That'll be fifty bucks, please. (What do you mean, too high? I just fixed all your lights didn't I? Cheeeez.... some people. :-)

Urethane Foam

Many thanks for insulation info. A quick question. Where do I get this foam (do you know any brand names) and exactly what is it called. I have noticed several different types, some expanding and some not. Also they all seem very expensive. One large can costs about $6 and does not seem to fill very much space...

David,

In small quantities the foam IS expensive. The spray-on stuff will probably cost you about half a buck a square foot for a 1" thick deposition.

Harbor Freight sold the spary-on stuff in two-bottle kits but no longer carry it. I'm digging for a new source and not having much luck. The stuff they sold was from Taiwan and used CFC's for the propellant, illegally, apparently. Hobby shops usually carry two-part urethane foam in pints & quarts. You either mix & pour, or paint on one, spray-on the other using something like a Windex bottle. Model railroaders use it for building mountains and the like.

I use different brands of the canned stuff. 'Foam Sealant' is a low-expansion formulation from 'MD Corp' [Macklanburg-Duncan, Okie City], 'Touch-n'Foam' is high-expansion stuff made by 'Convenience Products Inc' [St Louis]. The R-factor of the foam as an insulator and its strength as a structural component is a function of its density, which can vary from a low of about 22 pounds per cubic foot, about the same as pine, to a high of about six pounds per cubic foot, a bit lighter than the lightest balsawood or cork.

I stated that rather poorly — high-density foam weighs more, has more structural strength.

I pay about $3.50 for a 12 oz can (Home Depot, Oceanside, CA). That's the high-expansion (low-density) stuff. One can yields about two cubic feet. You can increase the density by spraying the foam with water, causing the surface to cure more rapidly/denser.

'Ideal' insulating formulation results in a density of between 12 and 18 pounds per cubic foot, yielding an R-factor of about 16 per inch of thickness. I don't want to add that much weight that high above the CG of my bus so I'll shoot for about 8 lbs/cu.ft.

The Volkswagen bus is virutally uninuslated. Early models used styrofoam panels 1/2" thick, but they were improperly applied. Later models used less expensive fiberglas, which was also improperly applied. By applying expanding foam directly to the metal you achieve a perfectly insulated capsule, allowing you to use less insulation. Try for as thick a layer as you can get on the ceiling but even half an inch will result in a profound difference.

Expanding urethane foam contains polyurethane isocyanate. Don't eat it and don't let it get on your skin. Water vapor in the air acts as a catalyst and curing agent; the stuff is safe enough once it hardens.

Urethane foam contains fire retardants but will burn like a bitch under the right condtions.

Check your yellow pages for commercial outfits. They use spary-foam on roofs, to insulate refrigeration trucks, ducting and so forth. You should be able to find someone willing to give your masked & prepped van a spritz. Use the canned stuff to get in behind the metal work.

You can do a fair job on the overhead surfaces by squirting the canned stuff onto sheets of waxed paper, pressing it into place, troweling it onto the surface — with your hands but through the waxed paper — and letting it cure. As it cures it will expand. Once cured, peel off the waxed paper. Repeat the process until you've achieved the depth and coverage you want. This is how I did my bug. Took about four cans, a week of spare-time work. (I didn't say it was easy :-) I ended up cutting away a lot of it; it expanded to a greater depth than I wanted, or to the wrong contour. There's a learning curve involved. A messy one. Don't let the stuff get on your hands or clothes; it has many of the properties of crazy glue. Acetone will cut it if it is not fully cured, after that, you're stuck.

I eventually got pretty handy at the waxed-paper bit, putting the paper on a piece of plywood, leaving a good margin, squirting on the foam in a fairly uniform layer, using the plywood to raise the waxed paper into position (it's too floppy to handle otherwise). It sticks, then gravity takes over and it starts to droop away from the ceiling. Thats when you start 'trowling' it and that's why you want to leave a wide margin of waxed paper. Once you get it troweled down to about a 1/2" thick layer, it will hold and you can start another section. But the sections can't be contiguous. Try to do alternating foot-square patches. Let the first batch cure — say, one can's-worth of work. Come back after it has cured, peel off the waxed paper, study what you've done, plan your next batch. I let mine cure overnight but some sections kept expanding for more than a week (!)

Start small. There are a lot of tricks to be learned. And what worked for me might not work for you; experiment.

I 'finished' the surface by sanding it to a uniform curve with a sanding block and #80 paper, a HELL of a job. Wear a mask and goggles, keep a fan blowing and a vacuum handy; that crap gets everywhere. I gave the sanded surface a spritz of white paint; the urethane is inert to most solvents; you can use polyester resin without fear of dissolving the foam.

One advantage of the sanded surface: It is anechoic, soaks up sound like a sponge. (Wizard pun... :-)

Urethane Foam II

The headliner is out, gone away somewhere. Maybe you took it out or maybe the PO got PO'd at it; it's not there any more. If there was rust on the ceiling of your vehicle, you've dealt with it. What you want to do now is insulate the ceiling with something that really works.

Urethane foam works. It's expensive but it makes an incredibly good thermal insulator and does a good job soaking up noise, too.

They make spray-on urethane foam but the most commonly available stuff is the foam sealant you see in hardware stores. It comes out of the nozzle as a sticky string that swells as it hardens. A bead of the stuff the size of a pencil ends up nearly two inches in diameter. The swelling is what makes it such a good sealant. The swelling is caused by gas expanding in the sticky syrup of urethane, and it's those closed cells that make polyurethane foam such a wonderful insulator.

Getting the stuff onto the ceiling causes a big question mark to form over your head, just like in the funny papers. The can must be held upside down for the foam to come out, but held in that position it's impossible to apply the foam to an overhead surface. And even if you could, as soon as it starts to expand, gravity pulls it away from the ceiling. You end up with the gawdawfulest mess since Herc was a stable boy. The method I used isn't much neater but it gets the job done.

I climbed into my '67 bug with a roll of Cut-Rite waxed paper and a couple of cans of foam. I was wearing plastic gloves and I'd spread some newspaper around to catch any mistakes. Shake up the foam and make sure it's warm. The stuff works best between sixty and a hundred degrees, and sticks better to a warm surface than a cold one. Make sure the ceiling is clean and dry. Give it one last precautionary wipe with a paper towel.

Tear the waxed paper into pieces about a foot long. Make yourself a whole stack of them, about ten pieces for each 12 ounce can of foam. Odds are, you paid between six and seven dollars for a can that size (1995 prices) so you can see this isn't a lo-buck operation.

Take a piece of waxed paper in one hand with your hand under the paper like a waiter holding a tray. Squirt a bead of foam onto the paper starting in the middle and spiraling out. Keep the beads about an inch apart with the last beat maybe an inch from the edge of the paper. Move fast, you want a bead about three-quarters of an inch thick. Put the foam can down. Be sure the nozzle rests on the next piece of waxed paper you plan to use.

Using both hands, lift the waxed paper up to the ceiling and stick the foam against the metal. Starting at the middle of the sheet of waxed paper, towel the foam with your hands, filling in the gaps between the beads. When you've got the foam mashed down to about half an inch thick it's stickiness will be enough to keep the thing from falling.

A plastic trowel will give you a more uniform surface. You can make one by cutting up the lid of a coffee can. I used one about four inches wide. Since the foam is soft you don't need much strength to trowel it around. Work the foam out to the edges of the waxed paper then leave it to cure. Sealed between the metal roof and the waxed paper, the foam can take up to a week to fully cure if the weather is cool. Just let it hang there like a pancake gone bad until the stuff is rigid all over when you poke it. In most cases, solar heat will build up inside the closed vehicle causing the foam to cure in about a day.

Keep putting up your foam pancakes, spacing them about one-pancake apart. You'll run out of foam pretty quick and get a crick in your neck from trying to trowel the stuff smooth. Don't worry about the smooth part; urethane foam sands easier than balsa wood.

Come back when the foam is cured and peel off the waxed paper. You'll have the damndest mess you've ever seen. It looks like someone has stuck these killer potato pancakes all over your ceiling, or over part of it, or just 'way back there in the corner if you didn't have the guts to go for the gold.

So get some more foam. And some more waxed paper. And start filling in the gaps between the pancakes.

After you've blown about sixty bucks for foam you'll have a reasonably uniform layer of rigid urethane foam over your entire ceiling. If you're going to re-install the headliner, you're all done with the insulation, no further finishing required. If not exposed to sunlight the foam needs no other protection than its own dense surface.

If you're not going to use a headliner the interior of your vehicle will look a lot better if you sand the foam to a perfectly uniform surface and give it a coat of paint. The best sanding tool is a 1x4 about a foot long with all the edges rounded off, no corners at all. Glue some #80 open-coat sandpaper to the round-cornered block and go to work. But before going to work, dress for it. The dust from sanding urethane foam will go EVERYWHERE. Wear long sleeves with tight cuffs and collar. Wear safety goggles. Not glasses, GOGGLES, that fit tight to your face. Wear a filter mask. Cover everything in the vehicle you don't want coated with sanding dust. Now you can go to work.

The coarse sandpaper cuts through the foam like it isn't there, so be careful. Do a light once-over of the entire surface. That will knock off any high spots and give you some idea of the general contour you're working with. Since the roof curves you'll have to take it into account, doing most of your sanding fore & aft, working side-to-side only near the flatter center of the ceiling.

Your goal is a uniform surface. If you discover any low spots you'll want to fill them with additional layers of foam. Use the original procedure except this time really trowel the foam flat. If the swales aren't too big the foam on either side will allow your trowel to find the proper level. Come back to your sanding after the low spots have cured and start over again.

Insulating your vehicle with cans of foam sealant is the sort of job that you know will get done if you just keep at it. There's no skill required, you're making mud pies. When the mud pies are hard, you rub them with a board. All the rest is mere detail.

What you'll get for your efforts will be a quieter, more comfortable vehicle, one that's warmer in winter and cooler in summer.

Sermonette

When the manufacture of glass fiber was perfected it proved to be an excellent insulator and quickly found its way into refrigerators and around hot water heaters and a thousand other applications that needed to keep something hot or cold. Modern refrigerators and freezers use a thin layer, typically half an inch, of high-density urethane foam. NASA does too, although a thicker layer of the stuff. That's what insulates the space shuttle's external fuel/oxidizer tank, that giant orangeish-brown torpedo with the solid-rocket boosters on the sides. Inside the tank(s) is hydrogen and oxygen, both in their liquid state, more than twice as cold as the coldest Antarctic night. Urethane foam is a good insulator.

Urethane Foam III

Background: I want to spray a 1" layer of rigid urethane foam on Grendel's ceiling, possibly other surfaces as well.

Problem: I couldn't find any spray foam in consumer-sized quantities.

Solution: I kept looking and...

The stuff is called 'Spray N'Fill', brand name is Inst-Foam Products Inc., a division of Flexible Products Co., 1500 Cedarwood Drive, Joliet, Illinois 60435-3187 USA, tel 800-800-3626, local tel. (815) 741-6800.

'Spray N'Fill' is sold by Harbor Freight(!), their item # 31951-1AJA, $19.99, which is nearly $20. That buys you one cubic foot, which you may spray as thin or as thick as you like; the stuff cures instantly. Cured R-factor is R-5.6

What You Get for $20: You get a red cardboard carton about 13" high, 6" wide and 3" thick. They don't want you getting into this carton but the lower four inches are cut away forming a pocket/handle into which is curled a pair of hoses attached to an applicator, plus a couple of plug-in nozzles.

To use the stuff you plug one of the nozzles into the applicator, turn the carton upside down, pull firmly on a rip-cord and fit the pulled cord into a slot so it stays 'pulled'. What you've just done is compress the valves of the two spray-cans inside the carton. The upside-down position puts the valves downward and the HCFC propellant in the cans forces the two liquids through independent hoses to the nozzle you've plugged into the applicator. The nozzle contains a mixing chamber where the two liquids are swirled together and a spray-nozzle where the mixed urethane foam spews out all over everything, hopefully by design. But for the unwary, the applicator is fitted with a caming valve that will pinch-off the tubes if you twist the valve strongly enough, shutting off the flow of liquid to the mixing chamber.

One of the liquids is white, the other brown. When they encounter each other in the mixing chamber they combine to form a fast-curing, high-density urethane foam. If you hold the applicator about a foot from a surface, the foam will spray onto it just a fraction of a second before it becomes fully cured, long enough for the droplets to weld themselves into an homogenous mass and bingo! You're in the spray-foam business.

Is It Worth It?

I don't know; too early to tell. At about two bucks a square foot it's certainly one of the more expensive forms of insulation but it is quick, relatively easy to apply and has a good R-factor. Plus it is an ‘all-position’ kind of stuff, just as happy clinging to a ceiling as a floor.

I can see a lot of negatives to Spray N’Fill but some of its positive aspects are unique, things you can’t do with any other form of urethane insulation.

I’ve a hunch Grendel’s insulation will consist of several different forms of urethane foam, with Spray N’Fill reserved for areas such as the overhead, that don’t lend themselves to regular canned foam or the rigid stuff. And the use of urethane alone isn’t carved in stone, I’ll be using other insulators as well.

I’ll keep the list informed of my experiments and use of spray foam but I hope others will give the stuff a try since a single opinion is hardly a fair evaluation.

Wire Through the Body

What is the best way to pass a wire throught the body for lighting, antenna wires, etc.? I'm inclined to drill a hole and glue the wire in place with silicone, but there must be a more elegant and leak free solution.

Ken,

There's a bit of a trick here.

The trick is that whatever passes through the shell of the body — and is supposedly isolated by some form of elastomeric fitting — grommet, self-formed RTV plut or what-have-you — the wire MUST be prevented from moving... you must secure it to the body or chassis as close to the penetration as possible. This usually means drilling ANOTHER hole, one suitable for a #6 or #8 machine screw.

The reason for fastenting the thing down is pretty simple — if it can move it will either break or cause the failure of the grommet.

I like to run the wire thru a short length of dead soft tubing, run the tubing thru the penetration, bend the tubing to conform to the body at that point then secure with a clamp on either side — you can use the same drilling for both clamps (ie, the hole for the #8 machine screw). The penetration is usually sealed with black GE silicon RTV, the big tubes of the stuff from the hardware store — I've found it holds up better than other brands and has a longer shelf-life — one tube will last just about forever.

But this fails to address a rather important point. If you're talking fog lamps and such there are several UNUSED penetrations present in your body-work. Some are obscured by plugs or perhaps filled with debris but a close search will usually reveal them.

If you need to penetrate the roof, just do a good job of it. Debur the drilled hole(s) really well and sand both sides — treat it like a critical repair. Build up several coats of primer around the drilled hole(s), wet-sand to restore the contour, spray with your color coat, allow to cure and then rub it out. It will look as if the hole was MEANT to be there. Now you can install your grommets or what-have-you.

Making a hole in the body-work isn't always a good idea but if you have to make one, do it — just do a good job of it, insuring it will never rust. The next guy may want to weld it up. (Welding-up such a hole is a snap: Sand back to bare metal, back the hole with a copper block and hit with the migger, making a roseatte-weld. Grind smooth and treat as with any body repair.)

A word of caution: Most of the campers, sunroofs and convertibles I've ever seen — regardless of model — have rusted from the inside-out.

We generally don't think of a hole for a wire as converting the vehicle into a convertible but in fact we've just done the same thing — allowed a direct path for water to get inside.

ESSAYS & ODYSSIES

Essays

Madam Meeyamo
Mind Your Business
MurMuirs of Reality
Neighbors
Neighbors II
On-board Spares
Pilot Error
Positive Things & Buses
Road Trip From Hell
Science Fiction
Stainless Steel Craftsman
The American Way
The Flying Pig
The Forever Car
The Glowing Letter
Those Damn Brakes
Ultimate Heater
Under the Bus
VW "Quality"
Wage Deflation

Odyssies

Rincon Rocket
The Big Sur Run
The Inuvik Run
The KC Run
The Tehachapi Run
The Grendel Files

Paint Jobs

The thing that's always bothered me about my paint jobs is the brush marks. By the time you get them all rubbed out you're just about down to bare metal again. And don't talke to me about spray-paint, I tried it. Don't work. The nozzle clogs up about once a minute and your arm gets tired of pumping before you got the job half done. Besides, nowadays you can't hardy find a good fly-sprayer, everybody using those spritz cans. Oh, I tried them too but don't see the sense of it. Soon as you get the top off the stuff gets all over you.

Sponges. That's the ticket. I don't know why I didn't think of it sooner.

The Home Dee Pot store had a sale on sponges, big square-edged things; I guess they can grow them any shape they want nowadays. Buck each. I bought two. Stopped by the Paint Dee Partment and bought a gallon of their best stuff, the can with that little Dutch boy on it. Eighteen whole dollars for just the one can. But it's guaranteed for twenty years or you can bring it back, get another can. Cleans up with water, too.

Took it home and painted the pick-up, the wife's Ford and my old beetle-bus, all before supper. Went back out while the wife was doing the dishes and used a razor blade to clean up around the windows.

Fine job, mighty fine. Can't hardly even see the rust anymore, 'cept for the holes. Soon as I fix the ladder I'll do the high parts. Just wait 'til the wife sees her little Ford, big smile for sure.

Alternative Fuels

When discussing alternative fuels the questions asked make it clear the majority expect such fuels to be very similar to gasoline in their convenience and energy content. The truth is, the only 'alternatives' which meet that criteria are themselves derived from petroleum... with one exception: Diesel-powered vehicles burning vegetable oils.

When it comes to personal transportation, Americans come equipped with a set of automatic blinders, expecting any alternative fuel, vehicle or what-have-you — to provide about the same speed, comfort and conveniece we presently enjoy and to provide it at nearly the same cost. This basic assumption is extremely unlikely. Indeed, it is illogical, given the rules of economics and existing governmental regulations regarding automotive safety.

The seminal work on gasoline-powered internal combustion engines as a motive force for personal transportation dates from the mid-1880's. From that time to this, all of the 'alternatives' presently touted by various special interest groups including the environmentalists, have been extensively explored, with the majority of the work being fully developed and mature by about 1905(!).

Each time there is a technological advance the body of information covering personal transportation is re-examined by persons hoping to become rich by applying that technological advance to the field of personal transportation. These people dream of becoming another Henry Ford but two facts argue against such sudden success. The first is that all of the existing automobile makers are doing exactly the same thing, hoping to improve their product by incorporating the new technology. This is what saw turbine powered cars and trucks on the streets of San Francisco in the late 1950's, being tested there by Chrysler Corporation. It is also what sustains the billion-dollar research facilities maintained by the major auto makers.

The second fact arguing against a revolutionary change in personal transportation is more subtle. As a nation we have become accustomed to a certain standard of service, conveniece and comfort. We want our cars to be warm and quiet, with a good stereo system — and lots of cup holders. We want an automatic transmission and an engine we don't have to think about. These are the blinders we all wear when it comes to personal transportation. (People who drive old Volkswagens fall into a different catagory of course. Indeed, the fact we, as drivers of automobiles, are even discussing the question of alternative fuels IN THE PRACTICAL SENSE sets us well outside the mainstream of American thought.)

But we are human. If an alternative fuel — or a completely new source of power — can not provide us with what we have become accustomed to, it stands little chance of commercial success. This fundamental fact has been proven time and again.

The proof of this may be seen in realistic, practical, down-and-dirty alternatives to what we have today. Shut off the gasoline and within ten days I would be chugging around town, my '67 VW beetle powered by wood, a huge bellows on the roof to hold the combustible gas derived from burning wood in a small oven on the back bumper. It would be horribly inconvenient — compared to gasoline — with very limited range and not much power, but wood-burners are proven technology (they used them extensively in Europe during World War II) and not too difficult to build.

Alcohol would not be practical because of the cost and the economic realities of modern day agriculture, which is dependent on the petroleum industry for the high yield and low manpower typical in American agribusiness. Without gasoline, or petroleum derived fertilizers, our crop yield would plunge. There would be no surplus grain for export — or for conversion to ethyl ethanol. We would be forced to use wood alcohol — methyl methanol, which is as unpleasent a stuff as man has ever invented.

Burining wood DIRECTLY, either to use the gases produced for internal combustion, or in a steam-powered EXTERNAL combustion engine provides remarkable fuel efficiency when compared to the wood-derived alternatives. In effect, you cut out the alcohol-brewing middleman. But here again, when it comes to personal transportation you would not have the comfort and convenience we presently enjoy. And while we would eliminate the various oxides of nitrogen that are a by-product of fossil-fueled internal combustion engines, pollution would still be with us. Non-gasoline based pollution would simply take different forms — those resulting from the burning of wood (or other vegetable matter), the production and combustion of alcohol, and so forth.

There is considerable humor in anything having to do with pollution and the environment. The most practical form of personal transportation is the bicycle yet a majority of people who call themselves 'environmentalists' drive cars. They think about bikes... and talk bikes... but they drive cars. Such hypocracy is not their fault, of course. You and I are to blame; we force them to drive cars because of our insensitivity toward our planet. And there is more than a grain of truth in that.

The motorcycle is a good middle-ground alternative for personal transportation. In fact, simply thinking smaller is all that would be needed to drastically reduce the problem of pollution. Cars having engines of 500cc or less — about 30 cubic inches — are presently EXEMPT from California's smog laws, the most stringent in the nation. And the idea of a car with such a small engine is not as silly as you may think. Fiat built millions of the things and they drove quite well, thank you :-) Of course, they are tiny things and the stereo sounds tinny and there isn't a cup-holder to be seen... (On the other hand, they would be very cheap to build... until you tried to meet the present safety standards. And of course, there is very little profit margin in building small, inexpensive cars. This latter reason alone is enough to squelch any hope of seeing small, efficient cars on American roads — the politicians and the automakers simply won't allow it. What's good for General Motors is good for America... at least, according to General Motors.)

The bottom line is that if you are serious about the elimination of pollution you must be prepared to make radical changes in your life-style and in the existing structure of our nation's economic base. And when it comes right down to it — when the scope of the required changes is understood — the overhwhelming majority of Americans opt to do... nothing at all, other than continue doing what they have done before.

B–29's & Large Engines

I would have a good guess that Bob Hoover might have some interest and insight on these engines.

.. which was like waving a yellow flag at a gorilla.

The B–29 was fitted with the Turbo–compound R–3350, a twin–row radial engine fitted with three supercharger turbines linked to the propellor shaft thru hydrualic clutches, hence the 'compound' part of the name. The turbines drove the surpercharger compressors but also fed otherwise unrecoverable energy from the exhaust gases to the prop.

3,350 cubic inches was only a taste of things to come. The B–50 and B–36 were fitted with the four–row, 28 cylinder R–4360, rated at 3,500 horsepower. Most of the 4360's were normally asperated, the turbo–compounding development never being carried forward due to Pratt–Whitney's growing involvement in jet engine production.

Despite its enormous size and complexity — just changing the plugs was a two–man job — the 4360 was a reliable powerplant with a recommended overhaul period of 1,500 hours. By comparison, a modern jet engine capable of producing the equivalent of 30,000 horsepower has an 'open' overhaul period, determined by analysis of the lubricating oil to detect markers infused into the bearing material. Such engines often provide 10,000 hours of service between overhauls. The typical VW engine is lucky to survive 2,000 hours of automotive service, most requiring major overhaul after 800 to 1,500 hours.

The forbears of the R–3350 are older than those of the aircooled Volkswagens. The first Pratt–Whitney engine barked to life in 1929, three years before Professor Porsche fired up the boxer–based four–banger that would become the powerplant of the People's Car.

There is magic in every engine.

Auto Mechanics 101

I'm over at Pacific Bugs and there's a bunch of kids wetting themselves around this bitchin' sano lowered '68 bus, the one with no hatch on the engine compartment so everyone can admire the chrome. Chrome everything. The kid has even chromed the wires.

I go in, get the gaskets I came for, come out. The kid who owns the bus is explaining the facts of engineering reality to his loyal subjects. "No, see, you don't need that spring because the distributor is only turning at one–fourth engine speed."

"Wrong."

Stunned silence. Their Master has been Challanged. And by some greasy ol' geezer driving a Toyota, yet.

I shoulda kept my mouth shut but American kids are already too dumb to pour piss out of a boot. On the other hand, ignorance is bliss. And the more veedubs the kiddies screw up, the more business for me. I open the door of the truck, start to climb in.

"Excuse me, sir," very snotty. "But the air–cooled Volkswagen engine is a four–stroke engine," the Master Mechanic sez, real cool, little grin. "And the distributor turns at…"

I sigh, shake my head. "Wrong again. Four cycle, not four stroke. Two strokes, four cycles. And the distributor turns at half engine speed, not a quarter. Go count the teeth on the gears."

Confusion ripples across a half–dozen pimply faces. Gears? Teeth? I climb into the truck, fire it up, back out. "And you need the little spring because I say you do, so put the sonofabitch back in." Hard stare at the Master Mechanic. He blinks and I drive off. The kids gape after me.

I've no idea what spring he was talking about. Being omnipotent isn't as easy as it looks.

Baja Firewood Kit

The following is prompted by a private message.

A Baja Firewood Kit consists of the following: A pair of heavy leather gloves. Heavy as in thick — the kind used to handle hot steel. Plus a piece of light line about eight feet long.

Make the length of line into a loop and fasten the ends with a square knot. This is what you carry your firewood in.

Go looking for firewood. It will be laying on the ground. Most of it isn't much larger than twigs. It will have thorns — hence the gloves. As you collect each piece, tap it on the ground — gets rid of hitch-hikers. When you have a handful, put it into your rope sling, passing the loop through itself and grasping it where it draws up on the bundle.

Keep looking. When your bundle is about two feet in diameter, head back toward camp, still looking.

When you have a bundle about three feet in diameter you'll run out of rope —you're all done.

This sort of firewood is often called 'squaw wood' meaning stuff anyone can pick up — no ax needed. The stuff burns up fast. To learn to live with this kind of fuel-source you have to break the bon-fire habit — keep your fire no bigger than a frying pan. The usual routine is to dig a little trench, curb it with a couple of rocks to hold your grill or pan, keep the fire — a small one — in the trench. This is a cooking fire, not a TV-Boyscout-Who's got the weanies kind of fire. Move it away from the camp. There won't be any coals to speak of. You have to tend this kind of fire constantly, feeding it a twig at a time. If you plan on keeping yourself fed, learn to use a Dutch oven — you build a second small fire on TOP of the oven. You can cook up rabbit, quail, snake and so on in about half an hour — and use up nearly all of a three-foot bundle of brush.

On the Pacific beaches you can usually find driftwood but you'll still need twigs and small stuff for kindling. A bow-saw is generally handier than an ax when it comes to collecting real firewood. (An ax is mostly for splitting or notching. Saws are for felling and cutting-up.)

You generally do your cooking while it's still daylight. You can't prepare a proper meal without proper light. You can cook beans and stews in stages —use up your morning firewood, insulate the Dutch oven and carry it with you — continue cooking it that evening. So long as it's still hot, it's still cooking. Ironing board covers make handy insulators. You want a real thick pad to sit the thing on plus a sort of cap like a tea cozy, big enough to completely cover your Dutch oven or other lided kettle — with the lid fastened down. You can sew the cozy with fiberglas thread or even safety-wire — it doesn't have to be pretty to work.

People often overlook beans as camping fare because they take so long to cook. Fact is, beans don't take as long to cook as people think. The secret is to not cook too many at one time, and to soak them good — right up to the point of sprouting — before cooking.

While it's best to do your cooking during daylight, once it's cooked you can heat it up after dark — just wait for it to start smoking. ("What's that funny smell?" "Supper.")

And if all this sounds ridiculously labor-intensive, it is. Get yourself a Coleman or Primus. Do your cooking standing up.

We should be able to find some roasting ears, either down toward the cape or when we come thru the Magdalena plains around Villa Insurgentes. Fresh corn goes great with fresh fish.

Camping, Tents, Baja and Buses

I don't use a tent when I knock around down in Baja, not that it doesn't get cold and sometimes, rarely, there are reports of rain. (I've seen rain in Baja, but only from a distance.)

Standard Baja camping equipment is two tarps and four metal poles; metal, because if you use wooden ones some damn fool will put them in the fire. Lotsa rope; rope is very handy stuff in Baja.

You use one tarp as a shade. The only tree in Baja is in front of the mission at San Ignacio and they don't like you to camp there. So you tie one side of the tarp to the roof rack and prop up the other side with your metal poles, lash everything down with rope. Use bridge spikes as stakes to secure the rope. Bridge spikes are those humungous nails you've seen at Home Depot (and wondered what they were for). Now you know. Bridge spikes are Baja tent pegs. (Because you can't drive a wooden tent peg into the ground anywhere south of Maneadero. And some damn fool will put them in the fire.)

You use the other tarp as a ground cloth. That's where you sleep, on the ground cloth. Under the shade. (Down in Baja it's even sunny at night.) You set up your table on the ground cloth, and your cot, and your Coleman stove. Leave the porta–potti in the bus, along with the icebox. And the magazines. Put the shotgun near the Coleman stove, down by the propane bottle.

In Baja you fish; that's why it's there. You don't shoot; guns are illegal everywhere in Baja except in Tijuana and then only at night in the downtown section. Everywhere else you gotta use a machette. But a machette or even a pistol is no good against flies, least ways not against Baja flies. Oh, I used to use a pistol on them; most guys start out with a pistol. But if you don't hit them suckers square you won't kill them. And a wounded fly will get madder than hell. So use a shotgun. I know; it's not a sure–thing either, but it will knock them down, give you a chance to go after it with your machette. Once you got the wings off them suckers you can get in close, finish them off with your pistol.

It takes about thirty minutes to set up camp in Baja, unless you've got women along. It takes longer with women along; give yourself lots of time. Set up camp, take a stand, knock down the Boss Fly to let the others know you mean business, then go fishing.

Women always want you to bring a tent along. And extra clothes; stuff like that. Truth is, you don't need that much in Baja; the fish don't give a damn what you got on. But woman are handy things to have around, especially in

Baja, what with all that gutting and cooking to do. So mebbe you'd better plan on a tent. And wearing clothes.

If you've got a VW bus you can get one of those nifty little tents that hooks on to the spray rails, sets up quick as bunny, lets you get the boat in the water that much sooner. But they're hard to find; you might have to make one.

Here in southern California they've got these fabric supermarkets, big as a football field; sells nothing but fabric. Sailcloth. Upholstery stuff. Foam. Dacron for airplane wings; every sort of fabric you can think of and all the gee–gaws to go with it. Go down there and get you a buncha' tent–fabric, take it to an upholstery shop. Or a sail loft. Hell, mebbe they even got tent shops; check the yellow pages. The fabric will cost more than the sewing and he'll need a pattern. I'll leave the pattern up to you; mebbe you could ask a woman, they mess with patterns. If your wife is handy that way, mebbe you could just take the tent fabric along the next time you go to Baja; give her something to do while you're out fishing; let her run up her own tent.

Cars & Houses

I recently received a disquieting sort of flame from a young man whose situation is very similar to my own in that he drives an old Volkswagen simply because it is the only vehicle he can afford. One of my articles had apparently stepped upon his toes, of which I imagine he has twelve or so but the basic content of his message was clear: In modern–day Ami–Rica he can afford neither a new car nor a home of his own. That was me, about thirty years ago.

I can not add to the young man's store of native wit, in which he is obviously deficient, but I could probably teach him how to build a house and would be willing to do so if he would but moderate his tone. That offer is not a sign of my nobility — having enjoyed the kid's comments I wouldn't bother to pee on him if his hair was on fire. But he's a symptom of a greater ill and in showing him how to build a house I am attacking that ill.

Want to own your own home? Buy some land, live in a trailer while you build your home. Building houses is really rather simple and that is not an idle statement — It is easier for an individual to build a house than to manufacture a car. Fewer skills must be learned and most are more easily mastered than those needed to perform a successful engine overhaul.

But I suspect young Americans would rather rant than learn, rather hide behind their consoles and vent their spleen anonymously rather than sweat or plan or change the way the country works. Ranting is safe. You will remain a wage–slave all your life and leave no legacy worthy of the name but it saves you all that unpleasant sweating and labor and thinking and having to face up to reality: If you don't like the way things are, change them.

CB Radios

CB radios are handy when running in convoy anywhere south of the line. They are also illegal or subject to various restrictions. Despite that, everyone uses them.

The best CB for use in Baja is the cheapest piece of crap that works, with a mag-mount antenna and a power lead that pokes into the cigarette lighter socket. You take off the mag mount when you're not using the thing, reach out the window and slap it on if you need it. Cheaper is better because some police decide they need the illegal things more than you; if you've got an ultra-expensive SSB Cobra with an illegal linear amp, the more they will lust after 'confiscating' the thing; cheap crappola rates little more than a passing snear. (Look for cheap rigs at garage sales and flea markets; five bucks is about right.)

But the thing that makes a CB useful runs counter to conventional wisdom: Don't use the radio. Zero chatter. No happy-talk. Leave it on Channel 9 and then LEAVE IT ALONE, unless someone starts shooting at you or the flames have finally reached the cockpit or you see a sign advertising cold beer at one peso a liter. Because surer than hell, if you use it like a toy there won't be anyone listening when you really got a problem.

If you're bright enough to come in out of the rain you can sit down and take the no-code ham radio test and get a Cheater's License (REAL hams all speak Morse). This will allow you to use some very sophisticated VHF equipment. With a Mexican ham radio permit in your wallet the cops give you a little salute, a nervous smile and leave your equipment strictly alone, even if it includes a kerosene powered Death Ray mounted on the roof of your van. But the ham stuff is expensive, and when running in a convoy in the remote regions of Baja you rarely need the benefits of static-free FM or the extended range provided by ham gear. (I once wiled away the muggy miles between Mulege and Loreto chatting another desert traveler. In Australia. [Thanks to the globe-girdling capabilities of the Amateur Radio Service.])

Travel in Baja isn't all that dangerous but it doesn't hurt to skew the odds in your favor. CB does the job at minimum cost (and makes prime trading goods under certain circumstances).

Chasing Speed

[The first sentence or so of this article does not seem to have survived anywhere. -KH]

thern California. The thermometer on the wall of the shop read 78. The one in the patio, 80. Those two thermometers never agree on anything.

I had to run all over doing errands and chasing down a part needed for an engine I'm building. Drove the thirty-seven miles into San Diego and another dozen trying to find a place to park only to learn the kewl VW-only place didn't carry what I wanted. What they carried was ''just as good', of course. Except for the fact it's a piece of crap. Drove another dozen miles to another place, they didn't have it either. Wound up back home or at least close to it, at Paradize VW in San Mucus. I don't like to shop there because they have funny ideas about how to price things. They also have a habit of trying to sell you old or damaged parts — "Gee... I never noticed that!" 'That' being the fact the box had been opened and the bearings polished with #36 sandpaper.

While I was waiting to be waited on a couple of kids get in this high-IQ shouting match. You know the kind:

> "Oh yeah?" "Yeah!"
> "Oh yeah?" "Yeah!!"
> "Oh Yeah??!" "Yeah!!!"

I was about to drop-kick their skinny butts out the door when they took it outside, followed by half the patrons in the store. I snagged the salesboy on his way out, got what I needed and left.

The Whiz Kids were having a dispute about their vehicles, both of which were puke-type bugs with big tires, little steering wheels and Kadron carbs sticking out in all directions. I don't know what the dispute was about but it was obviously important since they decided to settle the matter mano e mano, by driving like idiots, making a lot of noise and generally acting like fools, which they proceeded to do.

I caught up to them at the on-ramp to the freeway, onto which they fled in a cloud of smoke. Two clouds, come to think of it.

I caught up to them again as they were racing up the hill toward Mar Vista Drive, neck and neck in the two outside lanes, snarling up traffic as their wild rides ground up the hill. They were doing at least fifty, noses up close to the windscreens. They both wore baseball caps. Had them on backwards so they could get their noses closer to the glass, or something. Makes a bug go faster when you do that, I guess.

Warm day, old bus. You don't want to push it too hard going up a grade. I blew by them doing about sixty-five. Everybody else was doing seventy, mebbe eighty, the way they do. Drive too slow, you'll get a ticket for obstructing traffic. Seriously.

The kids in their respective pieces of crap where still back there, laying a regular smoke screen, struggling up the hill side by side, speed down to about forty-five when I reached my off-ramp.

I drove all over today, chasing parts. One hundred and fourteen miles. Five gallons of gas. Couple of hours of time. I wonder what those kids were chasing, what with their funny tires and all that chrome and no deck lids. It certainly wasn't performance. A stock bug could of eaten them alive.

Funnier Story

Remember me getting all het-up over those crappy bolt-on full-flow filter/pump adaptors that didn't fit?

They're still selling them. No, I'm serious! VW Performance Parts out in La Mesa and that other place, the one in San Mucus. And yes, they know they don't fit.

No, I don't know why they're still trying to sell them either. The thing don't fit and everyone with a lick of sense knows it.

Come to think of it, I know a couple of kids who'll buy the things...

Cheap Parts

(Comments were in response to a flurry of 'Mexico means bad parts' messages that later expanded to include any parts not made in Germany.)

There are thirty million people in the Federal District of Mexico (that means Mexico City). 'Mexico' is actually The United States of Mexico, according to their Constitution. The Federal District is similar in concept to the District of Columbia in the United States… of America.

Mexico City is nearly half a mile higher than Denver's fabled mile–highness. A fifty horsepower bug running on the curious stuff Pemex calls gasoline is lucky to get thirty horses at that altitude. One way to improve the situation is to use parts that weigh less; to build a lighter bug. This is far more difficult than it sounds. Mexican metalurgists worked with Mexican steelmills to produce different alloys. Mexican engineers redesigned the original German tooling to produce the lighter parts while preserving the original appearance, which they all agree is a thing not to be tampered with. They love their bugs as much as we do.

At least half the Volkswagens in Mexico are in Mexico City, mebbe more. Several times a day they all come to the same intersection. At the same time. Every single one of them. (I don't know why, they just do.) Fenders touch gently in the warm Mexican sunshine. The policeman who rules the intersection gets traffic moving again after an appropriate service charge is paid, for that is his job, one he paid a great deal to obtain, exactly as an American senator will pay millions for a job that pays thousands, and for the same reason.

The dimpled bugs are quickly made whole again and the cost is less than the little bite extracted by the policeman, for in Mexico labor and parts are inexpensive by (North) American standards.

Down in Brazil it is a warmish day, the temperature and humidity both standing at one hundred, degrees and percent respectively. An American walks into a Volkswagen dealership in the outskirts of Brazilia and asks for a heat exchanger, the left one please.

There is a hushed conference in hurried Portuguese. The manuals are consulted and sure enough, SOME Volkswagens were actually fitted with a thing called a heat exchanger. The wonder of it all draws a small crowd of customers and workers; a mention of snow is heard. Peru. The Andes. Someone runs to get Santos da Silva, the dealership's oldest and most experienced mechanic. With thirty years of Volkswagen experience Santos da

Silva earns $123.20 per month. He gives a solemn nod. Yes, there are such things as heat exchangers. He has seen them with his own eyes, years ago, when he worked in Argentina. They are for the cold, he explains. The crowd heaves a collective sigh and ponders the mystery of their humble Bugs exchanging heat for cold, a trick they thought only Mercedes could perform.

Although fanciful, the above accounts are not far from the truth. Now come with me to Germany, where a man is having a fender and heat exchanger replaced. The parts are made of heavier gauge steel, battleship quality for maximum durability. And priced accordingly. Even so, the cost of installing the parts will be twice as much as the parts themselves; a German automechanic earns more than a tenured professor of Economics at the University of Mexico.

Sermonette

There is no sermonette; you'll have to figure this one out for yourself.

Christmas Fool

Two weeks ago I took my ’65 bus off the road to replace the tranny, a chore I’ve been putting off for a couple of years. I figured I would have it up & running in five or six days.

Pulled the engine, then the tranny, then started doing ‘little’ chores. Replacing the emergency brake cables, running a new loom of wires for an overhead instrument console, replacing a tie-rod, adjusting the link-pins, doing the rear brakes... and later the front ones. They little jobs had nothing to do with the tranny swap but with the bus in the air and the tools all laid out, it was just too good an opportunity to pass up.

I rebuilt the outboard gear boxes and put everything back together, all nicely painted. Scrubbed the grunge off the underside of the bus and painted most of that before starting to put things back together.

Got the tranny, axles and brakes installed then tore down the engine enough to retorque the heads, do some minor cleaning, check the clutch & end play, add an oil temp sender and another oil pressure sender, the old one having develped a leak.

Plugged the engine back in, turned the vehicle around so I could roll it on level concrete, adjusted the toe-in, fired it up. Horrible! Shut it off.

It sounded like a valve problem. The engine has hydraulic lifters so a little clatter is normal after sitting for two weeks but this — it sounded like there was something loose inside the engine!

Since the problem had not been there before I tore things apart, I went over everything I had done. Part of the engine maintenance was renewing the gaskets on the exhaust system, which involved removing the heat exchangers and muffler. I also replaced the intake manifold with one having a cleaner heat riser. Small things, but a lot of them.

I checked everything, right down to re-doing the valve adjustments. Started it up. Horrible clatter! It sounded like a loose washer on the fan pulley. Or mebbe the alternator. Or mebbee....

The truth is, since the Grendel Episode I’ve lost confidence in my diagnostic abilities. I called Roland Wilhelmy, begged him to lend me his ear. He came by, drove the bus and we worried together. There was definitely something there. Maybe it WAS the alternator. We decided running the engine without the alternator would be a good test so I pulled the fan belt... and found my 8mm box-end wrench laying under the fan pulley. I’d misplaced it when tightening the lead to the alternator. It had been vibrating, occasionally touching the fan pulley, generating a musical ringing.

No excuse for it, other than being a damned fool. But finding that wrench was the nicest kind of Christmas present :-)

Cost per Mile

What does it cost to get from here to there? More than you think.

From a sub–compact's 43.8 cents per mile to the 62.7 cents needed to keep a full–sized sedan on the road, the cost of personal transportation in America is following an ever–rising curve.

Starting back in 1950, the American Automobile Association (AAA) has conducted an annual driving–cost survey. The costs are based on AVERAGE cost of gasoline, oil, mantenance and tires, plus fixed costs for insurance, license & registration, taxes, finance charges and remaining value after the end of four years and forty thousand miles.

Needless to say, the numbers are hopelessly optomistic when compared to the realities of owning a car in California, where the typical driver averages more than 12,000 miles per year. Taxes, smog checks, registration and insurance are also higher than the figures used by the AAA, giving a more realistic 54.6 cents per mile for a subcompact and 77.1 for a full sized sedan in California.

To figure out what your actual costs are, write to the American Automobile Association PO Box 75 1000 AAA Drive Heathrow, Florida 32746–5063 and ask for a free copy of "Your Driving Costs". You'll have to include a stamped, self–addressed letter–sized envelope. If you're a member of the auto club, check with them first. They may have the figures already adjusted for your state and locale.

As a point of interest, my 1965 bus costs about eleven cents per mile per year, based on 12,000 miles traveled. The cost break down is shown below.

Fuel	720.00
Engine overhaul fund	180.00
Insurance	106.00
Tire replacement fund	72.00
Misc. maintenance*	60.00
Oil, filters & lubrication	30.00

*Miscellaneous maintenance includes headlights, lamps, wiper blades, cleaning supplies and so forth.

Since I do my own maintenance, each month I put some money aside for tires and engine overhaul. Brakes and suspension parts are included in the tire fund. Actually, the funds are mixed and budgeted at about $25 per month. Since a properly built engine lasts ten years or more, despite the several brake jobs, valve jobs and new clutches along the way, there's always a tidy sum on hand.

Crazy Idea # 437

Which American–built vans have flat fronts and are approximately the same proportions as a Transporter?

Something by Chevy or GMC would be best because there are probably more of them. The thing should run, or pretend to run, at least well enough for it to be licensed. An older model — something with a conventional power–train — would be a better candidate for what I have in mind than any of the later–model vans. The 'power– pod' front–wheel drive assembly does not lend itself to what I'm thinking of.

What I have in mind is pulling a fiberglas copy of the nose of a splittie, slicing the front skin off the Chevy and giving the thing a face–lift, right thru to the dash and a few interior details.

Would it be an authentic copy of a splittie? I doubt it. Odds are, the dimensions would be off. You'd need to do a bit of sculpting in the mold to get a smooth VW–esque interface between the splittie–style nose–skin and the Detroit–stamped body shape.

But could it be done? A definite Yes! And would it look the same? Well… maybe. At a distance.

Why bother? Because we're running out of splitties, for one thing, although we're going to run out of loafs a lot quicker than anyone realizes. The late–model loafs are going to go because the engine is an orphan. The '68's thru '71's will hang in there because the basic elements of their power–train is still being manufactured — you can keep them running. Early splitties are already running into parts–availability problems with brake drums and reduction box gearing. As the pool of available parts is used up their prices will skyrocket. Bus owners may be handy with a wrench but damn few of us can turn out a hypoid pinion gear.

So why bother? I suppose the only valid reason is too keep alive the spirit if not the soul.

What would something like that cost? Probably a lot more than you think. Basically, it calls for re–engineering the nose of the vehicle, using a composite skin to replace the steel.

Preserving the early–bus look & feel isn't too difficult — we can steal the basic shape simply by pulling a mold from the nose of an existing bus. Then comes the Hat Trick — marrying the skin to the Detroit foundation — and pulling a second mold from that. But the second mold is only a transitional step. The second mold would be the tool used to create the final shape from which a third — and final — mold would be pulled. If the final mold were fabricated from composites rather than plaster, it would be good for up to a thousand copies, plaster is good for maybe twenty–five before the cost of the patches outweighs the cost of making a new mold.

Once you have a properly engineered skin, doing a nose–job is fairly simple. Using proven composite–to–steel bonding techniques, the nose of the donor vehicle would be cut–away according to a pasted–on or projected–on pattern, the interior cleaned up and the new skin bonded to the foundation using a combination of pop–rivets and epoxy. The rivets are a standard procedure in this kind of thing, the new nose–skin having been designed with structural channels deep enough to conceal the head of the rivets. Structurally fastened to the foundation, various types of filler are used to extend the composite structure to existing panel–joins. We know it's going to crack so — as with sidewalks — we include the cracks in the design. Properly prepped and treated, such joins are no more prone to rusting than other methods of fabrication.

That's the easy part. Here comes the tricky stuff.

Inside the vehicle we have to deal with the engine, especially with the cooling system. Feeding air to a radiator without chopping up the Transporter nose–skin is a do–able thing… but engine access is another matter, as are the structural questions. For adequate crash protection the floor–boards must form a part of the structural bond to the nose–skin. I can see where some locally fabricated pieces will have to be welded to the foundation to facilitate the modification.

To preserve the 'feel' of a split–window Transporter, I think the dash would have to be a virtual copy. Finding a suitable circular speedo–head is a no–sweat kind of problem but I would like to provide the engine with good instrumentation, the mounting of which will probably be one of the tricky bits. Then come things like a VW–type steering column and wheel, the turn–signal switch, the ergonomics of seat–pedal–steering and so forth — It's really a much more difficult problem than coming up with a marriageable nose–skin.

What about the rest of the vehicle?

With regards to the body, it would probably be best to stick as close to stock as possible. Oh, we could come up with some dummy panel–joins to make it look like we have a rear hatch — a few things like that aren't very difficult. And VW–clone bumpers wouldn't be much of a chore, assuming they were wood– or foam–cored fiberglas structures. (Don't wrinkle your nose — such bumpers work better than steel when it comes to energy absorption.) Maybe some moon–type hub–caps to carry–through the Transporter 'feel'. But no major surgery. Ummm… well, maybe a pop–top — but that would have to come later.

As for the power–train, everything we need is already here, parked right over there in that Chevy S–10 pickup. Nice little V6, a variety of trannys, and differentials in a variety of gear ratios – – all stock, all available at reasonable prices. Or run–what–ya'– brung — leave the original power–train intact. One of those.

When can you get one?

Get serious. There is at least a man–year of dedicated effort involved in such a thing, to say nothing of the material costs. Chances are, it's never going to happen. But print this out. Stuff it in the 'Crazy Idea' file. One day…

One day yours will be the last Type II in town — kids will point at you when you go past. Somewhere along in there the idea won't seem so crazy. Of course, by then all the conventional vans will be gone too.

Crazy Idea #438

Peking to Paris? No big deal.

Howzabout Duluth to Vladivostok?

Or just a summer-long run around Europe?

Not a Rally but a Run. (The difference? We all win. And nobody wears those silly driving gloves.)

Once your wheels are on the road it isn't too difficutlt to get where you want to go. The trick for Americans wanting to drive through the streets of Odessa — and I don't mean Texas — is HOW TO CROSS THE POND.

So you go to Duluth, Minnesota. Seriously.

At Duluth you drive your bus into a cargo container and lash it fast then hang around until another fool arrives — a cargo container will hold two VW Transporters with lots of room to spare. Then just wait for the ship to sail. (Actually, it'll probably Diesel or mebbe steam but folks still... oh, never mind.)

The ship, a skinny thing suitable for working through the locks of the Great Lakes, plugs its way up and across Lake Superior, fumbles past Niagra Falls and runs into the open sea at the mouth of the St. Lawrence River. That's in Canada. From there it's only a few days to Europe — probably Rotterdam. Cargo container gets plonked onto the dock, you open the doors, drive away.

Or, you can ship the bus and fly over, pick it up in Rotterdam. But it's probably cheaper to ride the boat.

Of course, this falls into the Crazy Idea catagory (#438, I think, although I proposed the same thing a couple of years ago). Folks think this sort of thing is crazy because it would probably be less expensive to fly to Europe and rent a bus. Or a car. Or just buy a rail pass and pretend you're a very old student, camping out at the youth hostels.

But buses are fun, especially if it's your bus. And you have some crazy logo on the side. And there's a dozen of you all whizzing down the autoban with your American license plates and surfboards with the Stones doing something noisy on the stereo. Whizzz.... "Did you see THAT??!!" (But in German, of course.)

How do you organize something like that?

With a lot of work. And a map. Your route has to follow your trail of support and that has to come from other veedubers, which are few and far between in Europe and Russia. But there are some. So you start making contacts and sticking pins in the map and each time you score a new country you start assembling the required travel package for that particular country, using your veeduber contact. For instance, it would be handy to have a contact in Duluth, to find out if the bulk-carriers still haul the occasional cargo container mit passengers — cheap transportation to Europe.

What's a pracitcal minimum? Prolly six, eight buses, dozen or so people. Too big, they think its an invasion. Too small, you don't get the news coverage that insures the friendly reception needed to put the fun in such a run.

What are some of the possible routes? Well.... (running my finger down the map...) We could cross over to Sweden, run up and across to Finland, cross into Russia, see the museums & stuff in Leningra... oops St. Petersburg, come back via the Baltic countries — a kind of Baltic Sea Circumnavigation Run. Put the buses back in the boxes, diesel home.

Or we could head straight down for Spain, Europe's Baja Peninsula :-) Or circle the Alps, one direction or another. And of course, we can drive to London. Well... nearly so (The Chunnel is just for trains... but they'll carry your bus.)

Practical aspects? No real young kids — too many hassles at the borders. Ditto for pets. And no booze or drugs or weapons you can't conceal in a hollow tooth.

On a run like this, one with lots of languages and borders and miles, the paper-work is the killer but like paperwork everywhere, the answer is to plan ahead. Like, two years. Or more. Which will give you plenty of time to stock up on old Levis and LP's and spare parts and stuff like that. Not for selling, which is illegal. But for gifts, to give to our veeduber friends who help us out along the way. (So they can sell 'em :-)

What happens on a Run like this? You get hoarse. Everybody in Europe has a relative in the States and you're expected to know them, like, if you live in LA you should know Krista's uncle's brother's cousin Sarah who lives in San Francisco. After all, you both live in California. How big can it be? (Hint: Almost as big as France.)

A run like this, you don't drive a lot, unless you really want to get to Vladivostok — in which case you'd probably have to winter-over somewhere. What you do, you drive a little and camp a lot. And you walk a lot, too. You've got an agenda, and you stick to it when it comes to crossing borders and catching ferrys, but otherwise you tend to hang out — nobody gets to know a place the first time they’re there.

I think the most important thing you get from a Run like this is the realization that people are pretty much the same no matter where you go, sort of distant neighbors.

—Bob

PS — You can replace Duluth with any other seaport and the scenario stays the same. Duluth just happened to be the most mid-western American seaport I could find.   West-coast veedubers may want to consider Crazy Idea #439 —Stockton to Ayer’s Rock :-)

Custom Hat

He kept looking at my head. Every time I reached for a tool, the guy was alooking at me. I finally eased the creeper all the way under his bus and out the other side, got up and took a peek in the passenger-side mirror to see what was hanging out of my nose. Nothing. And no funny smears of grease. Beard wasn't on fire. Teeth hadn't fallen out. But he kept LOOKING AT MY HEAD!

Finished up, told him he could rebuild the starter if he wanted to but I didn't know any source of new solenoids and that was the real problem. He didn't care; as a mechanic he probably made a fine programmer. Paid me; told me I could keep the old starter if I wanted it. I didn't, which kinda surprised him (I got enough junk to worry about). Then he sez: "I don't suppose you'd consider selling your hat?" My HAT?

Took it off to see the gold coins I'd missed. Nada. Old, faded olive-drab looking thingee, kinda greasy around the bill. Got a little VW bus embroidered on one side; you gotta look for it. Over on the other side it sez 'VANS'.

"Where'dya get it?" He's all puppy-eager. Clean hands. '73 Westy, all polished up and neat.

I couldn't recall. "Some race... " SNORE? Some guy was handing them out.

"Would you take ten dollars for it?"

That caught me. It was a second before I started to laugh.

"Twenty?"

Hell, the damn fool was serious! I handed him the hat; he handed me a twenty. Put on the hat, one size fits all. Drove off happy as a clam.

Couple days later I was over by the airport, stopped in at the VANS sneaker factory, picked me up a new hat. $4.95.

"You wouldn't believe what happened to my old hat," I told the kid. But he didn't want to hear unless it involved ten foot waves. Took my money, gave me the hat.

Veedubers is some strange folk.

Dual Carbs and Winning the Race

The bilateral symmetry of human beings causes us to readily accept the correctness of two carbs on a Volkswagen engine. We 'stand on our own two feet' and swear to things we have 'seen with my own two eyes.' Conventional Wisdom sez two things are better than one; even nature thinks so.

When it comes to engines, sound engineering practice calls for one carburetor (or fuel injector) per cylinder, anything less is a compromise. This was achieved on the Volkswagen through the use of fuel injection, or mounting a pair of Bug Sprays on special manifolds atop dual-port heads. (The Holley Bug-Spray carb, like the Dellorto, is a pair of single-barrel carbs in a common body.) But with the 200 cfm Holleys long-gone from the veedub scene, and a full-trick Dellorto set-up running close to a thousand bucks, most of us eager for a multi-carb set-up settle for the plebeian high induced by a pair of Kadrons. Actually, it's a pretty poor compromise compared to the glories of one-carb-per-cylinder, but Kadrons are cheap, look macho and don't run all that badly, at least, not if we have the Treuhaft aluminum carb-mounts, dual-port heads and manage to keep that crappy linkage from falling apart more than once a week.

Big Hat, No Cattle

Alas, the two-carbs-are-better-than-one argument is largely without substance. Two 40mm carbs will definitely flow more air than one 34mm carb, but unless you've spent at least as much on improving the flow of your heads as you have on your carbs, the potential improvement goes largely unrealized. With stock heads on a stock engine you'll see no significant improvement in performance until you push the revs above 3,500 rpm or thereabouts. But Kadrons are cheap, look macho and don't run all that badly...

So why do many people run Kadrons? The answer may surprise you. A lot of people go to Kadrons because in their haste to bolt on a few horsepower they do things that make their engine run worse.

Louder is Colder

The first thing a kid does to his bug is throw away the stock muffler and bolt on an extractor. Extractors are cheap, sound boss, and everyone uses them so they must be good, right? Wrong. The stock 'muffler' is actually an expansion chamber, any muffling is accomplished by the glas-packed diffuser cones in the tailpipes. Wanna go fast/make noise? Pull your tail pipes.

Install a pair of straight pipes. You'll pick up about the same top-end gain you'll get from an extractor, and become the noisiest kid on the block. But doing that would fly in the face of Conventional Wisdom; better to stick with an extractor and avoid reality. Unfortunately, most extractor exhaust systems actually degrade the performance of your engine, and for a very simple reason: they can cause the intake manifold to ice up.

Without sufficient heat the VW manifold ices up very easily, reducing the internal bore to a tiny hole. The intake manifold is heated by exhaust gases routed through the heat riser pipe. The typical cheap extractor is shipped with the heat riser ports undrilled and is installed the same way. The manifold immediately experiences icing problems.

Carburetor and manifold icing can occur in any climate and any temperature, about the only time you're safe is when the humidity is below 10%, which occurs during temperature extremes. But Conventional Wisdom pays little heed to icing problems; after all, the engine is too hot to touch, how could there be any ice in there? (You'll find the answer in any Physics text.)

Various local experts will diagnose the icing problems as 'flat spots' in the distributor (icing often chokes the engine when pulling away from a stop sign), a bad carb (you may see some black smoke), ignition problems (a rough, stumbling idle is common with manifold icing), bad plugs, and anything else they can think of. But ice? No way, dude!

Unwilling to admit that adding an extractor actually makes their bug run worse, the next step is to slap on a pair of Kadrons. After all, they've tried just about everything else. Wow! Talk about performance! And Conventional Wisdom wins again.

What's Happening?

Here's what's been happening in the engine room. On the stock muffler the heat riser takes part of the exhaust gasses from #2 cylinder and feeds them through the heat riser pipe DIRECTLY TO THE TAIL PIPE. Not the muffler; the little pipe pierces the muffler canister and continues to the base of the left tail pipe. On cheap extractors, even when the heat riser ports are opened up, the heat riser connection on the left side simply dumps the gases into the #4 exhaust stack. Due to the length of the heat riser pipe, by the time the gases from #2 arrive at the flange of the #4 cylinder, they are met with the hotter, higher pressure exhaust gasses from that port. The result is little if any flow through the heat riser pipe. It quickly clogs, reducing flow still further, clogs some more and finally gets blocked shut, providing the intake manifold with no heat at all. Without manifold heat, icing problems become painfully obvious.

(The first extractor I ever saw was, I think, from EMPI, back in the late 60's. It had a heat riser pipe from the #4 flange to the collector, insuring proper gas flow through the heat riser tube on the manifold. The engine ran a center-mounted Weber progressive on a trick EMPI manifold. It ate me alive, three for three.)

But everyone sez Kadrons are the cure. Sure enough, the Kadrons and the extractor seem made for each other. The engine runs at least as good as it did when stock, mebbe even better. (Factoid: With their short aluminum manifolds, icing is seldom a problem with Kadrons. The manifolds absorb heat directly from the cylinder heads.)

A Whiff of Reality

So why don't we see more dual-carb set-ups running the Baja? Or even reaching the finish line before the cut-off time? (Ummm, you noticed that, did you?) Well, it has more to do with reality than Conventional Wisdom; Conventional Wisdom sez it's always the fastest car that wins, right? Wrong. It's the one that finishes first. Period.

So what do they run? As a rule, the winners drive vehicles that have the fewest parts; the fewest things to go wrong. Single carbs — usually a dual-throat Del or progressive — are winners because the throttle linkage is less prone to fail and a single carb eliminates the balance problems common with dual-carb installations. With a single carb there's only one fuel line to worry about and your air cleaning problems are reduced.

The truth is, a good dual-throat or progressive carb, installed on a proper manifold, has no trouble outperforming the typical pair of Kadrons, and does so for a lot less money. Progressive carbs — those having separate throats for high and low speed —offer considerable advantages in cost, economy and ease of maintenance over a pair of Kadrons. (The best milage I've ever gotten on a bug — between 35 and 37 mpg — was obtained with a clunky Japanese progressive off a Datsun pickup. The primary was about 26mm, the secondary not much larger. It didn't do anything for the top end but I sure passed a lot of gas stations.)

Progressives are especially useful on buses, where your interest is more in the torque curve than max rpm. Progressives also allow you to run the late-model distributor instead of an all-or-nothing centrifugal type. Several after-market suppliers offer progressive carb kits for the veedub, most for under $200. Before succumbing to Conventional Wisdom it might be wise to check them out.

Making it Work

So how do you make the heat riser work with an extractor? The only real cure is to take the heat riser pipe off a cheap Brazilian muffler, extend it to the collector of your extractor (ie, where the four tubes come together). The collector is a low-pressure area relative to the exhaust stacks; you'll get good flow and the cross-over tube won't crud up. (You can't use the pipe off a German muffler because the flange is part of the #4 exhaust stack casting.) But if that sounds like too much work, the cross-over won't clog up as quickly if you drill out the #2 flange to about 1/2" while keeping the hole in the #4 flange something smaller — 5/16" or 3/8". (But it's still going to crud up on you.)

Sermonette

I'm a serious racer. I compete everyday in the Hoover Endurance Run. The trick is to see how far I can drive my bug, baja, bus and Ghia on the least fuel, maintenance and repairs. I expect to find the finish line somewhere around the 150,000 mile marker. It's a tough course, including some of the worst off-pavement stretches down in Baja, rush hour LA traffic and high-speed trans-continental runs on the interstate freeway system. But the nicest thing is the cash prize; I make a little money every time I drive, and smile all the way to bank.

No one has ever gone broke by catering to Conventional Wisdom, even though it has never won a single race. Unless you happen to be a politician. Or a magazine editor.

Engine Fires

A trite phrase sprang up in southern California with the introduction of the fuel injected flat fours. “There’s only two kinds of Volkswagens: Those that have had an engine fire and those that are about to.” But the odd thing was, veedubs have ALWAYS had engine fires, and in the case of the bugs and buses, the cause was almost always the same.

In over 90% of early VW engine fires the steel fuel line breaks where it passes through the breast tin on the driver’s side of the engine compartment. The broken line dumps fuel directly onto the neck of the #3 exhaust outlet. The rest is history. Once the fuel line breaks, gravity keeps the fuel flowing to the fire. When the magnesium tranny housing heats to the point of ignition, even water can’t put it out. (That’s what’s inside a Thermite grenade.)

Why does the fuel line break? Because of the failure of the rubber grommet where the steel fuel line passes through the forward breast tin. Located only inches away from the the #3 exhaust stack, which runs red hot, the grommet soon hardens. Vibration does the rest, first crumbling the grommet then providing the motion that allows the breast tin to cut through the steel tubing like a hacksaw. A dull and toothless hacksaw but one that cuts a lot faster than you would think. This scenario of component failure and wear is generally known as The Engine Fire Syndrome.

The fix? Make a bulkhead fitting.

You can make a bulkhead fitting that’s good enough for the job using lamp repair parts, purchased at a hardware store. The light socket is attached to the lamp by a piece of threaded 3/8" steel or brass tubing. The threaded tubing is widely available, often sold bubble–packed in an assortment of lengths. You need a piece about an inch long. Matching nuts are sold the same way, they are usually hanging side–by–side among the other lamp repair parts. You will also need a pair of flat washers with a 3/8" center hole. Be sure the washers are large enough to cover the hole in the breast tin. Fender washers work best but you’ll have to drill them out to pass the threaded tubing.

Assemble the parts so as to sandwich the breast tin between the two washers. To make sure it doesn’t come apart, bed the washers and nuts in high–temperature RTV compound. It’s messy but I’ve found this is the only assembly method that stands up over the years.

In proper terms, what you end up with isn’t a bulkhead fitting but a pass–through. And what you pass through it is a piece of 5mm steel fuel line (that is, regular VW fuel pipe) about three inches long. Bed this in RTV as you insert it into the threaded sleeve with a twisting motion (but don't get any in the fuel line). NOW you have a bulkhead fitting. Use regular push–on fuel line (but with clamps, please) to connect to the bulkhead fitting and you're all done.

The Engine Fire Syndrome was first identified about 1958. Despite frequent fires, VW showed no interest in fixing the problem, insisting the lame rubber grommet they used was good enough so long as someone inspected/replaced it every 3,000 miles or so(!), which they did, back when there was a VW dealer in every town and service was cheap.

Making a bulkhead fitting from commonly available parts will prevent a lot of engine fires but the fuel system on early Volkswagens remains a compromise between safety and cost. Having invested considerable time and money keeping our bugs alive, it seems silly to put that investment at risk by using push–on fuel lines. Threaded aircraft–type fittings are a better solution; the carb and fuel pump can be modified to accept such fittings. Using a true bulkhead fitting through the forward breast tin, and braided stainless steel flex lines between there and the carb, will give you the safest possible installation.

If you're serious about safety and long–term durability, you may wish to carry the fuel line modifications all the way through to the gas tank, even to replacing the fuel pipe in the center hump with stainless steel tubing. This is best accomplished during a body–off resto. Once things are back together you'll know your fuel system will never fail.

A neat trick that gets around the difficulties of replacing tubing in the center hump is to run a new 3/8" diameter stainless steel fuel line EXTERNALLY. It is protected by a piece of 3/4" angle iron welded to the belly pan in the form of a 'V'. A bit of artful grinding and some careful bending allows the angle iron stock to follow the contours of the belly pan stampings. Tacked and then welded full–length, the modification is strong, attractive and durable.

I've been working on VWs since 1956 and have seen, personally or in photos, the results of several fires as described above. The cause of the fire was often overlooked because the steel fuel line appears to be intact. But on cleaning away the fire's residue you'll discover the tube is cut half through, which for a fuel pipe is as far as you need go to make the juice flow.

Engines and The American Way

I like engines; work on a lot of them, from motorcycles to ships. Over the last few years I haven't done much with American iron; I know it's out there and I've still got a Jimmy down in the field with a 440 V8 lurking under the hood, but bugs and bikes and things that fly are a lot more fun, and I'm of an age where the fun is important; I won't come this way again.

I've got a friend who is one of those 'Buy American' types. From what I learned, I'd guess the American auto industry has screwed him out of a hundred thou over the last twenty years. That seems to be the American Way.

His current ride is an Oldsmobile sedan called a 'Ciera,' whatever that means. The engine is a 3.3 liter V6, 90–degree type, traverse–mounted; it really fills up the space under the hood. Every option known to man; even the antenna runs up and down by itself. It's four years old, has 110,000 miles, about average for his driving pattern but a year older than most of his cars; he usually trades them religiously at the three–year mark. "That's when they start having trouble," he sez, and sure enough, he seemed to be having some, a lopey miss.

The dealer tells him it's time to trade; that he's having valve troubles. But my friend hasn't been doing too well lately. He's one of those aerospace rascals, presently trying to turn nuclear swords into mass–market plowshares. Money has been kinda tight and he's still got a girl in college. So I took a look at it for him.

Bad spark plug.

The three plugs on the rear bank looked like they hadn't been touched in the last 50,000 miles and their lack of electrodes confirmed it. But the three front ones were new! American cars… and American car dealers, and the good–rinch mechanic philosophy: lotsa badges on their shirt and not much else.

Old oil. Dirty air filter. Dry chassis. (Does this sound familiar? Somebody better start keeping an eye on the quick–lube shops; they're getting so quick they miss the whole car now and then.)

There's nothing to tune–up on this car; it's all electronic and fuel injected. I cleaned it up, did the chores, took it for a drive. Ran beautifully; 60 mph at 1550 rpm; engine just a'loafing along. Gets 27 miles to a gallon if you let the cruise control do its thing; my friend drives from San Diego to Tucson a couple of times a week, sez it only gets 25 with the air conditioner going.

Only 25, eh?

Time for a new car? Not hardly. Based on compression and a few other factors, I'd guess the Ciera is about half–way through its life cycle; it should see 200,000 and then some.

I laid it all out for my friend, showed him the plugs and filter. He got the picture right off; he can figure things out (he really IS a rocket scientist). But the news left him looking stricken. He's bought his last four cars from the same salesman, same dealer. And they've been giving him the shaft. Valve problem. Last time the tranny was acting up. (Trannys got filters too, you know.)

So we talked a little. Now he wants to buy a Volkswagen, learn to do it himself. I told him okay, but keep the Ciera. Nice ride. Beautiful engine. Pitiful dealer. But then, that's the American Way.

PS – Just for fun, I called a junky, asked what a low–milage 3.3 Ciera V6 engine was going for. "I can get you a nice clean one by Wednesday, run you four and a half, maybe five hundred… " Definitely keep the Ciera. For the next twenty years. And to hell with the American Way.

Grendel’s Computer

Mosquito Power

The kerosene lantern throws a pale yellow light over the keyboard, too dim to read the F–key’s black–on–dark–gray. I carry a penlight if I become lost in Qwertyland. I’m out in the boondocks, the nearest electrical power humming through the high–line down by the road. But I’ve got all the power I need. I’m running on mosquito–power. Behind me Grendel makes a mosquito–like sound as the solid–state inverter hidden in her belly converts twelve–volt battery juice into 110vac current. If the mosquito gets out of the tiny box the computer will carry on for an hour or two on its internal battery then it too will die, but not before giving me several warnings.

Night has fallen, pulling the sickle–thin New Moon out of the sky. The horizon is jagged, perfectly clear, the wind calm. The twilight graduated from apricot to lime to blue velvet and faded to black, leaving the full disk of the new moon illuminated by tawny Earthlight before it too was gone, quickly followed by Venus, herself a tiny crescent to the eagle–eyed. I am four thousand feet above the sea. The air is lip–cracking dry. The mountains of Mexico loom dark on the southern horizon little more than a stroll away. I am home, in the high desert hills, camping alone near a windmill accompanied by a 1967 Volkswagen bus with a past as checkered as her patch–work nose, now partially restored to normalcy.

Grendel’s computer comes with a printer, a small Canon that fires ink at the paper like a boy blowing spit–wads, except the Canon’s spit–wads are infintesimally small, their aim more sure than a Patriot after a SCUD. The printer too is welcome at the mosquito– powered powerplant.

The Toshiba lap–top weighs about six pounds, the printer about two. They travel together in a day pack along with an assortment of cables and paper and spare disks and pencils and pens and the things normally found near computers and people who use them to write.

I can’t post to the net. I have no telephone. There is a cell phone that will work with the computer, allowing me to send messages while galloping off in all diretions. But it is a hellishly expensive telephone, made — I think — by Motorola. So I’ll have to wait until I go by the store tomorrow. They will let me plug a wire into the telephone under the counter for a dollar. Then all of you will know why I haven’t been there for the last few days.

In fact, posting a message from the high desert is a snap compared to posting one from Shelton, Washington. Or from the Canadian arctic, which is what I'm going to try and do next summer, although I haven't quite figured out how. I'll have to jury–rig something. That will be after I rebuild Grendel's tranny and give her some decent brake drums and install a more powerful engine and maybe a skid–plate or two. There's not a lot of paved roads in the Arctic; almost as bad as Baja although I hear the weather is cooler.

I'm up here working on a roof, getting ready for the winter rains. I'm less than a hundred miles from home but Grendel doesn't like the grades and takes close to two hours each way. My 'quick' six– week trip to Washington has put me behind the 8–ball when it comes to doing my chores and earning a living. Sleeping over will gain me about six hours, what with not having to pack and unpack my tools. And I get to watch the moon go down behind Vulcan Mountain. Seems like a good deal to me.

Hot Showers and Snow

Here's one for the Crazy Idea Archive.

Certain members of the list believe a hot shower is a necessity of life.

If you'll accept that ten minutes of hot water constitutes a shower it may be possible to provide for that using a regular VW Transporter.

The idea involves an insulated non-corrosive metal tank holding twenty gallons and capable of withstanding 30 psi. The tank is plumbed to the #1 & #3 exhaust manifolds where a coil of stainless steel tubing is fabricated around the exposed portion of the exhaust pipe, just before it enters the heat exchanger. The coils are plumbed to the water tank, inlet at he bottom, outlet at the top so as to permit thermosyphoning. This is best accomplished using small diameter tubing at the cold outlet, larger diameter for the hot inlet of the tank. Additional plumbing runs from the bottom of the tank to a mixing valve and hose bib mounted at some point conveniet to the tank and the side/rear of the vehicle. A convenient filler must be provided, one that will withstand 30 psi.

A second water tank for cold water is provided. It may be at any location and may be of plastic pipe or fiberglas — something strong enough to withstand 30 psi. The cold water tank is plumbed to the mixer valve. A convenient filler must be provided.

Both tanks are plumbed to a source of compressed air. This may be a tank of air pumped up during normal driving by a vacuum driven air compressor. The air tank should withstand up to 100 psi and should contain at least 4 cubic feet at that pressure. A fixed 30 psi regulator is attached to the output, from which air goes to both of the water tanks.

The hot water tank is filled before the days run. Thermo syphoning should heat the twenty gallons of water to the boiling point in about four hours, after which it would vent to the atmosphere when pressure rose above 30 psi.

The cold water tank is not filled until the end of the days run.

To shower, the enclosure is erected, a hand-held shower nozzle is attached to the hose bib and the tanks are pressurized by opening the valve from the air tank. The temperature of the water may be thermostatially controlled by the mixer valve or manually controlled by those with a death wish.

Twenty gallons of water weighs about 160 lbs and occupies slightly more than 3 cubic feet. A tank having the least surface handles pressure best but a sphere is difficult to fabricate and mount. A square tank about 18 inches on a side would hold a bit more than 20 gallons.

The cold water tank could be fabricated from 3" stainless steel exhaust pipes secured to the underside of the vehicle.

Vacuum-driven air-compressors are available from J. C. Whitney for about $65. A pressured system would be less complex than one using pumps and would place no demand on the vehicle’s electrical system.

Assuming a mixing ratio of 1:1, which is probably wrong, 30 psi is more than enough to force 40 gallons of water through 3/8" tubing at a rate of 4 gallons per minute, ie, a ten-minute shower.

Since the system uses only waste heat and manifold pressure, once fabricated the cost of operation is zero although there will be some slight reduction in miles per gallon due to the added weight of the water and equipment.
Snow Camping

Twenty gallons of boiling water represents a considerable quantity of heat. If the van is well insulated, that quantity of hot water pumped through a small heat exchanger such as a dog-house style oil cooler, should be enough to maintain a shirt-sleeve environment in the camper for several hours. The water would have to be pumped and a biscuit-fan would be needed to blow air through the heat exchanger but the flow-rate and thus the energy consumption would be relatively low, probably less than 3 amps.

Solar heating suppliers carry 12vdc pumps suitable for hot-water pumps. Twelve-volt biscuit or muffin fans are widely available.

The water in such a system would have to be protected from freezing. The plumbing runs, which may be of either copper or stainless steel, should be thermally insulated.

I Make Mistrakes

A fellow wrote telling me how he'd religiously followed my instructions for installing a full–flow oil filter. It didn't work. He'd paid a machinist an inordinate amount to tap his case, built his engine with precision and care, got right down to firing it up… no oil pressure.

He'd put the Gene Berg oil–pump cover on backwards, neatly swapping the outlet to the inlet–side of the pump.

Another fellow needed to replace his starter–motor. I told him how but it didn't work — he couldn't get the starter out from under the car.

In the first case, I failed to explain which side of the pump is the outlet. In the second I failed to point out that the heater–duct bellows and the flapper–valve wire would need to be removed.

In a similar case I told a fellow he'd be drawing twice the amperage if he installed a dropping resister — that he might need a larger fuse. I meant to say wattage.

I can muster a battalion of niffty excuses for the legions of errors I've made but the bottom line is that I make mistakes… just like everyone else. If you find one, point it out and I'll do what I can to make it right. If you want to crow about it, that's okay too. But we all live in glass houses.

It Works For Me... (not)

Recent comments (May, 1997) about the pro's and con's of removing the thermostatically controlled cooling system from the Volkswagen engine have caused a lot of messages to come my way, many of which say 'It works for me'.

Actually, it doesn't but I had neither the heart nor time to tell them so individually. But when the number of such messages approached a dozen it was obvious something needed to be said.

Conventional Wisdom

Simple minds tend to accept simplistic solutions for complex problems, rejecting as invalid anything they are incapable of understanding. Providing such people with a detailed explanation is usually an exercise in futility — they want a quick & easy answer, confirmation of the Conventional Wisdoms on which their lives are based.

Successfully coupling the waste heat of an engine directly to the atmosphere, as is the case of all 'air–cooled' engines, involves some complex factors, most of which I don't understand well enough to define mathmatically. But these things can be discovered empirically through experimentation, which is how I came to know of their existance and to make use of them in building big–bore strokers that run cool.

A key factor I discovered was that for a given air pressure, the hotter the cylinder head, the LESS air will flow through it (meaning down through it's cooling fins). I think this has to do with the geometry of the space thru which the cooling air must flow and the fact air expands as it absorbs heat from the head.

Seeing the air–flow through my simplistic test–rig go down as the temperature of the aluminum head went up was a surprise. I had no idea what I was going to see when I started doing experiments along these lines but I was stunned to see that a hot cylinder head could virtually shut off the air–flow from a large squirrel–cage blower powered by a 1/3 hp electric motor. The air that did pass thru the fins was hot alright, the problem was there simply wasn't enough air–flow to carry away the heat I was dumping into head through a large torch with a rose–bud tip.

To get more air–flow I had to increase the air pressure. Eventually I was using a 1 hp motor driving a squirrel–cage blower 18 inches in diameter by about six inches wide. I was pumping a hell of a lot of air but even that proved insufficient for my simulated ‘full–throttle’ runs.

On test engines running with and without the fan belt, I used Temp–L sticks and thermocouples to learn how hot a head would get and how the heat was distributed. Using that infomation, I began conducting experiments to find out how to adequately cool the engine without the use of the engine–driven blower, as is the case when the engine is installed in an airplane.

I eventually solved the problem and went on to build a number of engines for use in aircraft, paying scant attention to the problem of cooling big–bore strokers when installed in vehicles — the solution was there, I simply had no need to apply it.

When I plugged my first 2180 into a bus I knew it was going to take a bit of work to keep the thing cool but by then I had a pretty good grasp of both the problem and the principles involved. My first effort was not entirely successful but my third… or perhaps my fifth :–) finally got the bugs out.

Big–bore strokers are wider than stock engines since you must use longer rods to reduce the extreme rod–angle produced by the longer stroke. The longer rod dictates a longer cylinder, the length made up with a spacer installed under the jug, pushing the heads that much farther away from the center–line of the crank. The bottom line is that the tin–ware doesn’t fit. The cylinder tin leaves a gap at the crank–case and the blower housing no longer fits tightly into the cylinder tin.

The tin–ware fix is relatively simple — weld strips of sheet metal to the cylinder–tin to fill the gaps. But the fix for the blower housing is more difficult. The most efficient cooling air is that having the highest effective density, meaning the high–velocity flow of air found at the out–most section of the blower–housing. That air has a specific purpose — it is deliberately directed toward the exhaust–valve area of the heads. Unless you widen the blower housing to match the tin–ware, you’ll loose that valuable slug of air… and end up with hot–running heads.

There’s no convenient way to describe the required sectioning and modification of the blower housing without the use of illustrations but my experiments taught me — rather painfully — that you must perform the re–section relatively high up on the outer curve of the blower housing, otherwise the flow appears to become turbulent — or some damn thing — and the head will still run hot, even though the blower housing is now a nice fit. But once you find the proper length of the re–sectioned part, the thing suddenly begins to work like gang–busters — the head runs cool.

While I was doing these experiments I came to appreciate the amount of work Volkswagen put into the design of the cooling system. Everything in the system is there for a purpose, the location, shape and mounting angle of the parts perfectly matched to the task that particular part was designed to perform. Based on my own admittedly crude and part–time experiments that spanned more than five years, I know the Volkswagen cooling system is the result of intelligent, well–organized design and testing, an effort that probably occupied several engineers for a considerable amount of time.

When we speak of the VW cooling system we tend to think in absolutes, usually triggered by an episode of over–heating. Only after I had become somewhat familiar with the gross cooling requirements was I able to appreciate the far more subtle process by which the cooling system regulates the operating temperature of the engine to a rather narrow range. Gross cooling prevents the engine from overheating but it is the more subtle temperature control mechanisms that insure the engine will enjoy a long service life. These subtilities include the shape and volume of the plenums present in the system, both inlet and exhaust, and of pressure ratios, parts placement and the surface–area of components designed to couple waste heat to the cooling–air flow. As I came to understand these things I was able to predict the effect of various changes and to confirm those predictions through experiments. This was a very exciting time for me.

(It may be worth mentioning here that my formal education is very limited. I went to sea at an early age. I did not graduate from high school nor do I hold any college degrees.)

Through my experiments I re–discovered certain basic principles of thermodynamics and, within the range of my instruments and the acuity of my observations, I was able to derive rough equations the application of which allowed me to go beyond the limits of the stock engine's configuration with a fair degree of confidence. I made a lot of mistakes during this period but such failures were not wasted. They simply told me I had gone too far, or had wandered off course. So long as the failures occured on the test–stand they cost only money, time and effort. (I blew up several engines during this period, and convinced my long–suffering neighbors I was totally insane :–)

With that as prologue perhaps you can understand my chagrin — and despair — each time I saw a message from someone who has torn out their cooling system and proudly declares 'It works for me!', or from someone in a mild climate who flatly insists the Volkswagen's cooling system is unnecessary.

Ignorance can be cured by judicious applications of valid information. But there is no cure for stupidity. An inherent lack of intelligence renders a person incapable of converting information into knowledge. Such people, typically brash and vocal, exist within their own version of reality, loudly declaring their condition with every word they speak.

Perhaps the saddest fact of all is that our commercially–oriented society encourages and preys upon such people.

Sermonette

If your engine does not have a working cooling system installed, you are being preyed upon — you're walking around with 'SUCKER' stamped on your forehead. Your engine will not last as long as it should nor run as well and anyone who tells you otherswise is merely declaring their own ignorance, their own version of reality.

Many who have removed their cooling system will argue I'm simply trying to sell you my version of reality. But there are a couple of clues you may want to consider before drawing any conclusion. The first is that I'm not selling 'reality' or anything else — no parts or engines or repairs… not even a magazine. I'm telling you about something I discovered and then confirmed with careful tests. This isn't Fool's Gold, it's the real stuff.

The second clue is that my version of reality is backed up by about twenty million Volkswagens. Doesn't it strike you odd they would waste so much effort and money on something that is unnecessary?

As to the "It Work's For Me" crowd, did you know man can fly? You can prove this for yourself simply by leaping off a tall building, something I encourage you to consider. But on your way to the roof, take a look out the window. The fellow who plummets past, flapping his arms and wearing a beautific smile is chanting 'It works for me!' And it does… until he hits the ground.

If you're driving around without your cooling system installed you simply haven't hit the ground as yet. But you will. And it doesn't matter what you chant along the way.

John Muir

I got this one second hand but confirmed it (see page 85 of the February 1979 edition of the Idiot book)... sez: “...be sure to get a 6v sensor if your car is 6 volt and a twelve volt sensor for a 12 volt system.”

John’s talking about the oil pressure sensor. John is full of hot air.

Folks, the oil pressure sensor is a Normally Closed, pressure actuated SWITCH. Voltage got nothing to do with it. Pump about seven pounds of pressure in the orifice, the switch opens, anything less, it’s closed. When it’s closed it completes the oil pressure warning light circuit by connecting the signal lamp to ground. When the switch is open, the light is off. It’s the second simplist part on a veedub (The old-style horn button is first.)

Here’s the story: I’m working on a bug, need a part, go to the local parts-place. Chatting with the clerk, who I’ve known for a few years, he mentions that some Volkswagen owners are more than a little strange... and he wishes he’d never heard of John Muir. Why? Glad you asked.

It seems that earlier that day a fellow comes in with a failed pressure sensor; the diaphragm was leaking. Insists on a six volt model. The counter guy isn’t sure if he’s serious or not; parts-manual sez “49 thru 82” or some such; one size fits all. But the customer isn’t about to fall for that trick. He’s got St. Muir’s bible and it sez exactly what I posted above; 6 volt sensor for six volt system. It also implies that parts-guys will sell you a bad one now and then (see the preceding paragraph on page 85). The parts-guy shows him the book but the guy with the leaky sensor sez a few unkind and unjustified things about the parts-guy and goes off in a huff.

I got my parts, headed back for the shop. Outside the parts-place a Mexican kid was selling flowers, nice ones. Bought a bunch in a little pink plastic vase, took them back in and gave them to the parts-guy. Told him he was right. All Volkswagen owners are a little strange. But we couldn’t get along without somebody to sell us parts now and then.

Madam Meeyamo

Normally, I'm not allowed to go to the grocery story by myself. It's because I get these ideas, like the time my wife sent me to the store for a loaf of bread and I came home with a hundred pounds of flour and this really neat idea for saving money.   Have you seen what bread costs nowadays?

Sometimes my wife or daughter will take me to the store but it's only to push the cart around and I have to promise not to read the labels. Some foods got the same chemicals I use in the shop for cleaning parts but it's considered bad form to read the label out loud in the store and especially tacky to laugh at what's in other people's shopping carts. So mostly, I don't shop. It had been about two years since I'd been to the store.

But this was an Emergency. Wife called, got me out of the shop, told me to run down to the store and pick up something. So I did.

The store had changed a lot since I'd been there last. They've got a big new deli over along one wall and even a little restaurant in the back. And a bank, right up front by the registers. Seriously. A one–man bank, right there in the grocery store. Next to the florist shop and dry cleaners. Beside the Madam Meeyamo Know's–All Psychic booth.

I wandered around for a while looking at things. A lady back near the meat department offered me some barbaqued chocolate– flavored tofu. Just across from her another lady was passing out samples of Chinese microwave pizza on a stick. They was doing a brisk business, yelling out how pizza on a stick wouldn't rot your gums like that tofu stuff, with the tofu lady firing right back about how her Japanese tofu flavored with Mexican chocolate was one hundred percent American, unlike that Chinese kack on a stick that was guaranteed to cause constipation.

Truth is, both tasted a bit like cardboard. Recycled, of course.

What with all the wandering around and reading the lables, damn if I didn't forget what it was I came for. I tried to remember but all I could think about was the IRS conversion I was working on when the phone rang. I plodded toward the door feeling pretty stupid. I should of written it down.

It was a lot harder to get out of the store than it was to get in. There was a press of people lined up to use the bank. Turns out, a one–man bank… or one–woman in this case, isn't real handy when a hundred people want to use it at the same time. Come to think of it, regular banks don't do much better, often having only one teller working even through they've got ten windows.

I worked my way around the crowd. When I came up against the Madam Meeyamo Know's–All Psychic booth I happened to catch Madam Meeyamo's eye. She was an attractive woman in her middle thirties wearing a business suit. I wondered if her name was really Madam Meeyamo.

"Actually, it's Helen Cates," she said. "The Madam Meeyamo schtick is a franchise."

I stood there gawking at her. I hadn't said a word. I wondered if she'd read my mind.

"Of course I did," she said with an exasperated smile. "I'm a certified psychic. And I'll help you with that thing you forgot just as soon as I take care of this lady."

Except there wasn't any lady. And then there was. She came huffing up from behind me with a frantic look on her face. "I forgot…"

"I know," Madam Meeyamo said soothingly. "That's why I'm here."

"It's for my niece's birthday party."

"Is that Ellen's daughter?"

"No, my brother Bill… "

"Karen or Halsie?"

"Oh… Karen, the young one."

Madam Meeyamo nodded her head, wrinkled her brow and stared intently at the woman who waited expectantly. "I see… pink. And a cake… "

"The candles! Of course! I need pink candles for the birthday cake. Oh, thank you!" The woman plunged back into the depths of the store. I stared at Madam Meeyamo, surprised to discover my hair really can stand on end if it wants too.

"Oh, don't be like that," she smiled. "Everyone forgets things now and then." She got that intent look on her face, staring at me like a snake after a bird. "I see… thirty–something… Oil. Thirty weight oil!"

"No, that's for my bus. I was thinking of picking up an exta case, seeing as I was in town. My wife sent me to pick up… something."

Madam Meeyamo gave me that stare again, her eyes all squinched up.

“Rubber pucks? I don’t think we carry rubber pucks.”

“Ah… that’s for the suspension I’m rebuilding.”

“You have to work with me on this, Robert.”

“Most folks… “

“…call you Bob. I know. But it reminds you of your Uncle Bob who was an alcoholic and you’ve never really liked the name. Try thinking about what your wife wanted you to get.”

I tried. I really did.

“Karmann Ghia? Is that some kind of pasta?”

“It’s my wife’s car.”

“I sense some hostility here, Robert. Maybe you should call your wife, ask her what it was she wanted you to get.”

I nodded, began edging toward the door.

“The phones are over there,” she nodded toward the deli.

“Yeah, but her number is at the house… “

“552–1381. And there’s a quarter in your left front pocket.”

“Paper cups,” my wife said over the phone. “Two dozen paper cups. It’s for the punch.” There was some sort of party planned for that afternoon at my wife’s office. I got the cups and headed home.

Coming up the drive I got this neat Idea, a kind of Psychic Hotline for Volkswagens, some sort of computerized list where folks could dial in, describe a problem and be told how to fix it. But the more I thought about it the more I realized it would never work. Nobody believes in that psychic stuff.

Mind Your Business

Growing up in a small central California town during World War II had a curious effect on my age. If you were big enough to do a thing, you were expected to do it and your age wasn't a consideration. That rule saw me driving a tractor when I was eight and piloting the Model–T into town on errands, a feat that made my older cousin David wild with envy for he couldn't crank the T–model, nor was he tall enough to reach the pedals. He assumed the role of co–pilot. I was a big kid so the cranking and driving fell to me. I didn't think it exceptional, it was the natural order of things.

A typical chore was picking up chicken mash at the feed store, or repair parts from the Ford dealer. Once we carried home an irrigation pump from the machine shop where it had been fitted with a new impeller. The pump was so heavy the front wheels of the Model–T came off the ground when I crossed the railroad tracks. Naturally, we had to back up and try it again.

Such errands never involved money. Back then, the economy of every small town ran largely on trust. Everyone knew my grandfather, who paid his bills promptly the first of each month. When running such errands we were always admonished to 'mind to your business.' As my grandfather's agents we were duty–bound to make no side trips and to offer no rides, other than to ladies burdened with packages. We couldn't even buy ourselves an icy Dr. Pepper unless the necessary nickels needed to do so were provided along with our instructions. Yet getting there and getting back was up to us. We were told what had to be done and left to get on with it. Our 'business' was to make a safe, successful trip to town and back. And we took our business seriously, aside from catching a little air now and then.
After bringing home a rebuilt or repaired part, the next step was to dismantle it in order to clean it. New, ready–to–use parts were rare things during the war and even those required cleaning since the cast iron was usually coated with protective grease. Aluminum parts were unheard of. Like the chrome–based green dye on packages of Lucky Strike cigarettes, aluminum too had gone to war.

The need to clean a part before installing it remains valid today although many aluminum parts are wrapped in protective paper instead of being coated with preservative. But a heavy preservative similar to Cosmoline is still used to protect new sets of Volkswagen cylinders & pistons, and it must be removed before the parts can be used.

About twenty years ago I saw a fellow rebuilding a Volkswagen engine at a local garage. He was plucking cylinder assemblies right out of the box and slapping them on the engine. No cleaning. No inspection. Thinking he didn't understand, I pointed out the need to clean them and was told to mind my own business, along with an ear–full about the hundreds of VW engines he had built and his years of experience. The fellow was perhaps twenty years old, half my age at that time. The garage is no longer in business.

I was reminded of the incident today as I was scrubbing a new set of forged Mahle pistons destined for Bob Polys' engine. The pistons and other parts are going to the balancing shop tomorrow and it's important that every trace of the heavy preservative be removed. And there was a lot of it, more than the usual amount. It looked as if one of the pistons had been dipped in the stuff. A mere rinse in the solvent tank didn't begin to remove the gummy tan grease, it took a lot of scrubbing with a fiber–bristled brush and running a bore brush through the oil scraper holes before it came clean.

Free of the heavy grease and blown dry with compressed air, the gram–scale showed only a few tenths difference across the set of four pistons, close enough for a regular repair. But the two– liter Polys engine will spend much of its life above five thousand rpm so the pistons will be matched to a tenth of a gram. A tenth of a gram of aluminum, not grease.

Had the pistons not been cleaned, the heat of running and the constant spray of oil from the journals would eventually remove the heavy coat of Cosmoline. But in the case of the piston with the blocked oil scraper holes, I doubt if the engine would have broken in properly.

I've already posted an article about jugs, explaining the need to scrub the cylinders and paint them, and to clean the pistons and rings, even though the parts are brand new. But having led the horse to water, the rest of the job depends on the horse.

The growing popularity of the Internet is causing many Volkswagen owners who have never heard of the various VW–specific mailing lists to discover the archive of postings maintained by Richard Kurtz. Sometimes they're happy with what they find. And sometimes they are not.

Recently, a fellow purporting to be a mechanic happened across the archive and took me to task over the 'Jugs' article saying many of the same things I heard from that other fellow twenty years ago. (This fellow referred to my continual emphasis on attention to detail as 'anal retentive' which shows he knows even less about psychology in general and the theories of Sigmund Freud in particular, than he does about auto mechanics.)

This fellow's main complaint seemed to be that he had not seen any of my suggestions '…in the magazines' or manuals. I've no idea what manuals he's been reading but when it comes to 'magazines' I can make a pretty good guess.

My response was to direct him toward another source providing the same information. Although I couldn't find a reference to painting cylinders in Tom Wilson's excellent "How to Rebuild Your Volkswagen Air–Cooled Engine," I notice the engine pictured on the cover of the book has painted cylinders. And on page 132 under the heading 'Clean Parts' Mr. Wilson says what all competent mechanics say — scrub the jugs. "Such parts are shipped with dirt–collecting grease and oil, and are never cleaned at the factory with engine assembly in mind. That is your job."

Sermonette

Free advice being worth exactly what you pay for it, when it comes to overhauling Volkswagen engines, if you've never done one the wiser course is to seek the widest possible range of opinions. And if someone offers an opinion, they should be willing to support it in the form of additional references and so forth. A few questions will be enough for you to tell if the person's opinion is based on factual experience or second–hand information, perhaps gleaned from one of the VW–specific magazines, whose primary business is selling magazines rather than overhauling engines.

Automotive engineering is a mature technology with a relatively narrow range of acceptable procedures for doing any given job. As you gather opinions on how best to do something you should see a distinct pattern, in that professional, experienced mechanics and engineers tend to do a given task in one particular way, and will offer a sound, well–reasoned justification for their chosen method. These are people who know their business, and no one can properly teach a subject they have not themselves mastered. In that regard, I think it would be best to use magazine articles for their illustrations and to discount their textual content unless it can be verified by other, non–magazine related sources. When it comes to engine overhauls, magazine writers and editors can surely teach us all a great deal about selling magazines.

When you overhaul an engine you are the Mechanic in Charge, the success of the job is up to you. For the duration of the job you are in the engine overhaul business. And it always pays to mind your own business.

MurMuirs of Reality

I first encountered John Muir's 'Idiot' book at the Ft. Myer, Virginia auto hobby shop, where I was building six six Volkswagen-based aircraft engines for members of the local chapter of the Experimental Aviation Association. The owner of the book appealed to me for help after attempting to cure a broken cam shaft by doing a tune-up, an event not covered by the 'Idiot' book (and not all that common in any case).

I was delighted with the book, especially the artwork, and immediately bought a copy. But as much as I admired what Mr. Muir had done to demystify auto mechanics it took only a quick glance through the text to make it plain the author was no mechanic. For example, he shunned ball joints and transmissions as being beyond the pale of mortal man when the truth is just the opposite. Overhauling a tranny is easier, faster and less expensive than overhauling an engine, and ball joints are a classic no-brainer: Out with the old, In with the new; far easier than rebuilding king-pins.

But what really bothered me was the number of safety-related omissions and John's advocating the use of certain procedures that caused expensive, permanent damage to the vehicle. This lead to an exchange of letters with John sometime in 1971.

When the four blind men examined the elephant the one who felt the trunk was convinced elephants were like snakes, the one touching the leg was sure they were like trees, and so on. John's view of automotive reality was similarly distorted. Like the blind man feeling the elephant's truck, John Muir failed to appreciate the overall 'system' that is a Volkswagen, and like the blind man, John had personal 'proof' of his conclusions: Pounding on an axle nut with a hammer and chisel does in fact cause it to come off. But any mention of the fatal damage inflicted to the bearing and differential gear was beyond his comprehension, perhaps because transmissions themselves were beyond his ken. He also appeared to have an inherent distrust of real mechanics.

A good mechanic is like a physician in that while we can not cure every ill our first tenet is to cause no further harm. John was not a good mechanic. I think he was a good writer, even a good philosopher, but my grandmother was a better mechanic; she was bright enough not to pound on things unless she knew it would not make matters worse. So while I'm sure John Muir was instrumental in saving a large number of bugs and buses from the smelter, I'm equally sure he was the direct cause of irreparable damage to a number of others.

(Loosening axel nuts with a chisel is a hold-over from the days of steam and plain bearings. The effect — commonly called ‘micro-flats’ — of direct impact loads on shafts supported in ball or roller bearings was explained by a series of articles in the SAE Journal in the early 1950’s.)

Another trait of a good mechanic is a willingness to learn; to test new ideas and opinions. The fact the current editions of the ‘Idiot’ books, which now cover just about every car known to man, contain many of the errors found in the first edition makes it painfully clear that whoever is running the store at John Muir Publications feels no obligation toward veracity.

I continue to recommend the ‘Idiot’ book as an excellent means of breaking down what may well be a cultural barrier; a feeling by some that the sweat and dirt of honest labor is somehow demeaning. For despite his inaccuracies, omissions and hilarious mechanical gaffs, John Muir did more than any one I know to make it clear that each of us is in charge of our lives. People often lose sight of this fact as technology intrudes into the most mundane aspects of everyday life, such as personal transportation. In modern-day America personal transportation is a virtual necessity, but for a growing number of our population it is little more than a dream. John Muir showed how the dream could become reality by explaining the Rites of Passage. All you needed to do was sweat a little. And learn a lot. All you needed to do was become your own mechanic.

John Muir is dead. Despite his admonition to ‘Don’t Think,’ if his books taught us anything it is the importance of learning; of thinking for ourselves. I think it would be an insult to his memory to stop learning, to succumb to blind faith. And while his books contain errors, I’m sure they would have been corrected had he lived. I’ve a hunch he wouldn’t mind at all if you took care of that chore for him.

Neighbors

Since Old Man Foster died back in ’66 the place next door has fallen on hard times. His son came over from Borrego and sold off about half the acreage and moved into the house but he was a barber and we already had two in town and it’s not that big a town, or at least it wasn’t back then. He finally had to sell out and move. I never got to know him. They was only here a couple of years and I was in the Navy then and it didn’t help that I sported a beard, then and now. Barbers have a natural dislike for beards.

After that, the Foster place really went to hell, first bought by a bunch of hippies who were going to live off the land, except none of them knew a thing about farming, nor much about work, spending most of their time talking about things they didn’t understand which was just about everything, and smoking funny– smelling cigarettes. They lasted about two hungry years, the last one living mostly out of our garden. Then there was the rock group, flush with cash and eager for a place in the country where they could play loud music day and night. It took about two years to sue them into silence. Three times. The third time the judge slapped them with a fine so big they decided it was time for another World Tour and left one night without even saying good–bye. Or locking the doors. Or paying the fine.

Our next new batch of neighbors were quiet as the grave. Sorta stand–offish. Lots a coming and going, always at night. Lotsa UPS deliveries of chemicals and laboratory apparatus. Then the ether exploded and put their speed–cooking chemist in the hospital and didn’t do the house much good either. Me and the other neighbors put out the fire; we’re in the country and it was all volunteer back then. Don’t know what happened to the owners. They dumped their buddy at the door of the Emergency Room and kept right on going.

After that the place stood vacant for a couple of years, slowly going to ruin. Got broke into my wetbacks who let their cook– fire get away from them and burnt off the west end of the back porch before we could get it out. They was cooking up one of the neighbors prize Nubian goats. We’re all afraid of fire up here on the hill, what with no water to speak of the closest help some distance away. After the second fire we started taking turns, checking on the place at night, chasing away the lovers and the wetbacks and the what–nots.

That’s why I throwed down on the new owners with a shotgun, I though they were burglars or Messicans or some damn thing. It was only loaded with bird–shot so I snuck up good and close before I announced myself. He just about had a heart attack and she peed all down her leg when I shouted “Hands up, you motherlovers!” Strange car, middle of the night. It seemed the thing to do. Except I didn't say lovers. But they got my drift. The For Sale sign went up about six months later, right after the coyotes chased their cat up a tree and ate it. City cats never believe how well a coyote can climb.

The School–Teacher Family was nice enough. Man and his wife, both teachers, one little boy about six. They wanted to get to know us and we was willing but the spiders got in the way.

I'm no naturalist but I'm naturally curious and we got some really strange spiders up here on the hill. There's a big green one with brown spots that makes these beautiful webs, some as big as a bed sheet, nets his dinner then eats the damn thing and makes a new one. There's another spider looks pretty much the same except he's mostly brown with green spots, makes a web about the same size. But damn if he don't patch his web instead of eating it. That got me curious as to which is the better strategy, a new web or a patched one, so I started watching those guys real close. The spiders hide–out during the day but you can tell one web from the other because the Patcher always has an odd number of radials in his web while the Eater has an even number. Each time I'd find one of their webs I'd figure out who it belonged to, measure the web then come back after dark and measure the spider, keeping track of which kind grew the fastest.

I was hunkered down in the weeds counting the radials of a new spider web I'd discovered when Mrs. Teacher and the boy comes down the drive. I was keeping track of the radials using a mechanical pencil as a pointer, counting my way around the clock of the web as they drove by. Real slow. Heads turning. I gave them a friendly wave and a nod but kept on counting. Some of them webs have nearly a hundred radials and you'd be there all day if you lost track.

The Teachers put up the For Sale at the end of the school year but it wasn't until they'd gone that we learned they hadn't seen the web, couldn't see it from their drive. But they had a nice view of me taking a crap in the bushes while conducting an invisible orchestra, or at least that's what they told the neighbors. And that I was a Peeping Tom, creeping around at night with a flashlight. Funny thing is, the neighbors never doubted them for a minute, not since I clipped the top of the eucalyptus doing a slow–roll over the house in a biplane a couple of years before.

The next batch of neighbors were into horticulture in a big way, growing America's favorite herb on the back of their newly acquired property, or trying to. I had to show them how to break down 'dobe soil with acid, helped them get the mulch just right. They lasted about two years. Four crops. Number Three was some primo shit. Or so I heard. Then came The Raid, with helicopters and SWAT teams and insane German dogs and more Deputy Sheriffs than a John Wayne movie.

So what's this got to do with Volkswagens? Well, it's like this… We got some more new neighbors, haven't met them yet but we sent them a Bread & Butter note like we always do, welcoming them and inviting them over for cocktails some evening; their option. Gave them our private phone number in case of trouble; call the Sheriff, they don't hardly bother unless there's shooting involved. But one of the talkative neighbors had already been there, giving them the history of the place and of their 'strange' neighbor with the airplane in the yard and all the antennas on the roof, so we weren't expecting to hear from them any time soon.

So I'm laying under this Karmann Ghia that has a bad CV. Got its ass hiked up on jack stands and my legs are sticking out from under. I've got the joints all cleaned and go to mark them and I can't find my white stencil pencil, which is what I use for marking. Sneak in the house and borrow a bottle of my daughter's nail polish and use that. Neat little 'L' on the left axel, little 'R' on the right, with perfectly painted little arrows and alignment marks.

It's not easy, using nail polish laying on your back, holding the bottle in one hand, brush in the other and trying to keep things neat. Sure enough, I got a piece of black gunk on the brush and can't get it off. Can't put it back in the bottle or my daughter would kill me. Shuffle out and get all greasy in the process; I'm not using the creeper. Sit down on a sawhorse and try to clean the brush. Bottle's in my left hand, brush in my right, big greasy thumb right there when I'm looking for something to sorta skim the brush on. Used my thumb nail.

Nail Sticks 'Pearlescent.' Real pretty, sorta pearly white. Makes a good marker for CV joints. And it went on my thumbnail neat as anything, nice smooth coat.

I had to just about paint my whole thumbnail to get the black booger off the brush but I finally got it. Looked up and there's the new neighbor, jaw hanging down to here, eyes sticking out like a couple of boiled eggs.

He didn't say nothing but you could tell what the damn fool was thinking. So I fanned–out my fingers like a girl, blew gently on the thumbnail and put on a second coat.

At supper my wife asks: "What's that all over your thumbnail?"

"Met the new neighbor today."

"Oh gawd," she sez real slow. "Not again."

Neighbors II

Adrift in a Junkyard

Some months back I wrote a mild spoof titled 'Neighbors'. But like all spoofs it was based on a kernal of truth — the place next door to us has had something like nine owners in the last fifteen years. The neighbors mentioned in the spoof split the blanket and took off about six months ago.

While I was away in Washington trying to convince Grendel to come home with me the place next door was sold and a new couple moved in. The other neighbors had no idea what had happened to me, my wife making only a casual mention that I was away taking care of some personal business. That probably got a few raised eye brows.

The new neighbors settled in, spending a lot of time and money sprucing up their new home, which is actually an old farm house built about 1922. We're a friendly crowd up here on the hill, keeping an eye on each other's kids and animals. I assume the new neighbors were welcomed and got to know everyone. They had been here about four weeks when I came rolling in with Grendel, posey'd nose, 'With Love, from the Forest' and other slogans blazened on the sides.

The new neighbors drive a Cadillac and something expensive, plus they have a little pickup for chores. Stu and Nancy. Nice people. But when I met Stu he was giving Grendel the eye. A buddy and I gave her a facial and got rid of the posey, even though she won't be doing anything but sitting with her feet in the air for several months. I painted the nose with red primer to protect the metal.

Then came the unfortunate howl from the left outboard gearbox on my '65. I knew it was having some problems — I've been meaning to get at the tranny for a couple of years now, and with a bad bearing in the gear reduction unit now meant NOW. So I shuffled the vehicles — we have seven, not counting the motorcycle — parked the '65 ('Green bus') beside Grendel, jacked her ass into the air and left her without engine, tranny or rear wheels.

The sight of two partially dismantled buses, both with bad paint jobs and crumpled noses, looming outside her kitchen window got Nancy, the new neighbor, a bit upset. For four weeks she had enjoyed a nice view of our hibiscus, pepper trees and cedar fence. Now she was staring into the bowels of a couple of wrecks. That was the day her parents arrived from Alabama to spend a week with the kids, see their new home and enjoy the view. ('No, dad. Look out the other window.')

As of a few hours ago the tranny is back in the ’65, everything rebuilt, cleaned and repainted. I want to do some chores on the engine but I should have that back in by Tuesday, then do a brake job, adjust the shifter linkage, install some new instrumentation and the green bus is outta there… to be replaced by a Red Bus.

Yep, another bus. That makes three. (I’d better send Joel a twix.)

I don’t know what I’m going to tell Stu and Nancy — or if they’ll even talk to me at all. But when the Rocket came along — my wife Jaysie has named it the ‘Rincon Rocket’ after the RFD mail carrier that served the Rincon Indian Reservation back in the ‘30’s — the bus was found on the Rincon reservation and is painted a shade of red that reminds one of Francis Scott Key and the British sack of Washington (I’ll let you figure it out).

Now the view will now be cluttered even more, since I’ll need to park the Rocket out back of the shop for a time. It doesn’t have an engine at the moment so once parked, it stays parked.

The topping on the cake came this evening. I usually start and run all the vehicles at least once a week. Fired up the Baja, let it warm up while I checked the ’68 bug, which doesn’t have its own battery. Came back in time to hear the Baja trying to swallow something, mebbe a valve. Shut her off. But now she will need some shop–time too, along with Grendel, the Rocket (which is a ’72) and the Green Bus. And the Toyota pickup has developed a shimmy…

Toyota pickup (nose in the air, front wheels off). ’67 Baja bug, crash cage pulled, bits & pieces here & there. Green bus, nose bashed, roof rack full of ladders, ass in the air, engine wrapped in plastic, lounging against the fence. Grendel, hell of a mess any way you look at her — light shines thorugh her walls and floor and nose. Rocket, a Low Rider, barely enough ground clearance to get her up the hill. It looks like it’s sinking into the ground — and will probably stay there. That’s what my new neighbors get to see when they look out their kitchen window. And they paid the earth for that place.

I hope Stu and Nancy have a sense of humor.

On-board Spares

All Volkswagens came from the factory with a rudamentary kit of tools as standard equipment. At the dealer each new vehicle was usually gifted with a spare fan belt and complimentary set of spare fuses. Up through the early 1970's it was not uncommon to find these things, untouched and even unopened in many cases — in older Volkswagens at wrecking yards. The tools were unused because the owner had no need of them, thanks to the presence of a Volkswagen dealer in almost every town of any size.

Times have changed.

While there are still a few Volkswagen dealers around most of them sell other brands of automobiles as well. Seeing 'VW' on a car dealers sign today is no assurance they even have a Volkswagen on their lot, VW parts in their storeroom or a mechanic on staff with more than a passing familiarity with an early air-cooled veedub. 'You don't see many of these nowadays,' he says as he opens the engine hatch and stands looking, mystified. Actually, you see it every day. The only one mystified is the mechanic. Today, your best mechanic is you.

So we carry our own tools... as Volkswagen intended. And carry a few spares, too. The most important spare on-board is a new fan belt, for the engine's cooling system depends entirely on that belt. And the electrical system, too. One belt. So we carry a spare. Or two.

Fuses are good. Older bugs and buses need only the two sizes — eight and sixteen amps — and most of us have learned the wisdom of using the better-quality Buss (brand name) GBC-type over the original Bosch or Siemens fuse, with their exposed strip of fuse-material.

We tend to NOT carry the things for which we already have two, such as headlights, tail-light bulbs or wiper blades. But the thoughtful do. And think a bit more, wondering 'What do I have just one of that might keep me from getting home?' and in their thoughtfulness add a throttle wire and clutch cable to their load.

Those of us with buses and those who yearn for empty places squirrel away a remarkable assortment of spare parts, often neatly packaged and fastened securely in the engine compartment of our boxy beasts. That lump is a carb, overhauled and ready to run, the one over there a fuel pump, this one a distributor, points gapped, waiting to fire and in doing so, carry me on my way.

An alternator or generator is a bit much but not so the bushes for either, or brush-holder with in-built regulator for the latter and regulator for the former, a spare often carried bolted near the first, a regulator-in-waiting needing only the quick transfer of connections.

Volkswagen has no interest in we owners of antiques — they can't survive selling fuses and belts, especially so since the fuses they sell are antiques themselves — the GBC's are better and the belts cheaper at that place down the street.

Carrying on-board spares adds a bit of weight to the load but prevents the deadly wait on the road, when the nearest clutch-cable is in Portland. And you are not.

So carry a few. Well-packed and preserved so they won't go bad. Nor will their prices grow, as they surely will if you leave them on the dealer's shelves. An on-board spare is here, right now. Portland is a Cascade Range away, an hour's drive or two-days walk and walking is illegal in much of modern-day America, especially if it's paved.

On-board spares are smart in the same way a Ph.D. is smart who never calls himself 'Doctor' and looks at things with quiet, knowing eyes. 'Ron,' he says as he shakes your hand. He has contributed to man's sum-store of knowledge and is satisfied with that. He's on a Journey and needs no one to celebrate his ego. On-board spares are like that — part of your Journey. Others turn back, drop out, give up. You've got what you need in your kit and drive on, promising to replace it when next you can.

Being smart isn't the same as being wise but carrying on-board spares is both and says much about the person who does so. Your casual "I'll be there," is taken by others as sterling, that you'll do what you say, because you always do.

For some of us it is not a celebration of ego to say we are as good as our word. We think, we plan and carry out those plans. We allow for the unexpected. And we carry a few spares on-board. 'I'll be there' becomes not an expression of ego but merely a statement of fact.

Pilot Error

My bus broke down today. It was that sort of day. I've been shaggin' parts for the LPG conversion, going here & there, asking strange questions of strangers and getting strange looks. Most automotive types are convinced you can't convert a veedub to propane so instead of answering my questions they give me the benefit of their lack of experience. It gets tiresome. But so does breaking down. I hate to breakdown and usually don't.

No warning. Right out of the blue. Jumped in the bus, belted up, turned the key. Nothing.

Oil & alternator lights were on, telling me I had 12vdc to & through the ignition switch. Tried it again. Nada.

This happened once before. The wire had come off the spade-lug on the solenoid. Without doing further tests, I skivvied under the bus, or tried too. No room. But I could feel the wire. It was At Home and Receiving. The first time it happened I replaced the female spade connector, added heat-shrink tubing to seal everything. It was tight.

I lay there in the parking lot half-under my bus trying to figure out what had gone south. A couple of simple tests would give me a lot of information but my tool kit was back home, holding down the new test-bench on which I'd just hung the 2180 for the LPG project.

Skivvied back out, went around front, began digging in the package tray. Found my cell-phone, the Ultimate Tool. Battery was dead. More digging. Found the 12v plug-in thingee. Plugged it in, called Roland Wilhelmy. I was supposed to meet him to transfer some parts, drink some coffee and exchange some sea stories. Told him of my plight and the possibility I might never arrive anywhere ever again except on foot and besides, the sky was falling. Roland told me to get a grip, he could be there in a while, with tools. I settled down to wait.

Part of the problem — and reason for calling Roland — was where I had broken down. It was a narrow, sloping parking lot. To push-start the bus I would have to push it uphill, making a tight turn in the process. Roland has a two-liter engine in his '65 bus and I have a chain in mine. If we couldn't solve the no-start puzzle he could pull me up & out of the parking slot, allowing me to roll down the hill (and onto a busy street), starting the bus by popping the clutch.

Or I could buckle down and solve the puzzle.

Although my real tool kit wasn't in the bus there was still the 'fail-safe' tools under the seat, including a small bottle jack. The little floor jack I usually carry in the bus was lurking under the new test-bench, pretending it was a dolly. The bus was heavily laden with an engine in the cargo bay along with a few hundred pounds of scrap steel destined for another project I have in mind. To work under the bus I needed to raise it. To raise it, I needed a jack. I started digging.

Found the jack but not the handle. Used a screwdriver. Raised up the bus by delicately balancing the edge of the rear torsion tube on the tiny top of the jack. Skivvied back under.

Once under the bus I discovered I couldn't see. Skivvied back out, found something white, tucked it into my collar like a napkin, skivvied back under, ignoring the stares of a couple of kids. It probably looked like I was going to eat the transmission.

The white material bounced the light, allowing me to see the starter and solenoid. No sign of damage. Traced the leads. Everything seemed okay. Skivvied back out.

I've fitted a headlight relay as a pilot relay for the starter solenoid. The pilot relay is mounted inside the engine compartment. Using a piece of wire about three feet long, I swiped some 12vdc from the B+ post on the alternator then probed the 'Switch' terminal of the headlight relay. It clicked the way a good relay should. I went back around front, turned on the key — and tried to start it again, just to see if it had healed itself — but got the same nothing as before. Making sure the brake was set and the tranny in neutral, I left the key on and went back to the engine compartment.

The inverter in the CDI module was singing, telling me the ignition system was hot. Whatever the problem was, it probably wasn't systemic. Using my test-lead, I probed the pilot relay again. And again, it clicked. But there was no transfer of power. The solenoid did not engage and the starter did not spin.

No power to the relay? Pulled the 'Batt' lead and scratched it against the chassis. Huge shower of sparks. It was probably getting power.

Which meant the relay had to be bad.

To check it, I used my test-lead to deliver 12vdc directly to the 'Load' terminals, which lead directly to the solenoid. Instead of actuating the solenoid I got another huge shower of sparks. Dead short!

Dead short in the relay? Or in the lead?

I disconnected the lead and again fed the terminal 12vdc with my test-lead. No sparks. The short was in the wire going to the solenoid... the wire I had just inspected, visually and tactilely.

The lead to the solenoid penetrates the firewall through a grommeted hole, along with several other wires. I pushed the wire back and forth. Or tried to. There was no slack. There should have been some. I pulled strongly on the wire. No slack at all. I went around to the side of the vehicle, fitted my reflective crevat and crawled back under.

Just forward of the firewall, obscured from direct view by the right heat exchanger, the lead to the solenoid had formed a small loop that appeared to be stuck on the corner of the heat exchanger. I felt all around the wire. It appeared to be stuck in a crack in the heat exchanger. I finally broke it free. It was not stuck, it was WELDED!

The wire was still in good shape, the insulation appeared to be cut rather than abraded. Free of the heat exchanger, there seemed to be an excessive amount of slack in the lead. I skivvied back out and sat there in the parking lot trying to figure out how the wire had gotten cut, where the slack had come from and do blondes really have more fun. About then, Roland pulled up.

I explained the problem, outlined the tests, told him what I'd discovered. We discussed the matter and decided, Yes, blondes probably DO have more fun. He also opined that I had a bad pilot relay.

"Shorted lead," I insisted.

"That too. And a bad relay," he declared.

"Lead!"

"Relay."

We settled the matter scientifically. His paper beat out my stone. Bad relay. But just to check I re-connected the solenoid's lead and toggled the relay with my test lead. It clicked but there was no transfer of power. Bad relay.

"Howcome?" I whined. I hate to lose scissors-paper-stone, especially standing in a parking lot in downtown Escondido wearing a paper towel for a bib.

"Dead short through a headlight relay usually eats the contacts. They either weld together or break off. These must have broken off." Roland holds an Extra Class amateur radio ticket. When it comes to relays, he knows his stuff. He can also play the spoons.

I dropped the bus off the jack, put things away, gave the carb a shot of prime, reached in with my test-lead and fed juice to the solenoid lead. The engine roared to life.

Heading over to my place to get the promised parts, we found ourselves on Highway 78, a modest six-lane county road. I was pulling about 3,800 rpm to keep up with the 65mph traffic in the slow lane when Roland puttered past doing about seventy-five, his engine at high-idle. His new IRS tranny and rear suspension, coupled with a husky 2.0 liter engine, makes his bus too fast. Old splitties shouldn't go that fast, especially not when the engine is going that slow. It ain't natural.

A small hill knocked my speed down to sixty but didn't effect Roland one whit. His old bus was running 75 in the #2 lane, steady as rock, engine going putter-putter-putter. I struggled up the hill thinking dire thots. First, his paper wrapped my stone, now his bus breezes out of sight going uphill! It was that kind of a day.

At the shop Roland helped me sling some engines around. Over a cup of coffee we decided I'd probably crimped the wire when I swapped trannys, having re-installed the engine in the dark and while working alone, at least during that last critical stage when the heater-box could have snagged the wire. As for the slack, it wasn't until I was home that I realized the entire relay, which is secured with a single bolt, was now oriented on its SIDE, having been rotated ninety degrees, apparently pulled into that orientation when I snagged the wire on the heat-exchanger while installing the engine. Had it pulled any farther, the spade-lug would have come free of the terminal and I would have discovered the trapped wire. As it was, the wire remained trapped over a sharp edge on the heat exchanger and after approximately four thousand miles, the inevitable occurred.

There's nothing wrong with the layout of the wiring nor the location of the pilot relay. The problem here was Pilot Error, flying an engine into a bus when conditions were below minimum. I should have re-checked my work.

Positive Things & Buses

A recent thread asked for positive examples of the benefits of bus ownership. That is the sort of question that reveals far more than it asks. On the surface it appears to be a simple request for information, to which I've responed in the first part of what follows. But peering deeper into our navels, we're liable to come upon a lint–ball we're unwilling to touch.

Those of you who have seen my 1965 bus know it is not a thing of beauty. The paint scabrous and pie–bald. One reason for its rough appearance is because the bus is in constant use, there is no time for cosmetic things. Tasked with a 900 mile trip several times a year plus an occasional longer jaunt, more than 1,500 miles to attend the Big Sur outing, or hauling a ton of Portland cement to the top of Mt. Palomar, the bus is expected and required to do all. And it does.

The simplicity of the engine's design makes it amenable to modification, allowing incorporation of modern technological benefits not available when the vehicle was manufactured, such as electronic ignition, a full–flow oil filtration system, a better cooling system and more reliable electrical components; it now uses an alternator rather than a generater and runs better for it.

The bus handles better than it did when new, thanks to better tires and a stronger suspension system. Most importantly, the bus gets better gas mileage, requires less maintenance and is more reliable. Because of its age the cost of insurance is low, as is the annual license fee and it does not require the biannual smog inspection expected of younger vehicles, although its emissions are an order of magnitude less than those allowed by law.

My bus has not had an easy life and I am at least its fourth owner. It has suffered from collision and all of its major mechanical components have worn out through its years of service. But as things wore out, they were repaired, overhauled or replaced so that today only the front axle assembly and chassis are original as–manufactured parts, and the front axle will be replaced before I set out to drive to Inuvik, a few oceans away.

All of these things argue for the postive aspects of bus ownership yet to the mainstream of American thought, my bus and I are examples of failure. The bus contains not a single molded plastic cup–holder. It has neither carpeting, air–conditioning nor stereo. Indeed, it has no radio at all and incorporates none of the supposedly necessary features, all of which were designed for the lazy, thoughtless and immature. My bus has neither buzzers nor chimes nor even a light that springs on when I open the door. All of that falls to me. If light is needed, I must turn it on. I am responsible for my own safety, and for the safe operation and maintenance of the vehicle. In a society were no one is ever at fault, the buck stops here.

And therein lies the message and the only valid answer. The reliability — the honesty and functionality — of any vehicle, system, agency or anything else, is nothing more than a reflection of the person in charge. My bus. My responsibility. If it craps out, it's my fault. No excuses. This applies equally to every aspect of our lives. We have the capacity to shape our lives and determine our own destiny. Not some group or governmental agency or Book. You are the person in charge. You may accept or deny your responsibilities. The evidence indicates most have chosen denial.

The purpose of this list is not to preach the obvious but to illuminate the obscure. Unfortunately, in the modern age the obvious is often obscured, and not by chance alone. If the logic of that is unclear it's good evidence your life is not your own. You need to achieve a higher plane to achieve a broader view.

Road Trip From Hell

This is part sermon, part saga. I'm not sure which part is which.

I had to make a trip to Modesto, four hundred miles and change from my home in Vista, near San Diego. Weapon of choice was my 1967 baja'd beetle, mostly because it's faster than the '65 bus and gets better mileage. The bug has one seat. It is heavily modified.

Left Vista at noon on Tuesday, arrived in Modesto about eight hours later. Weather was hot (90+) for most of the trip. Average speed was high (80 to 90). Combined with a lunch stop and a couple of 'comfort' stops, block-speed worked out to about 60mph, fuel consumption a little better than 20mph. No problems noted although oil temp ran about 240 — 20 degrees higher than normal even for hot weather, and pressure about 40, 10 pounds lower than normal. Oil was 30W, a change from the usual 20W-50 in anticipation of the hotter weather in the Central Valley. And yes, it did get warm.

Driving around Modesto I noticed a new sound from the passenger-side front wheel. Checked the bearing and found it failing. Cleaned the hub, replaced inner & outer but was forced to re-use the old oil seal, unable to find a replacement.

But the problem wasn't with the bearing, it was with the spindle. Before I acquired the car it had suffered a spun outer bearing on the right front spindle. Apparently the long high-speed run up highway 99 had allowed enough motion between the race and the spindle to wear it below spec. That's just a guess; I carry a lot of tools when I travel but no precision instruments. But the new bearing was a loose fit.

Shopped for a replacement spindle at all of the local junkyards. Found some nice buses including a pair of Westies (Pic & Pull, near Empire, east of Modesto) but only eight bugs, only one of which had spindles I could use and of course they were already gone.

Decided to head home early, take it slow. Big mistake here was to elect to travel south via Interstate 5 instead of highway 99. I-5 is pretty barren. Departed Modesto about 6 pm Friday, counting on low speed, the cooler evening hours and the slightly higher elevation of I-5 to keep the bearing cool.

I spent nearly five hours to travel a couple of hundred miles south, stopping frequently to let the bearing cool, repack the thing and so on. I had one canteen of water (a gallon), used it to cool the bearing, repacked it twice. About 11pm I knew I wasn't going to make it home on the spindle/bearing. Called home, told them I would be late. Repacked the wheel bearing and headed east, hoping to reach Fresno about 100 miles away. Made it, or at least close enough to count, but it was the middle of the night (temp still in the high 80's). I flaked out in the bug for a couple of hours, parked outside a junkyard. (There's a fore & aft shelf instead of a passenger seat, long enough for a stretcher.) Local activity — and the heat — woke me up about 6 am. When I dismounted the wheel to repack the bearing, the cage came apart. So I went ahead and removed the spindle. I wouldn't be able to drive the bug but neither could anyone else.

As luck would have it, the yard where I'd parked didn't have any air-cooled VW's and no bugs at all but they put me onto one that did and a customer offered to drive me other there.

I figured out what tools I'd need, made up a pack, put on my straw hat (standard Baja-issue), slung the pack over one shoulder, canteen over the other and started The Great Spindle Hunt.

I didn't have any luck finding a spare spindle around Fresno but picked up a new set of bearings and an oil seal. It was Saturday, hot — over 100 —and busy. I was wearing levis, boots, long-sleeved khaki shirt and a lot of grease. People were surprisingly kind; I had to pay for only one ride. The costume may have helped, or perhaps it was the temperature — 105 at one point in the afternoon.

Finally located a spindle near Madera. Hitched a ride and got there just before they closed and was allowed to borrow a jack to facilitate removal of the spindle; I had a small floor jack in the bug but didn't add it to the pack due to the weight; I was giving lessons in sweating as it was.

Got back to the bug about seven thirty, called home — they were getting a little nervous. Got the spindle installed, did a rough wheel alignment using two pieces of plastic water pipe as a gauge. Couldn't do anything about the camber but got it close enough to work. Cleaned the hub with gasoline (the bug carries 25 gallons), got everything back together, started home.

Pretty dopey from the heat & work; probably a little dehydrated even though I'd downed at least a gallon of fluids during the day. Kept the speed down. Got to the top of the Grapevine about 1130, called home to tell them I'd be a little later than expected. It was cool up there, 4,000 feet above the valley floor. Had some coffee from the truck, smoked a pipe. Dismounted the wheel to check & adjust the new bearing. Couldn't find the metric allen wrench for the spindle nut. Had to empty the whole damn bug, search everything before I found it in the pack. (I used a piece of nylon luggage with a shoulder strap as the pack to carry the tools when I went hunting for the spindle.) Saw that as a sign; put all the tools back into their proper places, re-packed my bag, taking the opportunity to change trousers. But I only had the one shirt, now a bit the worse for wear. (I'd left them hanging back of the shop when I loaded the bug for the trip, drove off without them; washed the one I had every night I was in Modesto.)

Motored on down the mountain just in time to run into a freak rain storm crossing the LA basin. Lotsa lightning, heavy rain. Engine ran fine but started having some electrical problems, apparently due to a slipping fan belt. (The engine has no cover; if it rains, it gets wet).

Kept it rolling; there's really no place to pull off until you get across LA. Pulled off near San Onofre, adjusted the fan belt. Ruddy moon just coming over the mountains to the east, rising up through layers of clouds. Odd, fitful puffs of wind. It started to rain again as I neared Oceanside.

I arrived home at 3:34 having been awake about 22 hours. Total miles traveled, 923 to make-good a distance of about 870.

Sermonette

If you want to lose weight, buy a Volkswagen. I lost eight pounds in two days :-)

If you live in Modesto, forget using America On-Line; local access is only 2400 baud. (Sandy Eggo runs 38,400.)

If you travel for a few days, remember to No Mail the Vanagon list servor; musta been a couple hundred messages in the mailbox when I turned this thing on.

Always carry a spare right-front spindle :-)

Science Fiction

Allowing a bit of tom-foolery on the Transporter list on Fridays has become something of a tradition, even though the list(s) have only been around a couple of years. Traditions happen fast in America :-)

Reading the recent pro's and con's of fuel injection versus carburettion triggered a flashback. I was six or seven, the war was over, the town suddenly flooded with veterans. My dad had taken me to the barbershop, which happened to be attached to a garage on one side and a gas station on the other, a popular hangout for returning veterans.

The flashback involved an argument between some of the vets at the barber shop about the superiority of American weapons versus German weapons, especially aircraft and their engines. The fact the Daimler-Benz engine in the Messerschmitt Me-109 — and other German aircraft — used fuel injection was cited by one of the men as a principle reason for our victory — carburetors were better than the 'new-fangled stuff'. The conversation didn't stop there. It touched on the merits of self-starters on cars, elevators versus stairs and a host of other topics, all stressing the superiority of well-proven, old-fashioned technology over the hazards of all this new-fangled stuff. My dad didn't join in the discussion other than to nod now and then.

Walking home with my dad I asked if that's why we won the war —because the German's used fuel-injected aircraft engines. He laughed and told me that wasn't really what they were talking about. The German engine was at least as good as the Allison or Rolls-Royce. That astounded me. It sounded vaguely disloyal but I knew him to be a wizard mechanic — if he said a thing was so, you could take it to the bank.

What they were talking about, he said, was wanting to come home and find everything the same. But everything had changed. It was the changes that made them talk like that.

I didn't understand. Later in life I came to understand a good deal about engines. But my dad was talking about change, and about people, a subject I've yet to master.

Change is a constant. For the young, without a frame of reference, change is the normal state and is readily accepted as such — whatever is new is inherently better than whatever is old — new things and new ideas, at least new to youth, are quickly adopted by the young as their reality. But after we've lived for a time — once we've established a frame of reference — we begin to see that many changes are not new things but merely old things wearing a new coat of paint — someone keeps stirring the pot, the same old potatoes come to the top and sink again. Old potatoes are always 'New!' or 'Improved!' according to the people who sell them, and eagerly gobbled up by the kiddies because of it.

In time, we come to realize another constant in our lives is people trying to sell us old potatoes. Discovering we've been duped often leaves us bitter. When we reach that point we begin to view new things — and all forms of change — with suspicion. We cleave to what we know. What was shining and new and instantly embraced in our youth becomes the good, old-fashioned stuff of middle-age. It is our security blanket, a bulletproof vest against the missiles of a changing world. It is also the seed from which grows the tree of ignorance.

The wiser course is to test new things against our store of experience, adopting what is good, discarding what is bad but always with tolerance. Some bad things will always be wildly popular among our youth simply because they lack the frame of reference defining those particular evils. Merely telling them something is bad does little good — it lumps us with the sellers of old potatoes. There are some lessons each generation must learn on their own, a Rite of Passage between childish play and adult responsibility. Each generation must eat its share of old potatoes.

So what does all this have to do with fuel injection? Not a lot. But it has much to do with Fridays and this list and keeping our wits about us as we edge along the cliff of life.

Sermonette

By their nature, carburetors are a compromise, providing the optimum fuel/air ratio across only a narrow range of air-flow and manifold pressure. Attempts to resolve this problem lead to carburetors of blinding mechanical complexity.

>From an engineering standpoint, when it comes to internal combustion, gasoline-fueled engines, the ideal is one carburetor per cylinder. Fuel injection advances you toward that goal. Fuel injection utilizing electronic controls cabable of sensing the engine's state and feeding-back that data to the fuel-injection controller comes very close satisfying the requirements for optimum engine efficiency and performance.

As for the Science Fiction part of the title, that's just an old potato I threw into the pot :-)

Stainless Steel Craftsman

Today I witnessed one of the most astounding feats of craftsmanship I've every seen. Roland Wilhelmy, owner of a '56 VW Sedan that is undergoing a hands–on body–off restoration, replaced the bug's original steel fuel pipe with one of stainless steel. The astounding part is that he didn't take the easy way out and run the new pipe along–side the tunnel, Roland installed the new pipe IN the tunnel, and in the original brackets, to boot! And all without cutting or welding on the tunnel.

The early Volkswagen shop manual describes how to do this (Step 1. Remove the body…) but I have NEVER heard of it being done. The labor and shop–space requirements are so high that everyone I know who did it used the Alternative Procedure, running the new fuel pipe through the passenger compartment.

"I didn't like that idea," Roland said quietly.

So how did he do it? I'm not too sure; the shop manual sez you need a helper to guide the thing; Roland did it all by himself. (But I did notice a Pentacle on the floor of his shop :–)

My contribution to the job was to provide him with a piece of solid steel guy–wire exactly .156" in diameter. Working alone, he had already installed the new tubing almost the entire length of the tunnel, managing to thread it through the four intervening support brackets. He slid the heavy wire into the tranny horn where the original fuel pipe exited and somehow managed to insert it into the stainless steel tubing, out of sight inside the tunnel. Returning to the front of the vehicle, he commenced tapping on the end of the new tubing, projecting about four feet beyond the front axel. The stainless steel tubing inched its way around the bend where the tranny horns mate with the tunnel, following the line of the heavy wire, which now acted as a guide. In a few minutes the tip of the new tubing emerged from the tranny horn neat as can be.

Making the terminal bends in the new tubing and coaxing them into their respective positions took a bit more slight–of–hand but the job was finished in less than an hour.

I thought it was about the neatest thing since electric lights but Roland shrugged it off as no big deal. Perhaps not, considering what has gone before. He's already replaced all of the brake lines, done an IRS conversion to the rear suspension and there is a pair of disk brakes lurking up front, along with a steering damper, an important handling improvement lacking in early bugs. And the four–joint TransFrom transmission has their special tag showing non–stock gear ratios. Roland is building a Porsche–eater, disguised as a Volkswagen. Yet the original 36hp engine and stock 1965 running gear was neatly stored on welded racks, preserving the option of returning the vehicle to all– original condition. Roland also drives a suspiciously quiet bus that has a few more carbs than most other ’65 models.

As I was leaving, I noticed the body of the bug lurking back in a corner of shop, remarkably smooth under about a zillion coats of hand–sanded primer. Strictly stock. Perfectly straight. He’s replaced a couple of body panels, including the forward engine compartment curtain, fitting one from a late model chassis, allowing him to use the larger engine’s tin without modification. This is the kind of subtle attention to detail that you only see on race–winning road cars. The work was so neatly done I wanted to rub it against my belly. Asked how it was going, he gave another shrug. “Coming along.” And grinned. That grin is going to make a lot of Porsche owners trade up to a Yugo.

The American Way

Speaking as a mechanic, the preditations of dealers (and mechanics) on car owners has kept pace with the systemic dumbing of America. Here in California automotive interests bribed our elected officials to gut the automotive division of the Office of Consumer Affairs; we now have two (!) investigators to handle complaints. The population of California is about 30,000,000.

The bribes were all legal, of course — campaign contributions and the like. And the official word is that the staff reductions are part of a State-wide economy move. Besides (the legislators argue), the State office duplicated the functions of various city and county offices. Sure they did.

When we have a headache we don't think of cancer, we pop a couple of asperins and the pain goes away. Until the next time. But the problem of dishonest dealers and mechanics is only a symptom, the disease is more subtle and far more pervasive. Unless the root problem is dealt with, complaints, civil suits and letters to the editor are about as effective as treating cancer with asperin.

One reason I own older Volkswagens is because I can maintain them forever, no dealers required. I would rather have the work done by an honest, courteous dealer but I haven't run into one of those in more than twenty years. If my family is to enjoy the benefits of personal transportation I feel I've no choice but to become my own mechanic. (Lucky for me I are one.)

I would also like to own a newer car but it doesn't take a rocket scientist to figure out that the fair market value of the typical new car is from 67% to 73% of its price, according to Kelly's Blue Book. And insurance companies use the same kind of creative accounting, having one evaluation to calculate your insurance rates, another when settling a claim. This is 'good business.' It is taught in our business schools and its sharpest practitioners receive million dollar salaries and are celebrated in numerous Man of the Year awards. But it is neither fair nor ethical. With the bulk of Americans mechanically challanged with changing a flat tire, their options in personal transportation are limited to a choice between cancer and polio.

Up to this point a lot of people — possibly a majority — will agree with me, offering a verbal pat on the back for being the last of the red-blooded Americans with greasy fingernails. But that misses the basic message, which is simply that the system doesn't work. And what lies ahead is definitely dangerous territory.

I'm also prepared to shoot mad dogs and kill my own burglars. This is not a

Rambo-esque choice, it is a requirement for the security of my family since our hi-tech mega-buck public safety system has an average response time of about thirty minutes, if they show up at all. Our courts have ruled that public safety organizations are not obligated to respond to any specific call, only that they provide a uniform level of response to the public as a whole. So everyone please note: Wandering around my property at night may be hazardous to your health.

Far fewer Americans will agree with this latter position, but for the area in which I live it is as valid as the need to do my own auto repairs and for the same reason: The system doesn't work. The only question is, how long before this situation becomes the accepted norm for a majority of Americans?

The Flying Pig

There's a gal on the Vintage VW list who calls her bug 'Boris.' I mentioned Boris at dinner one night then had to explain, or try to explain, that a lot of Volkswagen owners give their bugs and buses names. My wife gave me one of those looks, quietly asked what I called my bus. Blank. To me, it's just the Green Bus. Before, there was a Brown Bus, before that a Red & White bus. I said I didn't give names to things. "But you called your airplane 'The Spirit of Vista'," she pointed out. But never flew it to Paris. "If I ever put wings on the bus," I told her, "I'll give it a name." And muttered something about doing it just as soon as pigs could fly. That cracked her up. It also named the bus. "The Flying Pig?" she laughed.

"I couldn't do that," I muttered. I used to have a buddy who was a cop, spent umpteen years building a helicopter. Called it The Flying Pig. Flipped it during a test flight and burned to death. I wouldn't want to steal his thunder. But maybe El Puerco Volador? Is that right? I'm always getting my Spanish mixed up.

A ham radio buddy came over after supper. He's got some strange plumbing problems. Only way to fix it is to make an adaptor that will allow old thin–wall ABS pipe to mate with new schedule 40 PVC pipe, but no one carries the adaptors. So we made some. Turned them up on the lathe. Took only a few minutes. Lathes are handy things and mine's fully automatic. Just grab the knobs and think about something else while the parts sort of make themselves. I was thinking about Flying Pigs.

While I'm working, my buddy is looking around the shop. There's an airplane engine under a bench, two fully dressed Volkswagen engines on scooters, a Datsun engine sulking over in the corner beside an orphaned 2–cylinder air–cooled DIESEL engine that might one day power something strange and noisy. Above the diesel hangs a row of heater boxes.

My buddy looks at the five Volkswagen heat exchangers hanging in a row. Five. An engine needs two, a lefty and a righty. So how the hell did I manage to end up with FIVE heat exchangers? I never noticed that before. All new, too.

Six blower housings. Three dog–house, three flat–backs. One of the dog–house housings is an after–market 36–hp style that proved it couldn't flow as much air as stock, ended up not being used. I've no idea how the others came to be in the shop. You leave the door open, stuff wanders in. My hands make another adaptor and my buddy hunkers down, peering under a bench.

Three 12v alternators, two Motorolas, one Bosch. Two 12v generators. A whole scad of 6v generators. Why do I keep that crap? Blowers. I had a nifty idea for using old blowers to make… I'll think of it in a minute.

A whole bunch of intake manifolds. Oops! Make that a bunch and a half; couple more of them hanging over there. Dual–ports and single ports, several of each. DP Kadron bases. SP Kadron bases. That makes… at least TWO bunches. And carbs. Lotsa carbs. Box of Kadron carbs. Box of Solex carbs. Whole big drawerful of other carbs including a lonely Bug Spray. Future projects, waiting for… the future, I guess.

Mufflers. Yea gawds have I got mufflers! Four stock bug mufflers, at least that many extractors. It's hard to tell with extractors. You toss them in a pile, they start squirming around, get all tangled together, you gotta spray them with a hose, beat them apart with a stick.

Black, greasy thing under a bench. My buddy gives me a look, brows raised. "Tranny," I tell him. Two more, back in there some place, along with a pile of axles. One of the trannys is a rebuilt, ready to run. I've been planning to install it in the '67. I better make a note to myself to get to it Real Soon Now.

Cylinder heads. Pile of them here, row of them there, two on that bench, pile over beside the grinder, couple over by the welding rig. The bench where I do head work has got this big box of valves, another box of fuel pumps, some old, some new. Shelves hold rebuild kits for carbs and pumps and generator brushes and wheel cylinders and a whole slather of reloading equipment for half a dozen different calibers. The reloading stuff should be over on another bench but that one's being used to test a six inch mirror for a reflecting telescope.

Stack of flywheels over by the milling machine, right beside a stack of stock, original, real VW–type Volkswagen hub caps for an early bus. Should be four. I count them twice. There are four. I feel relieved, give those five heat exchangers a glance. Still five of them.

Bus steering gear and steering wheel shaft leaning up in the corner behind the welding machine, like its waiting for a ride, which I suppose in a way it is.

Overhead, running pretty much the full width of the twenty–two foot wide shop is a pair of airplane wings. Volkswagen engine tin–ware is poked up on top of the wings, the smaller pieces hanging down on hooked hunks of welding rod, handy to get at. A stack of sump plates like little Frisbees. Funny gaskets. Sez 'GMC manifold.' There's an old Jimmy down in the grove. My hands finish another coupler as my buddy gazes at stuff hanging on a wire.

“VW air–vanes,” I tell him. “Goes inside those things overthere.” Two sets of air vanes, one reconditioned, painted with gray epoxy primer, others looking like something out of the La Brea Tar Pits, which tells me they came out of an all–original 1963, never–been–touched engine I recently overhauled. The thing blew an oil cooler seal, pumped oil all over for about six months before the guy sold it to a kid. They were both happy as clams, each sure they’d gotten the best of the deal.

I finished making the adaptors for my friend, chatted a while. “You’ve got a lot of stuff,” he said as I saw him on his way. Strong note of admiration, tinged with something else. Relief? Envy? Is it every man’s dream to have lots of stuff?

I came back to the shop to wipe down the lathe, cover it, sweep down. Seeing the shop through my buddy’s eyes was a strange experience, like when he stood reading the note on the chalkboard over where the phone used to be “Pullen – Concrete”, a reminder about helping Clint Pullen do a little sidewalk out behind his house so his wife’s wheelchair wouldn’t get caught on the stones. Clint’s been dead at least five years. After I moved the phone, I never used the chalkboard again. We did the sidewalk for Alice back in 1977.

I sat looking at the incredible collection of stuff that has crept up on me over the years, looking at it with mixed emotions. Too much stuff is bad for you, nails you down. But my formative years were during World War II, when everything was rationed, you even had to stand in line to buy food.

I was taught that throwing away Good Stuff was a sin. We needed all that Stuff to Remember Pearl Harbor, so we could Slap the Jap and Heel the Hun. They made us chant slogans like that in school, then sent us out to scour the neighborhood for scrap metal, knocking on doors, brow–beat old ladies into giving up their aluminum pans.

Have you ever tried to make steel? It’s not easy. Better to keep some on hand in case you need it, like that pile of tubing, or those old door panels. You never know when you’re liable to need a door panel for a… whatever the hell it came off of. And an old veedub axel makes a fine gun barrel. Remember Pearl Harbor. And Ruby Ridge.

I sat thinking a little too long, started going a little crazy. Bus right outside, pair of airplane wings strapped up across the ceiling of the shop. Five heat exchangers hanging in a row.

El Puerco Volador. Maybe I could use one of them door panels for the rudder.

The Forever Car

A recent thread (Methyl Hydrate) about fueling your car with alcohol to squeak by an emissions test touched on the morality of violating the spirit of a law intended to provide a healthier environment. The comments circled the mountain but failed to climb it. The real question has to do with the fact that transportation is a necessity of modern-day life and the role government plays in supporting that collective need. But before we can appreciate the 'morality' of something as arcane as gasoline versus alcohol we need to understand the fundamental basis for governments, for without that understanding the question of morality with regard to observing a rule imposed by government can have no foundation.

Governments don't form themselves, they are formed by people in order to gain some advantage, usually to enhance their welfare by forming a group large enough to accomplish collectively what they can not achieve on an individual basis, such as defending their homes. The paradox of government is that the individual must always give up certain personal freedoms in order to enjoy the collective benefits.

The sad thing about governments is that in every single case, government formed by the people eventually becomes so large it begins to prey upon the people who created it. Instead of being the servant of the people, it becomes their adversary. Our founding fathers recognized this flaw and tried to insure against it by stressing certain 'inalienable' rights, all of which have been abridged by our government whenever it feels threatened.

The fact remains that we can not earn our livings nor enjoy our 'inalienable' rights without access to transportation, it is a collective need. In recognition of that fact we have used governmental powers to foster transportation, from the earliest canals to the latest space flights. Public transportation was very much a part of the overall plan, up until the end of World War II.

When I was a boy the light-rail system of southern California was one of the finest in the world. You could travel by streetcar from Riverside, California to Newport Beach, a distance of nearly a hundred miles for about seventy cents and every metropolitan area enjoyed the use of a similar system. The corruption that lead to the demise of that magnificent rail car systems is a matter of public record and serves as an object lesson for anyone foolish enough to trust an elected official. Or the morality of large corporations. Even more chilling is that having successfully raped the southern California light rail system, the same corporations and agencies repeated the process all across the country. Government and industry acted in concert to destroy an invaluable public asset, replacing it with a few buses and the concept of 'personal' transportation. Their motive was greed. Public outcry lead to investigations and even a few trials in which corporations and government officials were found guilty of a variety of crimes. Their typical punishment was a warning, the maximum fine $5,000. What was good for General Motors was good for America. And to hell with the Americans.

In the nearly two generations since that time the public has been carefully trained to respond to the Pavlovian need for ‘personal’ transportation, squeezed into a succession of smaller and smaller boxes-on-wheels, brainwashed into believing they are doing the right thing. Today, the average American driver is firmly convinced that miles-per-gallon is the major factor in the cost of getting from here to there.

It’s all bullshit. Very carefully thought-out bullshit.

Personal transportation is a luxury, the cost rapidly approaching one dollar per mile. The major portion of that cost is spent buying your box-on-wheels, financing the money used to buy it, for insurance, licensing fees and other taxes. Fuel, oil, tires and maintenance makes up only about eight percent of the cost of personal transportation. Miles per gallon — and emission standards — are a bureaucratic joke.

Why are the costs so high? Partly to justify the mega-agencies who have ‘rediscovered’ the need for public transportation, who can only justify their billion-dollar budgets by comparison with the cost of personal transportation. (“See? Three bucks to ride the BART is cheaper than driving your own car! Are we great or what!”) The unfaithful stewards who have screwed the American public for so many years are haunted by the thought of old Volkswagens that cost only pennies per mile to run and seem to last forever, or by anyone bright enough to keep their car for five or ten years. Fortunately for them, most Americans aren’t very bright and our concept of history involves what we had for breakfast.

The dollar-per-mile cost of personal transportation is nothing more than a monstrous scam. Car manufacturers, banks, insurance companies and the legions of politicians they have bribed are all parties to this scam. And you are the scam-ee. (Okay, it wasn’t a bribe it was a ‘political contribution.’ If you’re addicted to a diet of bullshit perhaps calling it chocolate pudding will make it taste better.)

Want to guess what happens if you drop out of the dollar-per-mile cycle? What happens if you keep your vehicle longer than three or four years? Economic disaster, at least for the current crop of bean-counters. According to Consumer’s Union, people who drove the same car for ten years or more realized a ‘hidden’ income large enough to buy a new home. In the ‘worst’ case their hidden income was large enough to buy a new home and put two kids through college. This news did not play well in Detroit. Or Washington.

John Muir of "...Compleate Idiot" fame awakened me to the Forever Car theme more than twenty-five years ago. The intervening quarter-century has seen no change in the personal transportation scam or the fundamental ignorance of our society. Nor in the arguments such things engender. Most discussions about the benefits of keeping a car forever are quickly side-tracked by bean-counters who attack the figures, show them to be fallacious in a particular case and plaster that conclusion across the entire argument. The deeper implications are never discussed and the typical car owner, bombarded with a constant barrage of slick propaganda, chooses the easy way out: they buy a new car every few years and dive back into the tube.

Want cleaner air? Get rid of the cars. Emission standards are akin to trying to cure cancer with aspirin. Want to drive for a penny a mile, own a nice home and put your kids through college? Keep your car forever.

Now, did someone mention morality?

The Glowing Letter

I recently received an e-mail containing such glowing words of praise I could not answer it immediately. The writer was a woman, obviously perceptive, no doubt beautiful, young, wealthy and well educated. She had discovered the file of my articles maintained by Richard Kurtz and wrote to praise my wit, wisdom and tenacity in extravagant, but wholly justified, terms. In her eyes I was a cross between Albert Schwitzer, Aristocles and Wrong Way Corrigan, with a dash of Hercules thrown in. The outrageously complimentary letter had me strutting about the shop, shaking back my mane of golden curls with various body parts puffed up, jutted out and generally getting in the way of things.

I'm planning to make the run to Inuvik with the other crazies but recently discovered the astronomical price of gasoline as you climb toward the top of the planet. I'm financing the trip from my mad-money budget and the thought of paying nearly four bucks a gallon for fuel had me sweating bullets as I tried to figure some way around it. The Glowing Letter helped. I applied my wit, wisdom and tenacity to the problem and came up with a design for a pair of saddle tanks I could strap under my 1965 bus that would allow me to travel a thousand miles without refuelling, the idea being to do so with a load of low-cost fuel.

I didn't need 155 pounds of steel for the tanks, which should only weigh about forty pounds each, but when you buy scrap steel you've got to take what you can get. Forty-one bucks at two-bits a pound. Sixteen gauge hot-rolled steel sheet is tricky stuff to handle on a windy day and getting it into the roof rack was a real chore. Then I thought of the letter and the bit about Hercules. I tossed the steel onto the rack and drove outta there.

When you make stuff out of sheet steel the whole secret is in the design of the welded joints. Being fuel tanks, the design was even more critical. Accordingly, my design incorporated a number of joggles and off-sets and overlaps and baffles, all held to very close tolerances.

I didn't have the shear or the break or the press needed to make such artistic shapes and none of the local shops were willing to tackle the job, saying my tolerances were too tight and the whole thing overly complex. About the fifth time I heard that I started to get discouraged but I remembered The Glowing Letter and pressed on.

I finally found a shop to shape the steel. They immediately knew what I was trying to do and praised my engineering genius as they stood around watching me hump the steel off the roof rack. Their insurance didn't cover man-handling steel. But once I got the material onto their fork-lift, they took over. Beautiful shop. Their last contract had been some hush-hush stuff for NASA. Unfortunately, their shop rates were still in orbit but since they were the only people who appreciated my design and understood what I wanted, I went ahead and pony'd up the bucks.

That was just the start of it. Having procured and transported the steel, and having had it sheared and folded and joggled and offset, I then had to lug it all home, make up a couple of jigs and get busy with the welding, which was pretty tricky in itself, since 16 ga. likes to warp from the heat. But I kept thinking of The Glowing Letter and finally figured out the proper gaps and angles so the seams drew themselves into perfect alignment as the welding progressed.

Of course, the tanks leaked. I marked the leaks with crayon, ground down the welds, did it over. And over.

After only thirty or forty hours of welding, I had my tanks. Beautiful things and no leaks at all. But testing them for leaks had left a haze of rust on the inside. I had to buy four gallons of sulfuric acid and fill the tanks with water and add the acid and seal them up and roll them over and over and over as the acid etched the interior of the tanks.

It was messy work, and risky, too. I got some of the acid on my boots and ruined them. Perfectly good boots, less than twenty years old and just getting broke in good. Then I thought of the young woman. I wondered if she had large breasts. I decided she probably did. I made a note to buy some new boots.

Neutralizing the etchant came next, after a half-hour of running-water rinse. To keep the etched metal from rusting, I mixed soluble oil with the neutralizer. When I drained the neutralizing solution the soluble oil clung to the metal. I mixed up two gallons of sloshing compound then discovered I needed a couple of gallons of solvent to strip off the soluble oil before pouring in the sloshing compound that would seal the interior surface of the fuel tanks.

I haven't mounted them yet. There's still some tricky bits with the vent lines and the filler neck and the plumbing to the electric transfer pump, for which I'll need to design a fail-safe circuit so it can't over-fill the regular fuel tank. But that will have to wait until my budget recovers.

Last night I was going over the bale of notes and receipts amassed while working on the tanks. The numbers seemed kinda high. Depressingly high. I pushed them back into the file and checked the e-mail. There was another message from the young lady. I still hadn't gotten around to answering her first message and this one was even more complimentary. I read it, all wrapped up in a warm fuzzy glow.

In closing, she wondered if she might come by the shop to meet me. She also mentioned that some blue stuff was dripping from her engine that had her husband totally baffled and which the Volkswagen dealer would only look at for an incredible sum of money.

Blue stuff? Husband? MONEY?

Faintly, far in the distance, I heard the sound of laughter. I snatched up the bundle of fuel-tank notes and ran the figures again. I'd spent over three hundred dollars to save forty bucks. So much for wit and wisdom.

I re-read the woman's first message. My long blond surfer-god hair vanished, leaving me as bald as before. I read the second message again. By the time I finished, my Herculean physique was hanging over my belt. I fired off a snarling note telling the woman to stuff a sock in it, the only Volkswagen's I knew anything about were air-cooleds. And I obviously still had a lot to learn.

Those Damn Brakes

The Vanagon List addicts waited with abaited breath as Thom approached the top of Dead Man's Hill, dipped slowly over the crest. The bus accelerated rapidly toward the Southern Pacific crossing at the bottom where the wig-wag began to sway and the red lights flashed from side to side as the barred gate came slowly down.

With a scarlet wink the bus' brake lights came on. But the boxy bus continued to accelerate. A mournful wail was heard. Then another. One came from the General Electric diesel locomotive, the other may have come from Thom. The rear hatch of the bus sprang open and a red and yellow drouge chute popped out, caught the air, tugging free the Danforth anchor that clattered, sparks flying from the pavement as it grappled for a grip. The air bags mounted in the headlights deployed with an explosive POP! The hastily installed Vanagon roof dive brake shot up, slowed the headlong plunge for only a moment before being ripped off in the slipstream. The locomotive thrummed into view around the curve accompanied by a sharp two note blast on its air horn.

The anchor finally found a grip on the base of a road sign, bent it over with a comic ..spronnng!... and sprang free just as the Martin-Baker ejection seat fired, the rocket shooting Thom three hundred feet up to descend shaken but safe beneath a nylon canopy. The old Volkswagen shattered the guard rail and was struck broad-side by the thundering locomotive, which immediately toppled onto its side and went skidding along the roadbed, surfing a wave of ballast as eighteen cars followed right along.

The Volkswagen was spun around by the impact, hit again by a bloated hopper car, this time on the rear bumper. The impact caused it to roll back up the hill as neatly as a billard ball where it came to a stop tettering on the crest, its drouge chute trailing behind like a tatty bridal gown. The anchor was fouled in its chain and had worn off one of its flukes.

Thom came huffing up, a cloud of nylon clasped in his arms, bent with a frown to inspect the tiny scratch on the door where the diesel locomotive had struck, muttering darkly about law suits and rubbing compound.

"Damn brakes," he finally said. Two round-eyed boys helped him strap the Vanagon roof back on and watched in wonder as he drove off, dragging one foot. The sole of his VANS sneaker smoked as he signaled for a turn at the corner.

The Ultimate Heater

Okay, okay. I'll tell ya how to keep warm in your van in the winter. But it's going to cost you.

Take out a window. If you got a panel, read on.

Make a metal window to replace the glass window. Cut a 3" diameter hole in the metal window before you mount it. Buy a 3" vent elbow and a two foot section of galvanized iron smoke stack, 3" in diameter. Get a conical cap for the top. Rivet the elbow to the metal window approximately where you cut the 3" hole. Install the stove pipe onto the elbow. Both of these pieces should be OUTSIDE the bus. Drill two holes in your rain gutter and make guy–wires to hold the stovepipe in position when you're driving. Install the conical cap to keep the rain, snow and birds out of the stove pipe. Make a little brace out of wire to keep the smoke stack away from the side of the bus. Heavy wire. No, heavier than that.

This concludes the Stove Pipe instructions.

Making the Stove.

Go find an air filter for an early bus or Ghia, the kind that mounted off to one side. Cut/trim the air inlet so you can hammer the thing closed, but leave the air pipe fitting that goes into the bottom. Block off the crankcase vent fitting that goes into the top. Tear out the coif filter element and toss it. Cut the straight part of the air cleaner's outlet pipe so you can wedge it into the stovepipe elbow you've riveted to your metal window. Drill four holes in the metal window near the corners. Rig guy wires to the air cleaner elbow. You figure it out but the idea is to have the air cleaner sort of hanging in space when you get done and fairly sturdy.

Wash all the oil out of the bottom of the air cleaner. The bottom part is now your stove.

Score some flexible metal tubing. I used electrical stuff but there's real stuff available. Make a piece to fit onto the air inlet you left on the bottom of the air cleaner's air inlet horn, the thing on which you hammered shut the opening of. Drill a hole in your metal window for the other end of your flexible metal pipe. Or in the fender well. Or the side of the bus. That is your fresh air inlet. It feeds air to your stove. If you get the high quality flexible metal pipe you can squeeze it almost flat without hurting it. That is your draft control. If you're a handy sort you may even want to put a metal valve in it. Make it look like a little throttle valve.

Loading the Stove.

The air cleaner fastens together with four metal clips. Unclip them. Put some sand in the bottom of the air cleaner, about half an inch. Then some newspaper, then some sticks, then some charcoal briquettes. Set the paper on fire and put the top on your stove then press the top against the air cleaner elbow and fasten the four clips before you get burned or set the camper on fire. If I can do it, you can do it. Wait until the fire is going good then connect your flexible metal hose.

You now have a wood/charcoal/coal/old magazine–burning stove hanging in space inside your bus. If you touch it, you will die. In about ten minutes the interior of your bus will be at least 100 degrees, Celsius or Fahrenheit, doesn't matter. Hot.

If you decide on who should be Pope, throw in damp straw to make white smoke.

People will laugh when they see you drive by.

Bob

PS — You must be seriously cold or slightly crazy or a bit of both to try this. Oddly enough, it works like a charm. Keep oven mits handy for refueling. If you build it right you can heat water on the air inlet horn.

Post PS — Everyone who builds one of my heaters owes me at least a buck, mebbe more, 10% of which will go to the O.J.Simpson Defense fund. (What do you mean, he got off? No, see, I've been on this crazy trip and haven't seen the papers or TV or nothing. Seriously?)

Post P–PS — Never mind about the 10%.

Under the Bus

Down Baja way when you have a really bad day you get under the bus. If you're on trail and the thing will still run you roll it up on the side of the trail, wait for the ground to cool off then crawl under. Shade.

You don't have to get under your bus if you're on pavement. Someone will come along pretty soon, carry a message or you to the nearest place of refuge. But out in the monte you crawl under. Steel makes a better a shade than a tarp and south of Insurgentes the sun is vertical at noon.

I been laying under the bus a lot lately, wishing I was down in Baja. Sixty degrees. Light rain. Brisk wind. Hell of a thing for late May. But the bus kept me dry. Okay, sorta dry. Then the axle fell on my head.

The front axle assembly on a bus is fastened to the vehicle with eight bolts, four to a side. Big mothers. 12mm x 1.00. Fine thread. Head takes a 19mm wrench and a lot of muscle. But that's not the only thing keeping the axle in there, or rather, keeping it from coming out. You gotta pull the brake lines off the wheels and the steering link off the swing-lever and get those emergency brake cable outta there, along with the clutch cable — they run between the torsion tubes on the front axle and will keep it from coming free, as does the forward section of the shifter-rod. When you want the axle to fall on you, all you gotta do is take all that stuff off then remove the eight bolts, four to a side.

Of course, it'll just hang there. That's when I crawled under the bus to see what was wrong. Wriggled the axle. Seemed to be free. Wriggled it some more and sure enough, there it came, all two hundred and fifty pounds of it.

I managed to catch it on my forehead.

The reason it was so heavy was because of the spindles. And the brake drums. I pulled the wheels & tires but left all that other stuff on there figuring it would be easier to remove once I got it out of the bus. And off of my forehead.

My bus has a bad swing-arm pivot. It also has worn tie-rod ends. And the whole outfit was pretty dirty so I figured the best thing was to pull it out, scrub it down, fix it and put it back. Don't ever let someone talk you into doing this unless they're willing to hang around and help you put the sucker back in.

I took it all apart, right down to the leaves in the torsion tubes. Cleaned everything up real nice. Cleaned and painted the trailing arms, swapped lefts for rights to even up the wear.

With just the leaves in the torsion tubes the front axle assembly don't weigh hardly nothing. Got it into position then crawled under it, got it across my chest, nice and even, took a grip on the upper tube and pressed it into place. Or tried to. It's a tight fit. Crawled out, went around to the right side, built up a stack of wood under the thing, went around and did the same to the left side then wriggled one of the bolt-holes into alignment and stabbed it with a screwdriver. Went back to the right side, did the same thing but put in a bolt.

Working back and forth, side to side, I got a couple of bolts into each flange then wriggled it around, got in the other bolts, torqued them up nice and even working from side to side. Started putting things back together. Got the cleaned-up trailing arms back on — had to use a pipe clamp on the upper ones because the rubber snubber gets in the way. Took off the rubber snubber but it didn't help — the tube the snubber fits over gets in the way too. Pipe clamp worked fine. Eased the arm up and over the snubber bar, snugged the arm down on the torsion leaves so the locking bolt lined up real nice.

Got the Allen-head locking bolts into their pits, the locking nuts torqued down. Clamped a hardened steel parallel to the lower trailing arm eye, measured the offset, calculated the shim stacks.

Full days work, sixteen hours, most spent cleaning-up and painting. It is just past midnight, too dark to fool with setting up the link-pins, getting the spindles back on. Hoped to finish tonight but it looks like I'll have to sleep on it.

VW "Quality"

... this thing broke on me. I couldn't believe VW was stupid enough to make the thing out of plastic.

The history of Volkswagen 'improvements' is more an example of how to maximize profits by substituting shoddy goods for the real thing, replacing bronze with zinc die-castings, galvanized steel with cardboard (windscreen heater ducts) and so on. At the same time a number of quality and safety items were compromised in order to cater to the market's demand for more speed and bettery 'style'.

The success of Volkswagen in America has more to do with the quality of their advertising agency than the quality of their vehicles. The later models are filled with gim-crack devices of little pratical value, over-priced and difficult to repair. The early models have their own short-comings but they don't inlcude the above.

A recent article in the Wall Street Journal about re-importation of Mexican-built bugs into Germany says a great deal for the quality of modern-day German products and the management behind them.

Wage Deflation

In recent years the Internet has proven a gold-mine, both for information and literally for certain types of businesses. Perpetual Motion has made a strong come-back among the better educated researchers who frequent the various alt.energy newsgroups and Internet users from all walks of life have benefited by earning money in their spare time. For example, about eight years ago I received a message about earning money in my spare time. The message assured me I could make $500 a week without any special training and no investment of any kind, other than buying the twenty-dollar book that happened to contain the secret formula. As it happens, $500 a week is chicken feed.

By 1993 it was common to receive messages offering me a thousand dollars a week in return for my spare time but, thanks to the marvel of the Internet, as more people came on-line even five grand proved conservative.

Shortly after the turn of 1998 I got a message telling me I could make $10,000 — OR MORE — in my spare time, without any special training, without experience (they stressed the inexperienced part) and without any investment at all... other than the book containing the secret formula, which by this time had dropped to only $12.95, a perfect example of the superiority of capitalism over socialism, of competition versus monoplies, and freedom of communication as represented by the Internet.

But if all that sounds too good to be true, I'm afraid it is. Yesterday I received a message telling me it would now take a whole 90 days for me to earn a paltry $50,000 in my spare time. Oh sure, the conditions were the same — no experience needed and I would only have to work a couple of hours each week — and the book giving out the secret formula had dropped to only $9.95, plus shipping and handling. But it just wasn't the same.

What did I do wrong? Fifty thousand dollars in ninety days is only $3,888 per week, a far cry from the $10,000 a week they were offering me just a days ago. Oh yeah, they SAY the economy is booming but lookit the numbers! In less than a month the value of my spare time has dropped by more than six thousand dollars!

Come on guys, help me out here. Let's see if we can't get some laws passed or some kind of protection to insure we won't be cheated like this in the future. It's obvious that a couple of hours of our spare time were worth at least ten thousand dollars just a few weeks ago, now these pikers are offering less than four grand a week! Less than $600 a day!

Six hundred dollars a day is an insult for someone with lots of spare time to sell. Why, $600 a day is about what a doctor averages, assuming they give up golf and work weekends. If we let this trend continue, the value of our spare time will erode to only five or (gasp) even four hundred dollars a day, little more than we pay our politicians.

To prevent this unfair reduction in the value of our spare time I suggest all Internet users band together and immediately adopt a Reading & Handling Fee of $1,000 per message. This should show people our spare time is worth at least $10,000 per week. Of course, that could only apply to unsolicited messages, such as the ones from these pikers who are trying to buy us off with a paltry $50,000 every ninety days. Mebbe we can get the IRS to manage the Reading & Handling Fee List — they seem pretty good at collecting money from people who don't have any.

Rincon Rocket Rescue

A couple of weeks ago I mentioned I had acquired another bus. The previous owner was the husband of one of my wife's co– workers. When they split the blanket six years ago the bus — his bus — was part of the booty.

The bus is beautifully painted and has a luxurious interior but when the ex–husband learned it would have to stay with his ex– wife, the engine vanished. Needless to say, it didn't drive very well, ex–engine.

Over the past six years the keys have been lost, along with the registration. When the woman tried to sell the bus she found she had an albatross around her neck. Eventually she decided to junk it only to discover even the junk yards didn't want it… unless she paid them to haul it away. She lives on the Rincon Indian Reservation, about thirty–five miles from the nearest junkyard. She mentioned the matter to my wife, who mentioned it to me and I eventually agreed to take a look at the bus, thinking the woman would want to keep it if I could get it running for her. Wrong.

"Are you kidding? I never want to SEE that thing again!"

Monday, after getting back from Big Sur I drove over to the reservation and took the front bumper off the bus. Back home, I dug around under the bench, found some half–inch cold–rolled steel bar, welded up a pair of brackets and modified a bug tow– bar to fit them. Tonight, Roland Wilhelmy and I went back to the reservation, bolted on the brackets and attached the tow–bar.

Since there was no key Roland dove under the bus and popped lose the steering link. I couldn't fit under the thing — it has been lowered and wears low–profile tires that puts it about two inches off the ground. We rigged some lights, dropped the tow–bar on the hitch and pulled that puppy outta there. It proved to be an interesting trip home.

I towed it with a 1986 Toyota pickup. The 2200cc engine had no trouble getting the bus moving but there are five or six miles of 7% grade between here and there, and the 35 miles of road has only one straight section. Straight down, for the most part. The trip took about an hour but it wasn't at all boring, thanks to the Sheriff and the fog and the two inches of ground clearance and having the lights short out and that one little skid… Best to go slow when you're wagging an iron tail that weighs a ton and a half.

My wife dubbed the 1972 breadloaf 'The Rincon Rocket' and expects me to have it running in a few days. I just smiled. It will probably take that long just to get the pack rats out of the air ducts.

Anybody know how to unlock a locked steering column without using a key?
Semi–serious responses only, please :–)

Rincon Rocket Redux

Breadloaf Dreamin'

My wife wondered if she could use the Rincon Rocket for grocery shopping, as in right now. I give her a flat stare but she wasn't joking. She really likes the thing. Seeing me come in all greasy last night, she probably assumed I've fixed it.

"It has holes in the pistons."

She considers that for a while before making a gesture like a conductor asking for more volume.

"That's not a good sign," I explain.

"Pistons are those round things that go up and down?"

I've explained how engines work and nod, happy that she's remembered.

"Can you fix it?"

Another nod. She doesn't like nods but detailed mechanical explanations cause her eyes to get glassy.

"But not today…" she coaxes.

Shake my head. "It needs a new engine. And the front suspension is shot and the rear suspension has to be re–set. It's got bent tie–rods and no rear brakes and the booster has a big ding in it and I've never worked on this type of bus before."

The glassy look slowly fades.

"Plus a few electrical problems. No turn signals. No antenna. And the radio itself probably doesn't work. One of the knobs is missing."

No radio brings home the enormity of the repair. "I guess I'd better take the truck." Her Ghia is too small for serious grocery shopping. She doesn't like to drive the '65 bus; too hard to climb into. She sighs, shakes her head. "No radio," in a tone of profound wonder as she gives me a peck on the pate and goes off to buy groceries in the truck, which has turn signals and a radio and brakes and can be steered and stopped and started and climbed into just like a real car.

Whoever did the lowering, bondo'd a louvered panel over the lower front sheet metal, moving the turn signals to fixtures inset into the front bumper with blobs of bondo. The wires were pulled through an ungrommeted hole and shorted to the bodywork. Nor does the machine have headlights, although there are a pair of them installed. It has early bug headlights, artfully attached with sheetmetal screws. The early fixtures are installed so the cool looking lights are cross–eyed; the Rincon Rocket could not legally have been driven at night.

I can't tell if the front spindles are lowered or if the previous owner just pulled the leaves from the torsion tubes, but the ball joints are shot which, along with the bent tie rods, makes the question moot. I'll have to go through the front end. And the back end, too. I assume they merely re–indexed the rear torsion shafts, chopping off the rubber snubbers. With 185/65 tires, the vehicle sat so low the frame accumulated a serious case of road–rash.

Couldn't drive at night, lowered to the point where it would drag on anything larger than a cigarette butt, the Rincon Rocket was the ultimate in cool rides, with its snazzy paint and custom interior and non–functional turn signals and cross–eyed headlight fixtures and burned–up engine. Cool.

Locally, there is another cool breadloaf. Equally low, fitted with chrome rims and tires about as thick as skid marks, I see it lurching around town now and then. Its cool looks have won lots of prizes, it has even appeared in a couple of magazine layouts. Since the engine is all chrome, the owner thoughtfully removed the engine compartment hatch so everyone can appreciate the beauty within. Of course, without the hatch the compartment is unsealed, the engine spends all its running time breathing its own effluvium, readily overheats and must be trailered to the car shows. Another really cool ride.

The Cool Syndorme is typical of much of American car ownership. Shiny paint, lots of chrome and mechanically unsafe. Big hat, no cattle.

Aside from a couple of brake jobs and minor engine repairs, this is my first intimate breadloaf experience. Compared to a splittie the later bus wins hands–down for better brakes, a heavier frame and the four–joint rear suspension. Once I repair the damage inflicted by the Cool Syndrome it will be interesting to see how it handles, compared to an early bus.

Rincon Rocket Update

Keez

Pulled the handle off the sliding door, took it down to the local locksmith. Having gone through this with Grendel, I was nervous as a nun at short–arm inspection. Up in Washington, it took forty–two bucks and three tries for the ‘best automotive locksmith in town’ to make me one key.

The local shop makes no claim to being good with cars but the fellow took the handle, punched the numbers into his computer (!) and made me a key. Fifteen bucks. Took him mebbe five minutes. In Washington it took days, several conferences and nearly three times the gilt. Like I said, competence isn’t a hot issue in the PNW.

Back home, I unlocked the Rocket’s steering column, re–attached the steering gear, dismantled my hay–wired tow–bar and prepared to play mechanic.

In my earlier post I said the Rocket didn’t have an engine, which isn’t exactly correct. Her Type IV engine vanished with the ex–husband but someone tried to install an upright engine in its place. No air–cleaner. Big hole in the muffler. No engine compartment seals. No oil in the thing, although it did turn over when coaxed with a wrench.

Knowing it would be easier to park if it was moving under its own power, I removed the battery, distributor and carb. The battery because it was dead and corroded all to hell, the carb because it was just about blocked shut with black, greasy stuff, and the distributor because the vacuum can was busted.

With the carb out of the way I discovered the vacuum line to the brake booster was broken and the throttle cable frozen, or nearly so. Wires all clotted with oily residue. Coil attached to the blower housing with sheet metal screws and not even a VW coil, to boot. But since it fell off when I touched it I don’t suppose it really matters.

Plugged in a spare distributor, bolted on a spare carb, took the gas can off the engine stand and plumbed it directly to the carb. Got the spare battery out of the ’65 bus, plopped it in place. Cleaned up the cables and connected them. Got the idiot lights to work but not much else.

The new key turned and the starter cranked the engine. Gave it some more gas and there was this hellatious explosion. Blew the oil filler cap right off the engine. Put a dent in the top of the engine compartment and gave the cap a nice mushroom shape. Apparently one of the pistons has a hole in it. I guess

I shoulda checked the compression.

Got too dark to make any more mistakes so I left it until tomorrow. Things usually go better on Fridays. I'll get Roland Wilhelmy to come over and give me a hand. If he gets his head right in the engine compartment while I'm up front twisting the key mebbe he can spot something I've missed. Besides, one explosion a week is my limit :–)

Bob

PS – My thanks to the list for the many suggestions on how to unlock the steering column without using a key. Unfortunately, I was not able to try some of the more adventurous methods, being fresh out of hand grenades, and not having two pounds of Vaseline, a rubber sheet and a goat… oops, wrong list.

Rincon Rocket Update II

CCC Firewood

I couldn't convince Roland Wilhelmy to put his head inside the engine compartment while I cranked the Type I engine sitting all forlorn in the Rocket's engine compartment, acres of open space on all sides, nice view of the ground on three sides. Big hole in the muffler. I think the domed–shape of the oil filler cap gave me away.

Checked the compression. Interesting.

> #1 – 0
> #2 – 135
> #3 – 12 (mebbe 13)
> #4 – 0

With those kinds of numbers I didn't bother to check dwell, points or plug gap. We poured some juice in the brake reservoir, kicked it out of gear and rolled it down the hill. Used the come–along to pull her into the field below the house. Jacked her up, took off the rear bumper and pulled the engine.

It looks pretty bad, Bert. As in too many holes in the pistons, along with no heads on some of the valves. Otherwise, it was in pretty good shape — no oil leaks. Of course, it didn't have any oil left to leak.

The odd thing is, the engine looks fairly new and the serial is for a '72 sedan. I've a hunch it was a good running engine, probably pulled from a collision–damaged beetle and plugged into the bus. The smog people condone that sort of thing — swapping engines between the same model year. But without engine compartment seals there was no way the thing could have received a smog certificate.

In either case, it's a deader. I'll tear her down and see if the crank or case is salvageable. Otherwise it's fuel for Martha's next wilderness do. The heads need valves, guides, welding and an Act of God. Jugs are junk of course. Might be able to use the rear screw on the left cylinder tin, and maybe the intake manifold ends. Generator is shot — commutator is seriously scored, thanks to all the dirt sucked into the engine compartment. Carb is a Borsal 34, not worth the trouble to overhaul. Old–style fuel pump already has a kit in it — might be good. Distributor is trash until I can find a replacement vacuum can. Since the engine suffered a lubrication failure and blown jug I can't reuse the oil cooler — too much crap in it. I haven't seen the pump but it will probably be scored all to hell. No thermostat or air vanes of course. Everybody knows you don't need that stuff.

I'll keep you posted on the Rocket's fate but don't expect a whirlwind recovery.

Rocket Notes ('72 Bus)

Over the past few weeks I've been making friends with the 'Rincon Rocket, a 1972 VW bus mentioned in an earlier post. My observations may be of interest to early bus owners and anyone contemplating buying a bus.

Digging In

This is new territory for me, the first Type IV–powered bus I've ever worked on. My only in–vehicle experience with the Type IV engine is based on minor repairs to a few 411's and 914's. I've assembled several Type IV's for use in light airplanes but there's very little common ground between an aircraft engine and a bus.

Heating

Perhaps the most significant difference between the Type IV and upright engines is the cabin heating. Uprights use waste heat from two cylinders to provide warm air to the cabin, whereas the Type IV uses all four cylinders. In theory, this should double the potential heat available.

The late model bus has an auxiliary heater blower to force air through the heat exchangers even at low engine speed. The auxiliary blower is mounted in the engine compartment and draws air from that space. One of the first modifications I plan for the bus is to install a duct that will allow the auxiliary blower to draw its air from the cabin, converting the system in a recirculation heater instead of the present open–loop.

The auxiliary heater blower has an unusual electrical circuit, in that power to the blower motor depends on the state of the alternator's output, apparently shutting off the blower whenever the alternator's speed drops below the charging point. I say apparently because while the circuit is clearly shown on the schematic, the function of the various relays is not.

Ease of Maintenance

When it comes to maintaining a Volkswagen bus, 1971 and earlier buses win hands down. On the Type IV engine, changing spark plugs, adjusting the valves or replacing the points is orders of magnitude more difficult than with an upright engine. This is no doubt reflected in the Flat Rate Handbook.

I see this as another example of the many ways in which Volkswagen abandoned its founding principles and in so doing, destroyed the efforts of the post–WWII VW management team to develop a stong base of loyal customers and along with it, the invaluable network of dealers supporting them. Those of you who did not personally experience the Volkswagen phenominon will not be able to understand this. It probably strikes you as another geezer's tale of 'the good old days.' But consider this: You would think that when introducing a new powerplant, the manufacturer would make considerable effort to insure periodic maintenance could be performed quickly and accurately at minimum cost. But with their dysfunctional computerized diagnostic system, obscure fuse panel and buried distributor, Volkswagen did exactly the opposite, making later–model buses more difficult to work on and thus more expensive to maintain than the vehicle it was meant to replace. Whatever the mechanical merits of the the vehicle, if higher maintenance costs are not offset by greater utility, the new design must be judged a failure.

You can get a feeling for what I'm talking about by simply comparing the effort needed to do the same task on early versus late buses. If you do not presently own a bus, tracking down examples of each and proving this for yourself is an exercise worth considering.

(By comparison, when you open the hood of the typical Toyota or Nissan, you will find all of the periodic maintenance items within arm's reach and at a convenient level. Such things do not happen by accident.)

With regard to major maintenance items, things best done with the engine out of the vehicle, I found the Type IV engine a tight fit, it's removal made more difficult than necessary by being unable to remove the rear body panel. But after several thoughtful if greasy hours laying under the Rocket, I believe it will be possible to replace the existing panel with one that bolts in place. Indeed, were it only an appearance item, the task would be trivial, but on the later buses the rear panel forms a structural member that contributes to the strength of the frame in the area where the rear bumper attaches. Even so, its conversion to a demountable panel appears to be a do–able thing.

The Type IV engine with its aluminum crankcase, bigger heat exchangers and more complex shrouding is nearly twice the weight of an upright engine. Aside from that, it's removal and installation is about the same, with the later–model heater ducts being a bit easier to dismount and install.

Dropping the Type IV engine resulted in an amusing problem. On the upright engine the upper mounting bolts are concealed from view behind the blower housing, requiring you to develop a procedure for loosening them by touch alone. In the 1972 bus with its dual–carb Type IV engine, the upper mounting bolts were right there in plain view yet I spent more time unfastening them than I would have spent on an upright engine. This was probably a dual–feedback phenominon. My hands kept trying to unfasten an invisible nut while my brain kept yelling ‘There it is! Unbolt that sucker!’ My solution was to shut my eyes :–)

Electrical System

The later bus has a more complex electrical system. Alas, it is rather poorly thought out, with the fuse block tucked well up behind the instrument panel where it is not only difficult to see but almost impossible to work on. It needs to be moved to a location that will allow normally jointed humans to inspect and replace the fuses.

The ‘Rocket’ is fitted with a gee–whiz diagnostic system based on 1960’s technology that consists of a mare’s nest of wires leading to a test plug. But to be useful, you need the diagnostic computer and the card that programs it for your particular Volkswagen.

As I recall, even when new the computerized diagnostic system did not work reliably. Indeed, I don’t know of any local Volkswagen dealer that has such a device. Accordingly, I plan to remove the diagnostic system’s circuits. But since the diagnostic circuits are loomed with the other wiring, I’ll probably end up re–wiring the entire aft part of the vehicle. This is not as impractical a chore as it sounds since the quarter–century old wiring is not in especially good condition and would require extensive rewiring in either case. Better to do it over completely.

While the overall electrical system is more complex than in earlier buses, the differences are a matter of detail, such as additional lights, three blowers, more warning circuits dictated by unenforceable consumer–protection laws and so forth. By contrast, the engine’s electrical system is virtually unchanged. Indeed, the basic system, and its problems, is the same as with earlier buses, as are the cures needed to insure reliability.

I’ve found it most convenient to install a separate fuse and distribution panel in the engine compartment, as I’ve done with my 1965 bus. This results in a much neater engine room and a less cluttered installation. The fewer wires running about, the more reliable the system. The new distribution panel allows me to install compartment lights and a utility power outlet, while the failure–prone in–line fuses for back–up lights, blower and so forth are replaced by circuit breakers mounted on the new distribution panel, which also incorporates a local ignition and starting circuit, very handy when performing maintenance.

Marvelous Brakes

One clear advantage of later buses is their power–assisted front disk brakes and composite rear drums.
The power assist is conservative by modern–day standards, offering about a 2:1 pedal pressure advantage. But when coupled with front disk brakes the small advantage is more than enough to give you tire–smoking stops.

The vacuum canister is evacuated by a line running to the intake manifold below the carb(s) and maintenance involves only an occasional inspection of the hoses.

While dismantling the brake system I discovered that neither the brake rod clevis nor the brake pedal pivot is fitted with sleeves or lubrication points. Lack of sleeves means the thing is going to be difficult to repair when it wears, while lack of lubrication fittings guarantees that it will. That isn't to say those features were found on earlier buses, but given the importance of the braking system, I find their omission on a supposedly re–engineered vehicle very curious. I assume it's another example of the profit maximization pattern of management that has lead Volkswagen to its present third–rate status as an automobile manufacturer.

I plan to bush the clevis and replace the stock brake pivot bolt with one having a Zerk fitting.

Disk brakes were an option on 1970 buses, made standard equipment the following year. With the more easily maintained upright engine, yet fitted with disk brakes, in my opinion the 1971 bus is the best of the breed when it comes to late–model buses.

Conclusion

One bus doesn't make a fleet. It's possible I'm trying to view a parade through a knot–hole. Your feedback on my observations would be appreciated.

The Big Sur Run

Departed Vista, California about 1000 Wednesday heading north on I5.

The trip had four general goals. The first was to visit my son in Modesto, the second was a shake-down run for the tranny and overhauled outboard gear-boxes, installed just prior to departure. The third was to canvas junk yards in the the Central Valley for Thing parts that could be used on an IRS-conversion on an early bus. The last goal was to attend a gathering of Vanagon-list subscribers to be held at Pfeiffer-Big Sur State Park.

I traveled north to the vicinity of Bakersfield where I visited a number of auto-recyling yards on Union Avenue. No joy finding Things but I was told there were ‘several’ Type 181’s in a fenced yard in Maricopa. Drove there, arrived about sundown. Weather had been exceptionally good all day with clear skies and mild temps. Fantastic display of lenticular clouds over the Sierra-Nevada mountains.

Maricopa, with a declared population of 1,245, had apparently suffered a serious decline since the last census. I ate supper at Kathleen’s Kitchen where I pestered the patrons with questions about Volkswagen Things, resorting to making a sketch of one to jog their memories. Properly jogged, they all agreed they’d seen such vehicles (‘That Volkswagen jeep-thing...’) but never in Maricopa, although they directed me to a fenced yard that contained a Type III station wagon, and to an unoccupied house that had a ’68 Type II behind it. Several of the patrons were pretty sure the fenced-yard I sought was in one of the towns farther north along Highway 33.

I spent the night in the bus, parked in the center of Maricopa accompanied by a couple of big-rigs, using the deserted gas station as an RV park. The restaurant is next door to the abandoned gas station, making it handy for truckers. It also made it handy to tap the telephone lead going to the pay phone with lineman clips, allowing me to do a FlashMail session... if I had really wanted to.

Thursday, I continued north on Hwy 33. Somewhere between McKittrick and Blackwell’s Corners the bus began to hiss at me. A propane cylinder had become wedged against the heater duct under the rear seat and become so hot it blew out the pressure relief valve, filling the bus with propane gas. I ditched the bus and bailed out while it was still rolling. When the thing didn’t blow up, I crept back and opened the cargo doors. By then the propane had formed a defintely explosive mixture. I fished about under the back seat, removing tools until I could get a grip on the gas cylinder, all the while holding my breath, terrified of creating a spark. I finally managed to get a gripon the cylinder and tossed it out of the bus where it hissed a merry plume of propane while I aired out the cargo bay. It was still hissing at me when I drove away.

My tracking technique was pretty simple: I asked. Meandering north on Highway 33, I stopped at each gas station, truck stop and weigh station, showing them the sketch I'd made in Maricopa, asking if they knew of any such vehicles thereabouts.

At Avenal a trucker directed me to a 'whole bunch' of VW Things at a junkyard in Clovis, north of Fresno. His directions were specific, even to mentioning I would see them 'over the fence' as they were stacked atop one another. Sure I'd finally hit the Mother Lode, I back-tracked to Hwy 41 and headed for Fresno, stopping to look at a breadloaf I spotted near Lemoore.

Clovis turned out to be a bust. Everyone knew there were a bunch of Things real close by but no one could provide any first-hand information. (Two people mentioned a 'yard full' of things in the area I'd already explored along Highway 33.) I ran out of daylight before completing my quest and decided to head back toward the coast. Being some distance north of Fresno, I used county roads to get back to I5 and spent the night at the rest stop south of Coalinga.

Friday morning I explored the area around Coalinga for junkyards and veedubs but finally gave it up. The odds are, at one time there had been a few Type 181's gathered at one place at least long enough for them to have been seen and remembered. But if that place — and the pile of 181's — still existed, I had not been able to find it.

I headed over toward the coast on Hwy 198. Beautiful country, my favorite part of my native state. The weather had closed down and the clouds hugged the hilltops, with occasional rays of sunlight illuminating the hidden valleys. Traffic was almost non-existant on the picturesque but seldom-traveled road. I saw cowboys rounding up cattle using Austrailian Heelers. Stopped to watch. One man on horseback with two dogs plus one man in a truck, neatly gathered up about eighty cattle in less than ten minutes. The dogs returned to the truck on command, leaping onto the flatbed. Driven around the herd, they would leap off and harry strays out of the brush, bringing them back to the herd. My first experience seeing dogs work cattle in California. (I've spent some time on horseback popping feral cattle out of dense brush. The cattle usually win.) The dogs looked very pleased with themselves.

I came down from the hills at San Lucas to discover it had lost it's freeway. It used to be on Highway 101 but the new four-lane highway is about a mile to west, isolating the town. It still had its Post Office, general store, school and church, but the grain elevators appeared abandoned and the gas station is gone.

On the road connecting San Lucas to the highway I came upon a Chevy with the hood up, a distraught woman standing alongside hugging herself against the chill wind. I didn't see the two kids in the car until I'd stopped.

She didn't know what was wrong, it just died. It was her sister's car. She had run down the battery trying to start it. It had fuel and everything appeared normal but jumping it with my spare battery produced no spark. I gave her a lift into King City, dropping her at a station with a tow truck out front. It was about three in the afternoon.

I stopped at a taco stand and cleaned up the bus, putting the spare battery back in its place and straightening up a minor mess made by the kids, who had ridden in back. After a liesurely lunch of tacos and beans I headed back toward the freeway. I saw the lady huddled by the pay-phone at the station. Her Chevy was there but outside of the shop with the kids in the backseat. I stopped and asked how things had gone and got a confused story about the car's electronic module being fried and no spare available until Monday and she had to be to work tomorrow and they were really her sister's kids and she couldn't reach her... She was close to tears. I offered her a lift to her sister's place which turned out to be in Coyote, a town near San Jose, about a hundred miles north.

I had some Hersey's miniture chocolates in my tucker box and doled them out to the kids to keep them quiet. The woman became increasingly nervous as the trip progressed, worried about 'payment' for the ride and the form it might take. She was Hispanic, outwardly very self-assured but uncomfortable with my silences.

We got to Coyote only to find no one at home. The woman was now very nervous, partly from my warning the children not to play with the explosives in the black bags. My tools are in a pair of black canvas tool bags but the mild joke was taken seriously. The rest of the trip was remarkably quiet. I drove the woman to a second address and we found the sister there. Happy ending for all. The sister even offered me $10 for delivering the goods. I took it. Heading back south, I got as far as Salinas before I crashed for the night in a parking lot.

The next morning I broke my fast with a Granny Smith apple which proved to be a big mistake. Since leaving home I'd been bothered by a minor gum infection. The tough skin of the apple became lodged in a permanent bridge at the site of the infection and I couldn't deal with it without a water pick or the proper tools. Poking at it with my pipe tamper didn't help although it did tear up the gum nicely.

After eating a handful of Tylenol I drove to Carmel, hung a left and pulled into the State Park about 1030. I enjoyed the company of the group, along with a hot shower. I ate a cautious can ofsoup for lunch but the gum disliked Mr. Campbell as much as Granny Smith so I shifted to a diet of rum, sipped steadily from a coffee cup for the remainder of the day. By sundown I was feeling no pain :-)

I hung around until after the fireworks then took off for Modesto. Sunday, I made a quick trip home, arriving about 2130.

-Bob Hoover

After-trip notes:

Miles traveled: 1,593

Fuel consumption: 77.8 gallons (20.4 mpg avg.)

The tranny and gearbox installation, while a bit noisy, is working properly.

Based on wind-wander and driver fatigue, it’s time to rebuild the front-end.

The ‘cow-pie’ insulation works and will be applied to the remainder of the ceiling.

The sliding windows need to be rebuilt. There is an annoying wind-whistle and draft at anything over 60 mph.

The cargo-area heater duct is the perfect place to heat a can of soup.

Much of Highway 198 does not have cellular telephone access.

I used a blade-type fuse for the cooling fan circuit on the auxiliary oil cooler... but forgot to add spares to my kit.

Never eat a Granny Smith apple unless you’ve got some way to clean the debris out of your bridgework.

Never feed kids a pound of chocolate if you expect them to be quiet.

Don’t allow David or Bradley near anything made of magnesium.

—rsh

The Hairball Run

(The Grendel Files)

Prologue

Sorry to bother you with this but I've got a little problem. A personal kind of thing.

Things are tight right now. The Northridge quake busted the foundation under my shop and the building is coming down, slow but sure. But since Vista is outside of the official earthquake zone the cracked slab and canted walls must all be in my mind; since we didn't have an earthquake we don't qualify for any of the low-interest loans or other forms of assistance.

So I set out to fix it myself. But the Catch-22 is: No shop, no income.

Okay, that's the background. I'll work something out on the shop. Now comes the REAL problem.

I've got personal business in the Seattle area. It involves a dead shipmate. I can't afford to make the trip right now but it's the kind of thing a man has to do whether he can afford it or not. So I've been working on that and came up with a way to get TO Seattle. But I'm plumb out of ideas on how to get home.

Actually, I CAN get home. I've known the trip was coming up and I've been putting money by. Given what I expect to earn for driving a car to Seattle (my solution to getting there) I'll have enough to get home by bus or even plane (although I hate to ride in back). But as I said to begin with, I really can't afford it —the money is needed for fixing the shop, which to me is more important than a comfortable ride.

They won't let me use the car I'm driving up to tow my bug or bike, which was my first idea and the one I thought I'd be using up until today, when the Word came down: No Towing. Thinking I WAS going to tow the bug to drive home cost me a couple of opportunities to get back by other means. Now I've got about two weeks to work it out.

What I've got working for me is a bit of time. I've got to arrive on a certain date — still to be set — but getting home can take as long as it takes. Hitch-hiking is out. I'll be carrying tools, don't like the thought of getting them wet or stolen or having to lug them too far. And local cops are pure hell on civilian hitch-hikers in the Central Valley.

My only other idea is pretty crazy. Take a spare engine with me, find a bug or bus with NO ENGINE for sale cheap somewhere in the Seattle/Tacoma/Portland corridor, drive home in that, sell it and recover my money. I know;

Bob's Ride

Wed Aug 30 01:17:16 1995

Bob's Ride

Please accept my heartfelt thanks for the many ingenious suggestions for getting home from Seattle. For such a diverse group your kindness was remarkable in its consistency. And a little fey. I enjoyed the fun you had with 'Bob, Professional House Guest,' wandering the country like Charlie on the MTA, but it convinced me some of you were crazier than hoot owls in heat.

Your efforts on my behalf have been successful in finding me a few flowers in Washington. These particular flowers happen to be on a bus whose colors are described as 'mostly blue, white and rust.' The price is within my budget and the work is within my means. Providing an engine and installing it will be my part of the chore. And while I could not have found the bus without your help, I owe a special thanks to Mr. Eric Oster of Kent, Washington, and his understanding wife.

Eric was Our Man in Havana. Where others saw a hippie bus moldering in a field, Eric saw a possible solution to my dilemma and checked it out by performed a Laying–on of Hands with tools in them, after which he sent me a cautious message, to which I replied "Yeah! Go for it!" knowing the real chore would be to get the thing out of the field. With the help of his brother Earl, the bus — a 1967 walk–thru Kinda–kamper (bed but unpopable top; no shower or satellite dish) — was coaxed fifteen miles from the field, where its shade had produced a luxuriant crop of toadstools, to a parking spot near Earl's house.

Eric called tonight with a laconic, "Well, you got a bus… if you want it." I want it. The plan is to stop at Eric's to drop off my duffle, tools and a spare engine then to deliver the car I've contracted to drive to Seattle and collect my pay. I've some personal business in Seattle but I expect it will take only a day or two. When not seeing the sights, I'll plug in the engine and be ready to roll as soon as I get a good tail–wind. I can tinker my way south, sleeping in the bus on the way home. Once home, I should be able to sell the bus, making the dollar–cost of the trip virtually nil.

All thanks to Eric Oster, his patient wife and loyal brother, and to an electronic community which despite our lack of proximity has not forgotten the meaning of the open hand.

Name The Bus Contest

Sun Sep 3 06:27:04 1995

Name The Bus Contest Hair–Ball Run — It's On!

The engine I've slapped together over the past week decided to run today. I hope that hard knocking don't mean nothing serious.

I should have enough time on it to do the re–torquing by Monday, tear it down to fit into the trunk of the car I'm driving to Seattle. Be a tight squeeze but do–able. The bus is now at Earl Oster's house (Eric's bro) a few miles north of Olympia, Washington. I'll drop the engine off, deliver the car, take care of my business, plug the engine into the bus and toodle on home.

I've promoted a lap–top computer for the trip so I can keep in touch. I've never tried typing and driving at the same time. Tried everything else, though. And have the scars to prove it.

Getting home will take… as long as it takes, then I'll have to put aside my childish things for a while and earn some money so I can drive to the Arctic Ocean next summer. I may even decide to do it in the Oster/Seattle bus, mebbe even with the same engine. If I took my '65 bus with its big engine, we'd just run off and leave all those modern buses. Pure kindness on my part, poking along in an antique bus with a hay–wired engine just so's those newer things won't look so bad.

The Coyote keeps asking me for the name of the bus. The–bus–Eric– Oster–found–for–me seems a little long. Any ideas?

Name the Bus Contest

I don't name things. I would never think of calling a bus 'Mango'. (Sounds kinda like the Great White Hunter's gun–bearer.)

Why don't you guys name the bus? Let's have a bus–naming contest! Get Joel and Martha and maybe Rusty and Andrea to be the Name Selection Committee. (Anyone else? Lotsa lurkers out there, bound to be a judge or two amongst them.)

So we got what — four hundred listees? I figure maybe half of them is awake at any one time, mebbe a quarter of that even faintly interested in naming a bus. Probably more if we offered a prize.

Have to extend that to the Thing people, too. Things is sorta buses in disguise.

Name The Bus Prize

Howzabout an engine? No, not a free one! But I could screw the parts together. That's worth five, ten bucks right there. You name the bus and I'll assemble an engine for you; you buy the parts and pay for the shipping. Or drive by the shop and I'll stick it in, same deal. I'll have to limit that to air–cooled up–rights. I don't feel I'm qualified for a Type IV's.

Of course, if this thing I just slapped together blows up half–way to Redding, you may wish to reconsider :–)

Hair Ball Run, D minus 1

Wed Sep 6 04:36:19 1995

Hair Ball Run, D minus 1 Part one: Packing Up

The freshly assembled engine spent 5.8 hours on the test stand before I decided that was enough. I was working in the sun and it was hot. I left the engine to cool, began sorting tools.

I've got too many tools. Some are pets, still in my kit long after they should have been retired. I took some time wiping them down, gently laying aside those that must stay behind. They weren't dirty, the wipe–down wasn't needed. The handling was. Tools are like soldiers guarding some outpost, keeping the faith. I was culling them out, telling the ones I would leave behind they were not forgotten.

Each tool has a history, some good, some bad. Some are pretty to look at and a comfort in the hand, others scarred from many battles. I went through them twice, weighing the merits of experience against the strength of youth. The veterans carried the day. There will be other battles, and tools like hearts, can break.

The proper tool box was a dilemma. I might have to carry it home and 1,300 miles is a fair stroll, smaller was better. Yet it had to be big enough. The torque wrench and 3/4" breaker bar dictated the length and that narrowed the choice to three candidates. One was my brother's and took a bold pace forward. In life we had never worked well together but in death he is always on my mind. He was a good mechanic, although of helicopters instead of real airplanes, but the thought of carrying what he had carried pleased me.

I let the tools decide how they wanted to ride, dismantling the cooled engine as a test. They jostled one another at first, some eager, others grumpy, a few knowing I couldn't leave them behind and wanting to get on with it. By the time the engine was stipped to a long–block, the tools had found places ready to my hand and were comfortable with each other. There was room to spare. I could of added more but had reached the point of diminishing returns, the weight would rise faster than justified by the convenience. Even so, it was not a trivial load nor incomplete, with back–ups for all but the breaker bar and torque wrench.

Loading the dismantled engine called for the help of a friend. The heat was brutal and we were dripping with sweat by the time we muscled the long–block over the high lip of the trunk and got it positioned atop the rear axle. All else was anti–climatic, I've been down this road before. Spare spark plugs inside of ducting, oil lines stored in tail pipes. Fragile things swaddled into anonymous lumps. The trip would be wasted if a single thing were forgotten or damaged. The loading took about two hours.

Again, there was room to spare and with it a strong desire to add tidbits here and there, an urge suppressed despite the clamor of "Take me! Take me too!" from the very boards beneath my feet, for some of the load was wood. Eight blocks, two sets of four, the means whereby an engine could be made to rise above the ground two inches at a time, rocking back and forth until it was high enough to accept the floor jack run–up like a sixteen–pounder on its own two–piece deck, two pieces so one could be laid down before the other making a gun–deck as long as I wished. Wood can be burned for fuel or whittled into wedges or used as drifts or… wood is handy stuff to have around.

The parts and tools married in my mind, a meld of task and means. Neatly packed, secured against the weather, I am done by early afternoon and turn my mind to personal things. A couple of shirts, some underwear. To stay alert I'll gnaw bagels and sip coffee on the way, a useful trick picked up during long–distance solo flights, ferrying aircraft. From the closet I take the first bag that comes to hand, throw things into it, zip it shut. My wife looks on, amazed. Snatches it away, lays everything out like a Seabag Inspection — Junk on the Bunk. In a trice everything is folded and tucked and patted and placed and the bag is only half as full as before. Then she added socks, which I'd forgotten. And handkerchiefs and spare glasses and pills. Geezer–dom's rite of passage is how many pills you need to stay alive. I'm still a Novice Geezer. But getting there.

Then comes the Interrogation. Is this trip REALLY necessary?. It would take too many life–times to explain why some things simply need doing. She doesn't like shrugs so I nod. Did I have the phone numbers? Did I have the directions? What will I do if it rains? "Get wet" proved to be the wrong answer. Her sigh questioned my sanity but she continued in patient tones, a Girl Scout helping an old lady across the street. Credit card? Change for the telephone? And you WILL be sure to call… I nod at the appropriate times.

Interrogations usually last about twenty minutes, this one runs a little long.

She will worry while I am away. And I will probably find some precious portion of her household money in my bag, tucked into a sock or other place where it can't be overlooked. I'll use it for flowers when I return, and won't go away again. Until the next time.

Hair–Ball Run, D–plus–1

Thu Sep 7 11:07:40 1995

Hair–Ball Run, D–plus–1

D–Day was… interesting. I learned how to replace the thermostat on a car I'd never worked on before.

It was the long grades up Tejon Pass that done me in. Or the heat, which was hot. Or the fact the car, a 1990 Oldsmobile, was so heavily loaded it looks like a low–rider. Or perhaps it was the damn fool behind the wheel that was so delighted with the air–conditioning that he kept it turned up to 'Arctic' while motoring through the 100 degree heat. Or mebbe the fact the car hadn't been driven very much in recent years, and then only around town. One of those. I kinda like the nut idea, myself.

Pulled over, let it blow. Ever tried to work on a hot engine? A hot, STRANGE engine? Boy, is there a lot of plumbing under there! And they've got that poor engine installed SIDEWAYS. (I didn't have time to take it out, put it in right.) Ummm… funny flat fan belt… and no fan! Oh! There it is… electric? Ummm. I couldn't tell if it was the water pump, the fan belt or because I was smoking my pipe, but something was making that puppy over–heat.

Shutting everything off and running the heater on high allowed me to make about 35 mph without melting the thing down. The next down–grade cooled her off. But the next up–grade… aagghh! Pulled over, let her cool. Takes a while when the temperature is a 100. Tried it again. Waited it out. And again. And again. It was late evening before I topped the pass, headed down the Grapevine into the long valley.

There's something obscene about poking along in 100 degree heat with the heater set on Sahara while you're wearing levis, a heavy shirt and boots. I did a clumsy strip–tease as I rolled along, much to the delight of the bus–load of Japanese tourists who ranged alongside for nearly a mile to give all hands a photo–opp as I struggled out of my clothes. I smiled & waved. The clack of shutters drowned out the roar of the heater. Good heater.

I had gotten underway about 1430 intending to make a quick run to Modesto. But with the needle of the temperature gauge hovering near 280 my quick run turned into a slow crawl toward Bakersfield, where I eventually arrived wearing only my Speedo and socks. Bakersfield being what it is, no one noticed. I found some shade, parked the thing to cool off and went looking for an auto–parts store.

You can guess where my tool box was packed, and what had to be un–packed to get at it. Unloaded, drained the coolant, did the repair. Thermostat had failed–closed. Bad design. But the heater worked good.

Forgot to buy coolant. But then, I also forgot to pack about half the cables needed to make my recently acquired lap–top speak to strange wall–plugs and alien telephone systems. Rigged a smoke generator. This is coming to you via the local tribe.

Hope to make it to Redding today, about 400 miles north of Bakersfield. Wonder what will break this time?

Hair Ball Run – D+1

Fri Sep 8 01:59:54 1995

Hair Ball Run – D+1 The Long Valley

I finished the needed repairs this morning and got a late start from Bakersfield, where I discovered that without a motel reservation you must pay either too much or not enough. I chose the latter and ended up at the Singh Motel, where several members of the extended Singh family were evicted when the management realized I was serious about renting a room for the night.

Heading north, I kept my foot out of it, put the thing on autopilot and let everyone except bicyclists go around me. It was a long to Redding. The engine temp was a little hotter than a good water–pumper should be, even in the 100 degree heat. I've a hunch old age has caught up to the water pump. Or perhaps some critical passage between the heads is corroded. I ran the air conditioner, but kept it down to the Mild Autumn Day setting instead of the Arctic Blast that had proved too much for the system the day before.

The car is equipped with an AM/FM radio and cassette tape player. I had no tapes to play but fiddled with the radio. It took about a hundred miles to figure out how to work it, which proved to be wasted effort. I don't have a radio in my bug, nor in the bus either. Neat factory plates in the dash; no radio ever installed. In Baja there isn't a lot to listen to, and when you're south of the Line the sound of the engine and tranny is worthy of your full attention.

The airwaves were filled with people talking, mostly to hear themselves talk. What music I heard was country & western & not especially good. Some of the commericals were interesting. Apparently several laws of physics have been repealed, along with fundamental changes in basic economics. After listening for less than thirty minutes I found myself hoping the engine would blow up, just so I'd have something to do.

It didn't. I sat there, moderately cool and totally bored.

At Turlock I refueled and found a gentleman struggling with the telephone. He was Hispanic and had a serious speech impediment. I used his AAA card to call him a tow truck, something he'd been trying unsuccessfully to do for more than 'uyn owrahaha'. Nice guy; offered me money. I bought him a coke. It's the real thing. Friendship, that is.

I grew up around Turlock. I like to think the man wouldn't have had to spend an hour in the hot sun struggling to express himself into a telefono back when I was a kid.

Things shrink as you get older. Turlock had shrunk. Parts of it had vanished entirely. The only things that were larger than before were the prices. I fueled up, restocked my bagel supply and continued north.

Soon after the confusion of Sacramento, where you must turn west if you want to go north, I saw Mt. Shasta ghosting on the horizon. There be mountains to cross, with the engine running a mild fever. Mt Shasta and I kept an eye on one another for better than two hours; it's a fourteener, a shield volcano and not an especially good climb. But magnificent in its snowy cloak from my simmering viewpoint on the valley floor over 60 miles away.

I broke my journey at Redding where I discovered the Bates Motel was more than a movie set. But the price was right and the security was excellent, since it was impossible to open the door without hitting the bed, and the parking lot enjoyed a constant patrol, half the population of Redding having mistaken it for a city street. In the lobby, I interrupted a heated argument between a Rancher and an Indian, judging by their costumes. Water rights? Rustling?

"I tell you Ferman (sp) blew it! O.J.'s gonna walk!"

I bought a box of .45 ammo from the vending machine and eased on out of there, not wanting to become embroiled in the local range war. (I'm the only person I know who has never watched a Simpson episode, trail or cartoon.)

Tomorrow, some mountains. And maybe supper in Portland.

Hair Ball Run, D+2

Sat Sep 9 00:42:05 1995

Hair Ball Run, D+2 Wisdom of the Aged

For the chronologically challenged, D–Day saw me crawling toward Bakersfield blowing a plume of steam, thanks to a thermostat that failed closed. Fixed it. D+1 took me up the Central Valley, from Bakersfield to Redding.

Today is D+2. My goal was Portland, 423 miles (I think) north of Redding, that I hoped to do in about nine hours but took more like twelve, thanks to something called Vendaloo Curry, eaten in immoderate amounts whilst a guest of the Singh Motel in Bakersfield. Fortunately, Oregon has thoughtfully provided rest stops about every twenty miles. After considerable resting I shambled into Portland about 1900, gas gauge and guts both resting on E .

Following the honorable western practice of seeing to the horse before the rider, I wheeled into a Chevron station and commenced refueling. My welcome to Oregon came in the form of a snotty gas station attendant the size and shape of a haystack, who snatched the nozzle out of my hand. Yer not allowed to pump gas in Oregon! and muttered something uncomplimentary about Californians.

The small amount of gasoline that sloshed onto his shirt during the scuffle will surely do no harm since it s bound to leave the garment cleaner than before. And just to ward off any misunderstanding, the book of matches I tossed him was a simple act of generosity. I saw he was a smoker and I had plenty of matches to spare.

Oregon is such a lovely place it s really too bad there are so many people, although that number is now two less. I’m writing this from a hash house across the river in the State of Washington, while the young man in the Chevron uniform was last seen heading for Idaho, on foot but making remarkably good time.

I’m sorry my stay in Oregon was so brief but I’m proud to say I not only left something of myself there but that I repaid her in kind ten times over for what she and her gas–pumping citizen gave to me.

Getting Connected

The lap–top I m using is a marvel, or would be, had I remembered to bring all the wires and things that make it more marvelous than a six–pound Etch–a–Sketch. Hooking up to the telephone system has proven remarkably easy, thanks to a bit of experience wearing climbers, and keeping a set of line–man s jumper wires, the kind with the needles that can pierce a three–wire drop, in my tool kit.

If the motel has a phone, and if they don t demand $5.60 as a connection fee to provide you with local service , all you need is a double–jack phone plug — the kind that will accept two RJ–11 male connectors and has a single RJ–11 connector as an output. Unplug the wire to the desk set, plug in your adaptor and plug the computer's modem cable into the adaptor in parallel with the telephone cord. This will also work with the FAX machine in motel lobbies, assuming the desk clerk is busy checking in someone else and you have some experience with slight–of–hand tricks. Just make sure your messages are loaded in your Outgoing Message file, and that the speaker is turned off. The typical FlashSession on AOL takes twenty seconds for five full–page messages.

And it works at hash–houses, too, where Ellen and Windy talked the older–and–wiser–but–still–a–doll Dotty–the–Cashier into letting the crazy customer plug his funny machine into the phone under the cash register for a few minutes.

To keep from looking like a klutz, do your homework. Get local numbers entered into your Location Table before you set out, and make sure you modify them with a preceding 9 if needed by the motel switchboard. If the switchboard is an old mechanical type (most are, in small towns), add a couple of commas after the 9,, Your modem will read the commas as pauses, giving the switchboard s relays time to settle before punching in the local access number for whatever service you re using.

I dined on something called a 'Gresham Burger' then showed Dotty the trick with the broken tooth–pick. Portland is a quasi–Navy town and she'd seen it all before but she still laughed. Ellen didn't get it. Windy did, and blushed.

Tomorrow, my goal is the home of Eric Oster in Kent, Washington, where I'll unload the engine and tools. Then on to Port Angeles to deliver the car and make my way back to Seattle with my duffel bag. If all goes well, I should be able to start getting greasy by Tuesday or Wednesday.

Hair Ball Run – D+3

Sun Sep 10 14:27:20 1995

Hair Ball Run – D+3 At Seattle: Deliverance

Didit.

Washington is nice. Nicer than Oregon. Greener and friendlier, too. If Microsoft would answer their mail it would be just about perfect.

I encountered fog soon after departing Vancouver (no, the other Vancouver, the one across the river from Portland) that kept things cool. It was the first time in three days the engine temperature stayed near normal. The car was happy with its new home.

Sailors drink a lot of coffee and I d heard Washingtonians took pride in poducing a quality brew. When I saw a 'Free Coffee' notice tacked on a Rest Stop sign I wheeled in, bought myself a cup of the superior stuff for a fifty–cent donation.   It was so bad it reminded me of one of my earlier wives. Almost as bad as Oregon coffee.

Near Fort Lewis I made a pit stop, walked around getting the kinks out. Unlike Oregonians, the folks in Washington are bright enough to pump their own gas. Even Californians, universally feared throughout the Pacific Northwest, are permitted to touch the nozzle. So I pumped some. The pumps up here are not equipped with vapor recovery systems. And the gas was expensive. Bought a map of Seattle. Also bought a cup of coffee because it smelled so good, which can be like picking a cook for her looks. Lucked out. The coffee was as good as real coffee, but without the secret Navy ingrediants (diesel fuel and salt). I fetched my thermos and filled it up, added the missing trace elements, smacked my lips at perfection.

Bagels are unknown along the highways of Washington ("You mean those donut things? Sorry. Gee… you don't LOOK Jewish.") I fell back on my second choice: pretzels. Crunched and sipped my way north. Passed through Olympia but didn t notice. Arrived at Eric Oster s house in Kent about noon. Eric turned out to be a kid, a few years younger than the boots I was wearing but sported a magnificent black beard in which the surf was up, a point–break creating a neat standing curl around a reef of teeth as white and square as sugar cubes.

While I explained how we would have to grab the engine just so, to keep from throwing out our backs as we lifted it over the high lip of the trunk, Eric picked it up like an apple, stood examining it quizzically, trying to decide where to take the first bite.   Why don't you put that over there? I suggested gently, hoping he wouldn't throw it. He nodded, put it over there. He's about my height. His width is about my height, too. I kept waiting for Babe, the

Blue Ox to put in an appearance.

With the engine out of the trunk there was enough room to hold a dance. I threw a box of candy at Eric s pretty blond wife, mubbled something appropriate and lit out of there for Seattle.

Prior to delivering the car I restored the trunk to what it had been like before loading the engine, making reference to a sketch–map I'd made to get things back in their original places. I did this as we churned our way across the harbor on a car ferry, disinterested drivers dozing in their cars, flocks of Japanese tourists exposing film at the rate of several thousand frames per minute. Then came forty miles of bad road, delivery of the vehicle and a bit of paperwork that ended with me being driven to Bainbridge Island a few bucks richer. So far, the trip had gone almost exactly as planned.

Here must follow an interlude in this account while I take care of personal business. I ll pick up the tale when Eric drives me to Shelton, Washington, where the donor bus is located.

Hair Ball Run, Part II

at Sep 23 04:28:06 1995

Hair Ball Run, Part II

A Little Pneumonia.

That's what the doc–in–the–box said about week ago. "You've got a little pneumonia in the right lung." I assume Big Pneumonia hangs over onto the liver or something.

Wanna know how you get a Little Pneumonia of your very own? Sleep in an old bus, don't eat, work twenty hours a day, get rained on… stuff like that. First, you get this great chest cold; Canada Geese appear each time you cough. Then you get this really neat fever, during which you have insightful conversations with cats and things seem to be going just swell, except you keep falling down.

If you're lucky, you find a place of refuge where people will put you to bed, stick needles in your ass five times a day and clean you up when you shit yourself. Pneumonia is a fun trip. After five or six days, six in my case, you're strong enough to drink your coffee without spilling it. Of course, you still have to get home.

I'm going to drive home. In Grendel. That's the name of the '67 bus Eric

Oster said was in good condition.

Here's what 'good condition' means to some people: No brakes to speak of. Hammered brake line to rt. rear, the wheel with the leaky cylinder; the one with the bleeder broken off. Left front spindle cut & scored, link–pins rusty and having more than 1/4" of lateral play. Both right front wheel cylinders leaking; shoes contaminated, bearing seal failed, grease all over the drum. And the right spindle has been ground on too.

Eric said the bus had remarkably little rust. Howzabout blisters under the windscreen rubber, lower front door pillers rotted away, passenger– side cockpit floor with a nice view of the ground, cargo doors don't even touch the sill it's so rotted/sagging. Driver's side cargo–bay sill rotted, held together with paint. Rear of the front wheel arches rotted through.

'Good condtion' around Shelton, Washington (site of a state pen and home of the Climbers) means collision damage front and rear, no rear bumper, no engine compartment seals, engine hatch secured with wire, broken shifter–rod, tranny sitting on the cross–member, rear mounts collapsed, front mount solid steel, now ovaled out the holes so the tranny moves any which way it wants. Hub frozen on the left rear wheel — no idea what condition that brake is in.

And no seats. Or at least, no seat that will attach to the vehicle.

And no heat. Heater cables busted, knob broken off, central heater duct under the body missing completely — some clothes dryer hose hanging here and there. Throttle cable is bad too, chewed off at the ferrell.

It's kind of hard to see out of the Good Condition bus because the windows were not masked when the K–mart paint job was applied. Yup, right over the window seals, dirty hand–prints and dead bugs. Three cans worth of blue paint plus some white. Part of the top of the bus is white, the central portion beer–bottle bronze. Under that I fond some yellow, some white and finally, the original red below, white above.

There are no handles on the wind wings. Ditto the body windows. No rubber on most of the windows but lots of bondo and bathtub caulk.

No clutch return spring.

Battery hanging half way through the rotted floor.

No keys of course. And rear hatch is locked. And the title is not clear.

Wiring is a mess. Original ignition replaced by a Universal keyswtich, one that doesn't work. ("Oh, it works! There's a trick to it!" But never reveals the trick.)

Bug headlights instead of bus. They do a nice job, assuming you want to illuminate the sidewalk immediately to the right of the bus. Headlights wired to a cheap toggle switch laying loose on the package tray, the stock switch having gone the way of the dodo. And the ignition switch. And the door grab–handles. And the fuel gauge. Good Condition.

Good conditon means three different sizes of tire on two different sizes of rim; three 15's and a lonely 14" up front, just to make the steering interesting. Earl Oster, Eric's brother, is very pround of his impact wrench. He keeps it set to about 400 pounds so the wheels won't all off. Of course, it ruins the lug bolts, and if you're out in the boonies trying to change a flat, you quickly learn that 400 ft/lbs is a bit more than you can loosen with your fingers, or even with a lug wrench, assuming the Good Condition Bus came with one, which it didn't. Nor a jack.

So there I am, out in the boondocks with a dismantled engine, two hundred pounds of tools and eighty–six pounds of personal baggage with these two guys grinning at me. They've already got my money, now the question is what will I abandon to their honest and honorable care inorder to get home.

I smiled back at them and rolled up my sleeves. Being suckered is one thing, being scammed is another. They would have to kill me to win and while they came damn close, now it's my turn.

Grendel. It's a good name for what happens next.

Grendel, Saturday

Sun Sep 24 00:06:03 1995

Grendel, Saturday

The goal today was to give Grendel a new pair of eyes. What she had was a thing wrapped with masking tape held in place with a sheet metal screw on the right, and a bug headlight on the left. I also decided to do the turn signals since they were covered with blue paint and the right one was broken.

The trick to making a bug headlight bucket work in a bus is to fabricate a new fixed pivot. I used a brass #6 x 3/4 machine screw, a pair of cup washers (standard hardware store stuff) and a section of VW vacuum hose about 1/4" long as an internal spring. You have to shift the adjusters but that's about it.

Finding the keeper springs was the hard part. A visit to a local junkyard scored half a dozen; you need eight but six will work. I also lucked into a pair of unbroken turn signals (!) and a push–out window latch, a pair of headlight connectors and a halogen headlight. Ten bucks.

I had to de–rust and paint one of the buckets and retainer rings then transfer the parking light fixture. Having no gaskets, I glued the glass cover into the chrome retaining ring with grey rtv gasket maker then did the same with the freshly painted bucket after installing the parking light fixture.

Grendel has about nineteen coats of paint and part of the job was to get rid of it where the fixtures were to be installed. I used paint remover, a wire brush and a garden hose to get down to bare metal. Wiped it down with mineral spirits, dried it and gave it two good coats of grey primer.

I added a couple of extra ground leads to the fixtures, cleaned up the contacts and had everything together by 2100 this evening — about eleven hours work.

Grendel now has a penetrating stare. Highs & lows. Adjusted them against a backyard fence. Brillient yellow turn signals. Niffty parking lights (use them as part of the adjustment).

Tomorrow I'll dismantle the brake system. There's no return spring on the brake pedal. If I can't find one I'll have to rig something. The leaky right front cylinders have to go. They want $45 per cylinder at the local parts house (!) A buddy in socal is mailing me a pair, should arrive Monday. But the brake pedal is floppy/loose on its pivot, hasn't been lubed since Jona was a seaman deuce. May have to bush it but there's a machine shop nearby and bushings come in all sizes.

Also for tomorrow, do something about cabin heat, and work on the tail– and back–up lights. Monday means brakes and brakes means wheels and wheels means I can roll. I still have to resolve the stuck left–rear drum, and the horrors it may conceal. One step at a time. Do it right and you only have to do it once.

Grendel: Tires

Sun Sep 24 00:06:08 1995

Grendel: Tires

Used. P185/70–14's. $18 each, including balancing and new valves. Rims were $25 each at a local junky, one who takes plastic. Tires are Michlin (sp?) for two, 'Hercules' for the other pair. Grendel's original five tires included a 185/70–14 so I now have a full set plus a spare.

Engine is not a problem. And now the tires are not a problem. Lights, brakes, steering, cabin heat, wipers. Anything else?

One thing at a time.

Grendel, Sunday

Mon Sep 25 01:00:25 1995

Grendel, Sunday

Grendel now has tail & stop lights, plus one back–up light. Her driver's side front spindle is installed. This is the third spindle I've tried. The first was complete to the drum but once the drum was removed I saw the thing was trash, the king–pin and link pins frozen. The junky allowed me to pull another. It showed some motion and a good axle but when it was dismantled the needle bearings were junk. That was it, with regard to easy to get at spindles (ie, taken from pulled front axle assemblies). I had to dig #3 out of the ground. The axle was badly rusted but I hoped to salvage the link pins & bearings. In fact, the bearings were like new and the link pins had only a small amount of discoloration. Treated with authority, the king pin eventually loosened up. That left the axle. Cleaning got me down to a black oxide surface that was fat enough to NOT accept a new bearing. I worked on that for most of two afternoons, using steel wool and toothpaste until I could get the bearings to fit with a hard push. But that axle… lord, what a mess. My smallest Swiss file wasn't fine enough for the thread so I sharpened my pocketknife on sandpaper and began cutting the thread, twisting the knife around and around, chasing it with the axle nut off the old spindle. All tolled, I think it took about ten hours of work to get the nut to spin on. It wasn't difficult, just time consuming. And it was the sort of thing you could do sitting down.

That's the spindle I'll be coming home on. The old spindle was destroyed when it spun the outer bearing, welding it to the axle. Someone cut it off, roughly ground the axle, hammered on a new bearing and sold it to me. Good condition.

Due to collision damage to the rear of the vehicle I wasn't able to install stock tail light fixtures. I found some sheet metal at a hardware store and used my Makita to drill a series of holes that outlined the shape of the fixture opening, fastening the sheet metal over the opening with #6 machine screws, lock–nuts and washers. With the engine compartment sealed, it was a simple matter to drill the sheet metal plates to attach a pair of boat trailer tail lights, which are inexpensive in this area. Once I'm home I can knock off the bondo, beat out the dents and re–install the original fixtures.

The front brake cylinders should arrive tomorrow. While waiting for the truck I'll get after the cabin heat problem; maybe make a start on the interior wiring.

Total work time today, about eight hours. The people I'm staying with took me out to dinner. Sunday, my day of rest.

Grendel, Monday

Mon Sep 25 23:25:01 1995

Grendel, Monday

It's raining. They say it does a lot of that around here. Not a hard rain, but wet.

I'm waiting for front wheel cylinders, due to arrive via UPS. Tackle the wiper problem and discover there is so much paint built up around the wiper shafts that I have to chip it away to get at the nuts. Spray it with paint remover, use the wire brush. Do that three times before I'm down to bare metal. Remove the nuts.

Inside the cab, disconnect the speedometer cable and pull it free. The jury–rigged wiring includes several runs through new holes drilled in the package tray. Sort them out. Begin removing the three Phillip's head sheet metal screws that secure the package tray to the bus frame. Make that one Phillips head, one pan–head and one 3/8" SAE. Get them off. Remove the two… oops. One screw securing the steering column brace, remove the two 13mm bolts that holds the brace to the package tray, remove the package tray. It still has its original vinyl liner, now serving only to conceal twenty years of rust and 63 cents in change. The package tray has accumulated more than a dozen extra holes over the years, some drilled, some punched, all rusty.

Remove the 10mm bolt securing the wiper frame to the vehicle, work the wiper–arm shafts free of their grommets, remove the wiper motor and arms as a unit. One of the wiper–arm shafts is trashed. I may have to drive home with one working wiper, legal but not smart.

I dismantle the thing, take a peek inside. The wiper gear box is as dry as

Searle's Lake, the gears worn to sharp edges. The motor armature is oxidized black. I put it aside for a rebuild, continue with the wiring which is now more easily accessible.

During one of Grendel's several accidents she suffered two electrical fires. Part of the mixed up wiring, accomplished with trailer splices and duct tape, was done to circumvent the melted/shorted/open wires. I traced them back to their source, or as as close to it as I could get. Having melted, there were no color codes. I solve three of the puzzles, replace those wires with properly spliced runs. The 100watt trouble light does a nice job activating the heat–shrink tubing. Two puzzles remain and will have to be solved by powering–up that portion of the system. When they removed the stock light switch they tied a lot of the circuits together, leaving others disconnected. The high–beam indicator lamp and associated wiring is completely missing, the interior light lead vanished into a melted loom.

The UPS truck arrives just after 12 bringing four front wheel cylinders, a full set of metric taps & dies, a brass drift, another wire brush and several other useful items. I rig a plastic tent to protect me from the rain and tackle the corroded bolt holes on the salvaged spindle. The bores clean up nicely and I soon have the driver's–side backing plate installed on the rebuilt spindle.

The new front brake shoes, purchased locally several days ago in anticipation of the repair, are curiously thin, the lining material a bare 3/16ths of an inch thick. Indeed, the new shoes are a sixteenth of an inch THINNER than the greasy old shoes. The new shoes are 'Raybestos' brand. I wonder if they are any good.

Sand the drum. It has two deep scores and should be turned but it is close to the 9.9" max. I sand it and swab it out with lacquer thinner. The bearing races have a few light scores, enough so I would normally replace them. Instead, I clean them carefully, dry them and repack them with long–fiber wheel bearing grease. Pack the bore of the drum, as per VW's recommendation, alien stuff to American mechanics.

To install the new oil seal I use a piece of 2–1/4" ID exhaust pipe and a block of wood. The bearing seats with one blow. Carry the assembled brake drum through the gentle rain to my plastic tent, misty on the inside from the heat of the trouble light. I'm working on a floor of wooden blocks covered with clean cardboard, my coffee cup handy on the edge of the door.

The drum goes on more easily than I would have liked. This is the rusty spindle, polished to size with steel wool and toothpaste. Run the nut up on the threads that took so long to clean, seat the bearings while turning the drum. No crunchies and it spins true. Back it off, going by feel and experience since I've no dial indicator. When it feels right, I run up the other nut, strake down the locking tabs.

Adjusting the brake takes fifty–one teeth for the upper, fifty–three for the lower. These are THIN brake shoes.

Am I all done? Was it really that easy? I sit there, eyes closed, hearing the gentle tap of the rain on the plastic sheeting, letting my sense of touch be my inspector. Safety wire on the link–pin locking bolts and on the tie–rod end. It had been so long since the spindle was serviced that the cotter pins had disintegrated; replaced them with stainless steel safety wire. Put the jack under the shock and raise the rebuilt assembly, give it one last shot with the grease gun. The same piece of exhaust pipe serves to seat the dust cap, but lightly — I've yet to install the speedometer cable.

I like king–pins. You can keep a king–pin front end going forever with only a couple of tools. Ball–joints, you're dependent on someone to make the joints even if you do the installation. With king–pins, you can do it all yourself. But the link–pins need to be adjusted every second oil change. It only takes a couple of minutes but it's obvious the adjustment hadn't been made to Grendel in years, which is why the link–pin bearings failed.

I move around to the passenger side. I don't know why someone would adjust one side and leave the other but Grendel's passenger–side link–pins appear to be okay… until I try to adjust them and find the upper link–pin frozen.

It's twenty past six. My host has been waiting for me so they can sit down to supper. I've been at it about nine and a half hours. Time to call it a day, go clean up.

Grendel, Tuesday

Wed Sep 27 01:19:49 1995

Grendel, Tuesday

Grendel likes the rain, she soaks it up. It oozes in around the unsealed side windows and the latch–less wind–wings and through the dozen holes in the nose, discovered one night with the trouble–light inside. Ditto for the floor. Not only is the passenger–side a Daylight Area, so too is the driver's side, albeit on a smaller scale.

Tuesday was a long day, about twelve hours of damp work, but not especially fruitful. I installed the cleaned and painted passenger–side front wheel backing plate and got all of the brake components well started on their threads only to discover the bleeder valve from the old, leaky wheel cylinders was garbage. Went shopping.

Metric bleeder valves for Volkswagen's are stock items, assuming the store carries metric brake parts. The first two began sucking their teeth and shaking their heads as soon as I mentioned ''Volkswagen'. The third FLAPS was a busy place with younger clerks, one of whom merely reached onto a shelf and pulled down a tray of metric bleeder valves, leaving me to take my pick. Picked one. Seventy–three cents. Hiked back to the bus.

With the new, thin shoes installed I did one last clean–up of the brake drum, broke the glaze with sandpaper, wiped it down with lacquer thinner, began packing the hub with wheel–bearing grease. Flipped it over. There on the cardboard, between the two boards used to keep the hub off the ground, lay the outer–bearing race, a neat silver ring, brilliant blue on the side facing me. Cleaning the old grease out of the hub and dousing it with solvent had been enough to cause the race to fall out, since at some earlier time it had obviously spun in its bore.

More hiking. More sucking of teeth and shaking of heads. Finally tracked down a set of Volkswagen wheel bearings. Hiked back. My buddy in southern California had thoughtfully included a brass drift and some other handy tools when he shipped my tap & die set and the replacement front wheel cylinders. I delicately try the new bearing's race in the old bore. It drops in with a clatter. I will have to replace the drum as well.

If you ever hope to find a replacement front brake drum for a 1967 VW bus in a small town in the Pacific Northwest, there are a few things you should know. First, don't expect to find one. Second, take whatever you can get. I paid $35 for a junkyard drum with a damaged grease–seal bore and scored dust–cover rim. How did someone manage to score the rim? I haven't any idea in the world, but I know how you clean it up: two hours with Swiss files and carbide sandpaper. Ditto for the oil seal bore. Then some heavy–duty sanding to remove the rust from the friction surface and a stint with the wire brush to remove twenty years of rusty grime from the exterior, then a quick spritz of flat black paint because I don't like my work to look it came out a Russian labor camp.

The new bearing was a too–tight fit in the junkyard brake drum, despite my work with the sandpaper having warmed the mass of iron. Warmed it some more with a propane torch, warmed it until it was hot to the touch. The cold bearing–race was now a snug press–fit for an eighth of an inch, then warmed up and froze in place. Not having any bearing drivers, I used the drift, my smallest hammer, and played the criss–cross game. Tink–tap, tap–tink, working across/around the rim of the race, coaxing it into the shiny clean bore a fraction of an inch at a time until the sound told me it was metal–to–

metal all the way ‘round.

Bearings fitted, hub packed with grease, onto the axle it goes. Washer, first nut, play the Tightening Game, spinning it, spinning it, spinning it more as I hunt back the nut back and forth, searching for the sweet spot, waiting for the bearings to tell me they’d found a new home. Then on with the keeper and the second nut, draw it up tight and strake it over with the drift. One last spin. Smooth and even. I’ll check them again somewhere between Portland and Redding, check them a third time when I get home. Wheel bearings have a break–in period too.

Reassemble the brake system. Adjust the brake shoes. Thirty–four teeth on the upper, thirty–one on the lower; the junkyard drum is less worn than the original drum on the driver’s side. Then work on the wiring while I wait for my friends to come home so I can bleed the brakes.

The minor task of reassembling the wheels has taken nine hours, most spent cleaning the junkyard drum but a lot of time wasted running down the drum, bearing and bleeder valve. It has rained off & on all day long. I am steamy damp, my tools a mess.

My friends arrive with plans for the evening but are coaxed into providing the pumping action while I wallow under the vehicle with a flashlight, pint jar and length of rubber hose. It takes a while for them to understand the procedure. All the while the rain comes down. They notice days when it DOESN’T rain, use them to mark their lives ‘That day in June when it didn’t rain and we…’ It takes forty minutes to do the fifteen minute job and even then I think it would be wise to do it again. But not tonight. Not before a steaming shower. And not before I carry my poor tools indoors and wipe them down and apologize for treating them like castaways.

My friends have a washing machine and dryer. I put my filthy clothes in the former and consider climbing into the latter just to get warm. It was not a cold rain and there wasn’t any wind but the damp has soaked the heat from my bones until I move like a tired old man. Come to think of it, that’s what I am. I stagger upstairs to the shower, stagger out of it to write this.

A week ago I thought I would be on my south by tomorrow. But I know the condition of only three of my wheels and have neither wipers nor cabin heat and the wiring remains to be sorted out. I must take it one step at a time. If I stop to consider the whole of the job it’s magnitude will overwhelm me. So I tackle one thing at a time, doing it right so I won’t have to do it over. Doing it right, so it won’t leave me stranded on the side of the road. Doing it right because it feels good to do things neat and proper.

Today I resolved the problem of the leaky front wheel cylinders, and got a new set of bearings and a better brake drum in the bargain. Home is that much closer and I'm content for now.

Grendel, Wednesday

Thu Sep 28 00:33:05 1995

Grendel, Wednesday

I am wet. The rain continues to come down. Grendel soaks it up, absorbing it through her windshield rubber and side windows, spilling it onto the floor. I've removed the remnants of the rubber floor mat, allowing the accumulated rain to drain out through the rust holes in the floor, automatic self–bailing; the Unsinkable Grendel.

I have a windshield wiper. Singular. One wiper. But no wiper blade.

The passenger–side wiper shaft is frozen in the threaded brass spindle, the whole thing has been wiping back and forth for years, destroying the rubber grommet and bending the wiper actuating arm. I disconnect it, tighten down the spindle so as to provide something to bolt to the vehicle. Clean the commutator, file the sharp edges off the three copper brushes, repack the gearbox with grease, make a new gasket and put everything back together. The wiper runs better than new, having to power only a single wiper blade. If I can find one. Put everything back into the vehicle using RTV as sealant under the washers and nuts that compress the rubber grommets. Take out the windshield washers and clean the paint off them. The pump bottle is missing; if I find one, the washer nozzles will be clear, ready to connect.

The new accelerator wire is for a bug, not a bus. It will take two days to get another, which may well be the same. Competence is not a big issue in this region. Clerks talk to themselves as they key–in data with one finger; a twenty minute wait to pay for a single item is not considered excessive. Given the key–code for Grendel's doors, a local locksmith took three tries to get it right, first using the wrong code, then using the wrong blank. He is considered the best automotive locksmith in the area. He charged me $39 for the one good key… and the two bad ones, doing a favor for the tourist. Local veedubers shake their heads sadly over my engine. Everyone knows thermostats are bad. And I'm not even running a centrifugal distributor. Sad, sad, sad. They offer kindly advice as to tire size and hotrod tricks. Taller tires are better. I should be running a Power Pulley. And that oil filter will make the engine run hotter. This is truly an alien land.

I'm tracing down shorts. And opens. Much of the post–collision wiring repair was done with trailer–light splicers, except they used one size for all of the wires, cutting some of them in two. In a few cases they taped the wires together apparently intending to install a splice but forgot. Just the tape, plastic–to–plastic, the wires neither stripped nor wrapped, side–by–side beneath nine layers of electrical tape. I keep looking over my shoulder for the Mad Hatter. This is the bus considered to be in Good Condition.

The heater–box wires are rusted into their tubes. I'll wire the passenger–side heat exchanger open to provide heat to the windscreen, buy some long–johns for the trip home.

I now have the rudiments of an electrical system. As soon as I track down a problem with the turn signals I'll have a light–legal vehicle… except for the license–plate light. The plastic cover was painted and the plastic came apart when I doused it with paint remover. Yeah, I know it ruins plastic, but it removes paint. Diffuse light is better than none at all. I'll have to hay–wire something.

The driver's–side rear wheel, the one I've been unable to remove, wobbles in all directions. I suspect a bad bearing or stub axle or both. This will be the last major problem to resolve but I can't resolve it until I can drive the vehicle to a shop with a puller powerful enough to get the drum off.

In the meantime, it rains. And people like it that way. At supper tonight, when saying grace, my host's wife thanked God for the 'nice rain', having endured a terrible fifteen day dry spell. After the meal I went back to work, pausing for a moment to offer God another opinion. It immediately began to rain harder.

Feeling much better, hardly coughing at all. Worked nine hours. Desperately anxious to get home to insane, illogical, too fast southern California.

Grendel, Thursday

Fri Sep 29 00:57:59 1995

Grendel, Thursday

Water continues to come out of the sky. Grendel is on her new wheels, her belly a bit lower to the ground, her feet slightly wider apart. She will no longer shimmy and sway as she rounds a curve , she may even stop if I dance on the pedals and scream a lot. But she won't go. Her accelerator pedal is as limp as Odie's tongue. And her turn signals don't work. She has running lights and head lights and tail lights and stop lights. The interior light even consented to work, once I'd burnished the contacts and resoldered the wire. The headlights go from high to low, although you'd never know it. The indicator lamp is burned out and all of the local parts stores suck their teeth and shake their heads when I show them the tiny bulb.

She is extra–greasy in all her parts, sixteen strokes–worth in the upper front torsion beam on the right side. But the brake return spring, which I'm told is nothing more than a clutch return spring, is broken, a bungee cord wrapped about the horizontal portion of the lever and secured to the cockpit floor with a pair of #6 sheet metal screws. The clutch pedal shrieks dryly with each depression. I should take it apart and lube the pivot but I'm too tired and wet and cold.

The license plate light now has a new lens, a section of clear plastic cut from a ninety–nine cent butter dish, spotted On Sale when I went to buy pipe tobacco this morning. But the problem was not only the lens but the wires, broken when the engine hatch fell off. Because of the hinges. It doesn't have any. Good condition.

The rain no longer flows in around the radio antenna mounts. I've removed them, they were shorted to ground in any case. To cover the crudely hacked holes I've made up bullet patches like we used in Vietnam: beer–can aluminum with a smear of RTV, pressed into place. Light, tight and quick.

I ve used an eclectic collection of wires to restore Grendel's nervous system, spending a good part of the day binding them up in Basic Black. Yet there are a few Mysteries unresolved. Real head–scratchers. Copper whiskers projecting from a melted loom, four puzzles resolved but one remains. And the turn signals. Whoever cut the wires and spliced them back together failed to route the loom through the proper openings in the steering wheel brace under the instrument cluster, so that tightening down the package tray and steering column brace crushed the wires. I've repaired those that tested open but the color codes are obscured and I've no way of telling if the work was properly done to begin with.

With the wheels on the ground for the first time in nearly two weeks, I began playing with the gear shift. The shifter plate is worn to a knife–edge and should be replaced but parts at the local junkyard have become prohibitively expensive; they know I've no alternate source of supply and have begun to charge accordingly, a local sport honed to a keen edge since the Spotted Owl shut down the mills and the shipyard has felt the bureaucratic axe. Local teenagers call themselves the Last Generation.

Making Grendel go backwards is a chore, finding reverse a sometimes sort of thing. You can feel the gear shift hang up on the worn–out shifter plate, go reluctantly into reverse perhaps one time in three, finding second on all other occasions. Yet it's a roadworthy machine, the forward gears snick into place cleanly. The brakes are firm but only near the limit of the pedal's travel. The shoes are adjusted to maximum drag. It WILL stop, assuming I'm not going too fast.

The steering is tight, a minor amount of play adjusted out. The link–arm is good. Grendel should steer with more precision than she has known in years. If I could be sure of the condition of the left rear wheel I'd throw my duffel in the back and head south tomorrow. But I won't. I am safe where I am, safer than I would be trying to fix some minor problem half–way through the Siskiyous. My nearest safe haven to the south is my son's home in Modesto, nearly a thousand miles away. I have been a pilot more than forty years. I've learned to leave nothing to chance. Another day or two will put the odds of a trouble–free trip strongly in my favor.

If I study the rain perhaps I'll come to know it, to find something useful in such wasted bounty. I'll wipe down my tools yet again, listening to the tap of raindrops on the metal roof, dreaming of home and the arid vistas south of the line.

Grendel, Saturday. Help Needed

Sat, 30 Sep 1995 22:58:33

Grendel, Saturday. Help Needed

Having decided to stay here in the drizzly northwest until Grendel has four good wheels, I devoted most of the day to tracking down a new stub axle and reduction gearbox. And it didn't rain. The sun came out, the wind came up, the clouds blew off toward Canada and I was treated to wondrous vistas of Mt. Rainier and trees shrugging into their autumn dress, swirls of leaves chasing one another across the country roads as I meandered from junky to junky in search of the perfect stub axle.

Found one, I hope. The boss wasn't there but for $50 cash money the hired man will give me the run of the yard tomorrow. We shall see.

Back to the weldors and machine shops of the port, tracking down material to make a real puller. Found some Grade 8, 16 thread–per–inch threaded rod. Kinda rusty but it will clean up. Found some Grade 5 long–nuts at another shop, just about to close for the day. Bought two. A welding shop had some 1/2~ flat stock, was eager to sell but I needed it cut and the guys with greasy fingernails had already left for the day. Anxiously asked to re-turn on Monday, which I will do. There are some hungry people around the waterfronts of Puget Sound.

Here is what I'm trying to make: A steel pentagon fabricated from five identical pieces of mild steel, 1/2~ thick by 3–3/4~ long on the short side, each piece cut at a 35 degree angle on each end, the angles opposite to each other so the piece comes out as a rhomboid instead of a slanted rectangle. The steel will be two or three inches wide, which ever the shop has.

With a deeply chamfered hole to accept a lug bolt drilled in the center/middle of each piece, and the five pieces welded together in a flat ring, I will have a fixture that will bolt to a Volkswagen brake drum. Ideally, you'd flame–cut the plate from a hunk of armor plate. I'm winging it, trying to keep it within my budget and abilities.

I've spec'd a 35 degree cut instead of the 36 degrees because I don't expect any of the cuts or drillings to be very accurate. I'll have to do the drilling without benefit of a drill press and hogging out a hole big enough for a VW wheel stud is going be a pretty sloppy job without holding the work in a vise. I'll probably have to drill some small diameter holes in each piece, secure them to a baulk of timber with deck screws to keep them from moving around as I hog the holes in them with a hand–drill.

To assemble the pentagon as accurately as possible, I'll bolt the pieces to a brake drum, filing and cutting until I get a symmetrical fit. My host has arranged for me to use a small mig welder belonging to a friend. When I'm satisfied with the fit I'll haul the assembly to the friend's house then tack–weld the corners of the pentagon pieces.

To make the puller–part of the puller I'll ask the welding shop to cut me five pieces of 1/2" by 2" bar stock, six inches long along the short side with each end cut at 45 degree angles opposite to one another. Again, that isn't the proper angle but you've got to pay for each set–up of the saw, after that each cut is only fifty cents. I'll grind, cut and file to get the angles a little closer before I tack–weld the thing together. This part of the work will have to be done at the friend's house, and I'll probably have to drill some small assembly holes and jig the thing together with bailing wire to insure it's properly aligned before welding. Structures built in space then to move around a lot from the welding heat.

The threaded nut will be positioned about 4–1/2" above the upper surface of the pentagon, held in place during assembly by a section of the threaded rod. The Grade 5 long–nut 1–1/2" across the flats. I'll cut a 12" piece of the threaded rod for the screw of the puller, converting it into a bolt by welding a nut to the end. Normally, the puller–part would be the hub from a real puller, something with an Acme thread and enough beef to pull the world apart, but again, I'm going with what I can find, with what I can afford.

When I'm satisfied with the fit and alignment, I'll do the finish–welding, building up a nice fillet at every joint to carry the loads smoothly around the corners. If I weld from side to side, and give the welds a chance to cool before going on, I should end up with an accurately made Volkswagen drum–puller.

To turn the screw I'll buy a 1–1/4 socket and weld it to a five–foot piece of 1/2" x 3" bar stock. To prevent the puller from turning as I turn the screw, I'll weld attachments to the pentagon plate to accept a bolted–on anti–torque lever made from a section of angle iron or bar stock. The lever will press against the ground toward the rear of the vehicle while I play Tarzan on the five–foot long welded–up socket wrench.

I've calculated that I should be able to generate about 8 tons of symmetrical pulling force using only my body weight. By reversing the welded–up socket–wrench and raising it with the hydraulic jack, I can generate about 80 TONS of force. Of course, I'll never see 80 tons. Even 8 tons tosses the vehicle around. But if I were at home I would chain the swing–plate and axle to the concrete, allowing me to use the full potential of a powerful puller or welded–up socket wrench, which is my little trick for unscrewing difficult wheel nuts and popping off sticky brake drums. But I'm a long way from home.

And I could use some help.

My only measuring tools are my 6" machinist's pocket scale and a six–foot tape measure. I've calculated the diameter of Grendel's rear drums as 10.4~, both by direct measurement — wiring a pair of hacksaw blades to opposite sides of the drum and measuring between them above the hub — and by measuring the circumference of the drum with the tape measure and playing with pi. Starting with those dimensions I came up with a bolt–hole diameter of 8.025", lug–bolt spacing of 4.75", hub height of 2–7/16", axle projection of 1". These dimensions are important not only for fabricating the puller but for calculating the maximum loads in the parts. A small error can have a profound effect, given the leverage factors I'm dealing with.

Could someone please double check these dimensions for me? I'll probably make some paper patterns to double–check myself but tunnel vision is a marvelous thing, permitting a person to make same error over and over again.

If someone has a protractor and could lay–out the vertical straps, I'd like to know the angles. x–axis: 4.0125 (or half the bolt–circle diameter), y–axis: 4.4375". I've guesstimated the hypotenuse as 6". If there's an engineer in the house I'd like to hear his opinion of lengthening the legs to about 7 inches; the angle seems a little flat for the loads it will have to handle.

Grendel, Sunday

Mon Oct 2 02:10:03 1995

Grendel, Sunday

It was two Sundays ago that I wheeled away from Shelton in my ‘good condition’ bus, the one with brakes on one wheel, no brake lights, one tail light, one head light, a front spindle that canted inward at the top and rattled when shook and a left rear wheel that moved freely about as if mounted in soft rubber. No cabin heat. One windshield wiper. Throttle patched with bailing wire and bungee cords, ignition hot–wired. Mismatched wheels and rims. Good condition.

Today I motored Grendel gently to the junkyard where I’d arranged to remove a stub axle, parked where I’d been told. There was no one there except an insane dog, gnashing his jaws on the wire. I worried that the fellow wouldn’t show, I needed that stub axle.   The fellow finally arrived, a little nervous but wanting the fifty bucks. He went inside, corralled the dog and unlocked the gate, wanted the money right then. I didn’t want to play it that way. He helped me hump my tools inside, closed the gate, demanded the money again. I coaxed him out to the pile of trannys, not wanting to pay up until I at least had the thing in sight. We spotted one that looked like a keeper, moved a few trannys so I could get at it. He kept looking at his watch, whining about being late. The place was remote, no houses near. I paid him his money, accepted the key, was told where to hide it. He took off and I went to work clearing the tranny away from the pile, blocking the outboard gearboxes up. Scrubbed off the crud Didn’t look too bad. Pulled the drain plugs. No oil. Rotated the boxes with difficulty, got a gush of rusty water. Pulled the filler plug, peered inside with my mini Mag–light. Junkers.

The pile of trannys was about head–high, maybe twenty feet long by half that wide. Part of the pile was obscured with rear body tin including a cherry early bus rear panel, the one with the hole for a starter crank. I unstacked them, created a new pile, sorted them unconsciously by type, finally got down to the main part of the stack of trannys.

I found a good late model tranny about three layers down but getting to it was a chore, requiring me to move about a dozen transaxles before I could pull it to the edge of the stack. The pile of trannys was on the lip of a steep gully maybe fifty feet deep. The gully was filled with berry vines, shrouded by pines at least 200 feet tall. To get at the tranny I had to circle the pile, make a trail along the side of the gully, come at the tranny from the back. I was standing on leaf mold, a spongy black mass several feet deep. I got the tranny almost free, went to move one last obstructing axle from another tranny and something gave way, sending three trannys and me shooting down the side the gully.

It was steeper than the roof of a house and for the first twenty feet I was running in place, keeping upright, thinking I was doing pretty good for a guy who never learned to dance. I dodged the first tranny but that threw my timing off and I got clipped by the second. Then it was ass over teakettle, through the berry vines, sliding downhill on my back, head down with a tranny across my chest.

I hit something hard enough to knock off my watch cap and leave my glasses hanging from one ear, hard enough to spin me to the left where I came up against a tree stump, hard. The first tranny and an avalanche of leaf mold cascaded into the depths of the gully, arrived somewhere with a noisy splash.

I had rotten leave mold all over me, in my ears, up my sleeves. My left arm had taken a good whack but still worked. My glasses were bent. Bent them back, found my watch cap. Got myself cleaned up. The tranny I wanted was a few feet away, one axle uphill, the other down, balanced on something under the leaf mold. I was in a moldering pile of branches, probably lopped off a tree that had been chopped down. There were several trunks in sight more than three foot across, I was about half–way down into the gully. I used branches and punky chunks of wood to block the tranny in position, began searching for a trail up the side of the gully to fetch my tools, found my Mag–light and pencil laying where they'd come out of my shirt pocket. Checked myself again, made sure I still had my pipe and it was unbroken.

By the time I got my tool box down to the tranny it was nearly eleven. The bright morning had turned cloudy and was now threatening to rain. There was nothing to put between me and the damp leaf mold, the nearest green limbs were fifty feet overhead. I set to work, kneeling in the wet debris.

My slide down the side of the gully had disturbed the local residents, a surprising variety of pot–bellied spiders and colorful millipedes. One especially pretty one, black with yellow dots, gave me polite lesson in forest–floor etiquette when I gently touched it, sending a razor–like shock up my arm. There were fine hairs sprouting from the yellow spots, invisible until I lifted the thing with a pair of needle–nosed pliers and took a closer look. He had lots of friends. A tiny spider discovered a scratch on the back of my hand, had his first taste of human blood, liked it. I shook him off but he had friends too. I've had nicer places to work. And worse ones, too. At least no one was shooting at me.

It began to sprinkle but the canopy of trees kept me fairly dry. I used a wire brush to clear the bolt heads, gave them a dose of Liquid Wrench, tapped it in, constantly bothered by the tranny trying to take off downhill. The branches were rotten, kept breaking. A vehicle arrived at the junkyard, voices, a loud radio, the frenzied barking of the dog, muffled, then loud. Then louder. I waited, sweating in the damp cool of the forest floor, a ball peen hammer my weapon of choice. My tool kit includes a thing that makes holes and loud noises but I'd left it with my duffle.

The vehicle started up and drove off. I waited for the dog but heard only birds and a distant ultralight, struggling against the wind shoving the clouds north above the trees. I went back to work.

The stub axles were exposed, the bearing carriers gone. They had been buried in leaf mold which is acidic and were badly corroded but I thought at least one of them would clean up into a usable part. Several of the bolts were so rusted they rounded at the touch of the wrench. I drove on a six–point 1/2" socket, fractionally smaller than a 13mm. Only one required the use of vise–grips and chisel, all came away clean.

To free the stub axle I would have to pierce the sealing plate on the back of the gear box. I used my Makita to make a string of holes, slit them with a cold chisel, pried the slit apart, wedged in one jaw of an open–end wrench, soaked the sealing line with Liquid Wrench and worked at it, rocking the thing back and forth, slowly winning it free. I might have to reuse the part, tried to keep the distortion to a minimum. Sat back, sweating, flexing my tired hands. And saw the dog watching me. He was on his belly, partially hidden behind a tree stump about fifty feet away along the trail I'd made, angling up the wall of the gully. He made no move. I had a fit of coughing, not wanting to take my eyes off him, scrabbling blindly for the hammer as I hacked and wheezed until even the birds were silent. He was just laying there, watching me, his head concealed save for his eyes but his ass in plain view, immobile. I started to laugh and that brought on more coughing, finally just sat, my pulse somewhere up around two hundred. He was a big dog.

I went back to work, keeping half an eye on the dog, talking to it, telling it why I needed this rusty piece of crap, explaining in exquisite detail the hundreds of things that combined to put me there on the side of a gully in a dripping rain forest a thousand miles from home.

I never saw the dog move but he did, plowing a path in the leaf mold, advancing to another stump then to a clump of what looked like spinach, behind which he hid in the same idiotic way, face concealed, body in plain view. I talked to him while my hands made a killer's noose of safety wire, using a bolt for a toggle on the free end, something to give me a good grip. Join the Navy, Learn a Trade. I put my thinnest, longest screwdriver handle–up near my left side, the hammer on my right. The dog watched me while I worked. I kept talking to it. My pulse was okay now, I had it figured out. We were going to end up at the bottom of the ravine, one of us wearing a safety–wire necklace that once pulled tight, would stay that way. I was wearing a lot of clothes, I could withstand a couple of bites. I went back to work on the tranny.

When the lock nuts were removed I used the hammer and a brass drift to drive the stub axles free of the gear box, first the left, then the right. The dog was perhaps twenty feet away. I thought he would go for me when I stood up but his haunches weren't quivering, he didn't look ready to spring. I started gnawing at the snap rings. I didn't have a pair of snap–ring pliers but I did the screwdriver trick and got the left one off without bending it. The right one vanished into the gully with a musical ping! that brought the dog's head up as his eyes followed the invisible snap–ring. Good reflexes.

I couldn't do any any more work on the tranny on my knees. I stood up, armed with screwdriver and hammer, shouted at the dog. He pressed his head down into his paws, kept looking at me. He didn't want to eat me, he just wanted to talk. I felt like crying, I was so relieved.

So we talked. He was a farm dog, or maybe a farmer; I speak better Cat than Dog. All he could talk about was the weather and when he was going to get fed and what a rotten job he had. He was afraid of hammers and red wiping rags. I don't know why, he just was. I had two red wiping rags, one blue. I put away the red ones, lay the hammer down. He belly crawled to within five feet of me but refused to come closer, lay watching with doleful brown eyes as the rain misted his coat with pearls of moisture. I finished dismantling the gear boxes. When I drove the gear boxes and axle tubes off the axles, the dog winced with each blow.

It took three trips to get my booty and tools to the top of the gully. I positioned everything near the gate while the dog sat and watched. I opened the gate, moved everything outside, snapped the lock as the dog flung himself against the wire, snarling insanely, flinging slobber in all directions. He refused to calm down until I'd moved away from the gate, then sat, watching as I loaded the bus and drove off, forgetting to hide the key as I'd promised. When I returned, the dog went through his act again. I put the key in the agreed place and left the gulley and the junkyard and the crazy junkyard dog. I was tired, it was after three, a misty rain coming down.

Back at my host's house I worked four hours cleaning the rust from the stub axles, winning the threads free of rust until the nut spun on with oily smoothness. I don't know how I'll pull the corroded bearing but bearing pullers are common things and I can always jury–rig something.

Among the spares I brought from San Diego is a rear wheel seal kit, complete from cotter key to gaskets. If I can get the old drum off, and if the replacement drum consents to fit on the still sorta–rusty stub axles… assuming I can get the bearings off of them, I'll be able to rebuild Grendel's wobbly rear wheel. A friend already has fresh bearings on their way to me.

Tomorrow I'll return to the welding shop where they will cut ten curiously shaped pieces of metal which I will use to create a pentacle powerful enough to make a stuck brake drum come flying free. Welding is a kind of white magic and I'm a warlock of note.

I got off lucky today. Before writing this I showered, trimmed my beard. I've a purple bruse the size of a fist high up under my left arm, a dull red lump on my chest. But I also have two stub axles and no bite marks.

Grendel, Monday II

Mon Oct 2 21:54:19 1995

Grendel, Monday II

This was a GOOD day. Lots of problems but none too big to handle. Lots of progress on the wheel puller and cleaning up the repair parts obtained from the rain forest. And my buddy in Sandy Eggo raided my shop and is shipping me a box of bus bearings.

I'm sorta miffed at the welding shop's idea of accuracy. Spec'd some steel pieces to a given dimension and no two of the five pieces came out the same. These guys would starve to death in southern California, where 4.0" means something closer to the mark than 4.377" That's a BIG error for such a little piece of steel. The other errors were less but it still means I'll have to cut the things myself, by hand. And I could have done that to begin with (which I obviously should have done).

The shop I'm being allowed to use is a treasure. Basically, it's a lube bay with a bench, a 200 amp Hobart mig machine on a roll–around cart. But the bench comes with a vise. And under the bench are a lot of portable tools inlcuding a big drill motor with a half–inch chuck. I spent the day hacksawing my expensively mis–cut steel to the correct length and drilling holes in 1/2" steel, a fun thing if you don't have a drill press. I don't but I ain't complaining; I was dry and it was raining outside. I was cold but the coffee wasn't and he didn't mind if I puffed on my pipe while I worked. I got a lot done and will be back there at 0900, all elbows and assholes until I get the job done. Not much else to say since there really isn't much you CAN say about leaning into a drill motor for 45 minutes at a time. Five chamfered 5/8" holes through 1/2" mild steel stock, a couple dozen smaller assembly & alignment holes. After you've drilled one hole the thrill is gone.

I'm looking forward to slicing up that hunk of Grade 8 all–thread. I'm gonna have muscles in my beard by the time I get the wheel puller built.

It rained like hell today. I was too busy to notice. Maybe that's the secret. Sore & tired. Hot shower & cold beer just down the hall.

Grendel, Tuesday II

Tue Oct 3 20:13:14 1995

Grendel, Tuesday II

I felt the pulse of the Heart of Darkness today when I was kicked out of the shop I'd been invited to use. There was no reason for being told to hit the road except the momentary sense of power you could see flash across the guy's face. It seems the person who gave me permission to use the space did not have that right and in some strange way the outcome of the Simpson trial and the hippie nature of Grendel's paint job and my being from California combined to trigger a strange rage that could only be satisfied by a petty act of cruelty.

I can't describe the depths into which my spirit plummeted when told I couldn't use the shop. If this were a novel a White Knight would appear in the next chapter and the story would have a happy ending. But this is gritty reality and the last White Knight was captured by a black pawn centuries ago.

Without the shop and welding equipment it will be impossible to complete the drum–puller. The labor and resources I've already expended are wasted, sunk cost with zero recovery value. I hauled my gear out of the shop, called my host for a ride and sat waiting on my tool box, wondering what to do next.

The shop incident has put a strain on the relations between my host and I, to say nothing of my two week long stay. Circumstances may force me to abandon Grendel. But I'll give it one last try.

Coming back from the shop I bought a cheap electric drill and three titanium drill bits. The drill motor is a single–speed design with a plastic case, very cheaply made although expensively priced. It spins at 1,200 rpm and I selected the drill bits — all the same size — based on the drill's rpm rating and the fact I would be drilling cast iron. I plan to drill off Grendel's sticky drum.

Back at the house I repositioned Grendel so I could reach her with an extension cord, made myself a work area by rigging some bailing wire over which I can sling a tarp for when it rains. Today is dry, rather cold and windy but rain is the thing to plan for up here so I do a good job of it, with side stays, a built–up floor of plywood over scraps of 2x4 and a drain channel to keep the area around the left rear wheel as dry as possible. An old kitchen chair stood beside a trash bin down the alley. I hauled it back to Grendel, sat down and began to drill holes in the cast–iron brake drum.

In my mind's eye I can see a pattern of holes that will unlock the hub and allow it to come free even witout the aid of a puller. There are sixty–four holes in each pattern. I will need to repeat the pattern four times.

The titanium drills do a good job, eating eagerly into the cast iron. I spend five hours drilling holes, consuming the three drill bits and shattering my precious S–K 5/8" cold chisel, companion of many years. I finish one pattern of holes and part of a second. My arms and shoulders are shaking with fatigue when the setting sun ends my workday.

Drilling the hub is a destructive act. Undrilled, the thing would at least roll, the drum complete and apparantly safe. Having drilled the hub I've immobilized Grendel, a fact I haven't shared with my host. All of my eggs are now in the one basket of my skills, I must get the drum off or call the junkyard tow truck. Tomorrow I'll hike down and buy more drills and hopefully, a replacement chisel. Sometime tomorrow afternoon Grendel's sticky hub will lay in two pieces on the ground.

We do what we have to do in life. I have to get Grendel home. Then I'll think about why.

Grendel, Wednesday

Wed Oct 4 23:13:26 1995

Grendel, Wednesday

They have crows up there the size of chickens, and thick–furred cats that have never heard the howl of a coyote. A blue–eyed seal–point spent the day with me, oblivious to the whine of the drill and a muttering of curses when the point would dull or break, as they all eventually did. Six drill bits to complete the cuts, carefully photographed now that I've learned Web Page Richard can handle photos as well as text. Most folks don't believe you can cut a slot with a drill. Been there, did that. Got the T–shirt. But didn't remove the drum.

About five this afternoon as I started a row of holes intending to split the entire drum top to bottom, my host's neighbor, a nodding acquaintance after nearly three weeks, peered over the fence and said "If you're trying to split the drum, I've got something that may be faster than drilling." A nearly new

Makita 4" grinder. I was wearing a 32–tooth grin when I snatched the thing from him, plugged it in and began to slice cast iron.

I used up his grinding disk, will be down at the hardware store at the crack of eight for another, should have the drum turned into scrap metal by noon, mebbe sooner. And no, he can't renig on the deal, I've got the grinder right here beside me.

In case you've been wondering about this drum–splitting business, it's possible to lock a drum to a stub axle simply by over–torquing it. The drum is made of a marvelously soft mallable cast iron, wizard stuff for generating friction and soaking up heat without undue distortion. It is the kind of cast iron with big, chubby hunks of pure iron bound together with thin veins of carbon. It will bend before it will break. And it will flow if over torqued. If it flows into the splines, it can lock itself to an axle so strongly that nothing sets it free short of fire. Or chopping the drum into segments and taking it apart like a grapefruit, which is what I proceeded to do with my drills and drill motor. But there's more to it than drilling. The real trick is knowing where to drill.

The outer hub of the brake drum slopes down to an elongated hub. Inside the brake drum there is a similar hub but no slope; the inner hub is about an inch long, the outer more than twice that. Between the two is a thick web of metal about 1–1/2" thick at the splined bore, thinning to about 1/4" thickness everywhere except for the rim of the brake drum, which starts out being over 1/2" thick.

To drill a drum free of the axle you must drill not only the outer hub but the inner, the one you can't see. To insure you cut the inner hub you begin at the outer hub, drilling a small horizontal hole as deeply as you can and as nearly parallel as possible into the meat of the hub. When you've drilled full–depth for your particular drill you go up a size or two until you arrive at 1/4" diameter. Then you switch to an 'aircraft' bit, a longer than normal drill bit, and continue until the feel of the bit tells you it has found the spacer ring, which is too hard to be drilled.

This 1/4" diameter tunnel is the key to unlocking a frozen hub. You must drill four of them, all very nicely straight. You drill them in pairs about an inch apart on opposite sides of the hub, your goal being to remove the metal between the twin tunnels.

The easy way to remove the chunk of metal is to drill a series of small holes down to the 1/4" main tunnel. Since the surface of the hub has a pronounced curve you must drill your holes at an angle. But since the goal is the straight tunnel, and the starting point an inside curve, each hole is actually the entrance to up to four drillings, each one angled slightly, relative to the others, the object to remove as much metal as possible.

As your drilling progresses down the slope toward the threaded end of the axle, you begin drilling horizontal holes into the drum, starting the bit in each of the hole–craters you've just created. If you keep everything aligned the horizontal hole will encounter each of the angled holes you've drilled, allowing you to keep track not only of what you've drilled but where.

Eventually you will arrive back where you started, at the outboard end of the hub. That's when you begin using your drill bit as an side–mill and your drill motor as a milling machine. You are the controller and vise. It is not a task for the highly strung. By running the drill motor at top speed and slowly changing the angle of the bit, the side flutes will shave away the cast iron between the holes. Do it wrong and you'll snap the drill, leaving it embedded in the metal, blocking further chances to drill through that level. This is one of those procedures that is more difficult to describe than to do, which is why I took a number of pictures.

Eventually you will achieve a pair of square–sided grooves in the hub of the brake drum. The metal won't fall out in your hand because of the hundred or so webs remaining between the angled and horizontal holes you've drilled; your groove can only extend to the exposed portion of the hub since you must have room to lever the drill motor back and forth. For the inner hub, the available range of motion is too small to cut a complete grove, you will end up with a tunnel having a curtain of walls, the residue of your angled drillings. To defeat these remaining webs you drive a cold chisel into one of the groves. The chunk of metal will bend toward the other groove, fracturing some of the webs. Now do the same thing to the opposite groove.

It will take about a dozen hammerings of the chisel in each of the grooves, working the hunk of metal back and forth but eventually the chunk of metal will snap free. If luck is on your side the missing lump will extend entirely through the hub. You can then break the grip of the splines using heat and hammer blows, or apply a regular puller, the missing metal having made the thing a sloppy fit on the axle.

And then there are days like today, in which the chunky did not break cleanly through to the inner hub. It broke about three–quarters of an inch short, leaving me to figure out how to get rid of the chunkie, since the hub will remain locked to the axle so long as ANY of the inner hub remains.

I managed to leave chunkies in both cuts and was out of sharp drills, gnawing at the remaining half–inch of cast iron with a quarter–inch drill bit that I eventually broke. About then the neighbor leaned over the fence, I did a couple of cartwheels across the alley and began to burn the cast iron drum away in a shower of orange sparks. I ground on the drum until the disk could not make contact with the metal. It was about seven pm. I'd been at it for ten hours.

I'll be back tomorrow and THEN watch those sparks fly.

Grendel, Thurs IIa

Thu Oct 5 09:13:49 1995

Grendel, Thurs IIa

Thursday morning, about 0600 Dawn is trying to break through the overcast. No rain. Today is the day the drum drops off and I learn the cause of Grendel's wobbly legs.

Removing the drum is a necessary step. The alternative is to cut off the axle tube and the forged steel axle within it, slide off the remains of the axle tube, release the snap ring securing the axle within the differential carrier and replace everything, including a new emergency brake cable, since all of these things are terminated withing the citadel of the brake drum; if you can't pull the drum you can't free the e–brake cable nor dismantle the outboard gear box to get at the end of the axle.

I'm pleased that a number of you have found these daily notes of interest. I've tried to provide a mix of information and narrative so the notes will be of mechanical benefit. But I don't want it to turn into a soap opera. I'm dealing with a mechanical problem. There are some personal problems that dictate how I deal with the mechanicals, and even a few philosophical points that have tilted the playing field but the bottom line is performing a repair in the field with limited resources. There is also a good chance that the other problems have skewed my perceptions, I could be making a mess of things, or overlooking an easier path to the top of this mountain. Indeed, this partiular mountain may well be a mole–hill, blown out of proportion by my situation. Please keep these things in mind and read my notes with a critical eye. If you see something I appear to have overlooked, please give me the benefit of your advice.

As to the question of rewarding my host for putting up with me, that's a personal matter I've already taken steps to deal with. The most immediate need for them and me is to see Grendel's tail lights winking down the drive. Once I'm home some very nice things will happen and we will all look back on this visit with smiles.

Right now, I'm waiting for the hardware store to open.

Grendel, Thursday IIb, evening

Thu Oct 5 23:46:30 1995

Grendel, Thursday IIb, evening

The top half of the brake drum hit the ground at about 1243.

The bottom half is still clinging tenaciously to the axle despite a grip of less than half a circle. That puppy is WELDED to the axle. The weld is black iron oxide — rust — in granules hard enough to dull a drill. I could probably slit the remaining half of the drum into thirds, break them away with the cold chisel. But only if I had another cutting wheel.

Enter now, an introduction to Northwestern humor, such as ‘dry’ rain or ‘1–day’ photos that usually take only three days (but took five in my case and brought the preceeding admission).

The borrowed grinder is a small–spindle Makita. The one I have at home has the large spindle, as do most of the grinders I’ve seen. The joke is that none of the local stores carry disks for the small–spindle grinder. None. Zip. Not one. Nada. Zero.

Why not? Because everyone uses the large–spindle grinder, except the son–in–law of the man who loaned me the grinder. That’s where the grinder came from; a present from his son–in–law, who lives in another world where disks for Makita grinders having small spindles are common, all children are polite and O.J. got to ride Old Sparky to the gridiron in the sky.

When the fellow came home from work I asked him where he gets new disks. “Never had to, yet. But I hear they got them in Seattle.” And San Diego. I offered to pay him for the disk I’d used up but he waved it away, “Naw, just send me a couple of disks when you get home.” And grinned. Northwestern humor. He’d loaned me a grinder with a partially used up disk knowing I would be obligated to replace it, saving him a trip to Seattle. Or San Diego. Or where ever it is that I can find a small–spindle #80 disk for a Makita grinder.

At least half the drum is off.

Inside, the brake drum don’t look too bad. Good Condition, Shelton–style. It’s worn so thin you can almost see through it and the axle wobbles like a stick in the mud, but other than that, I’ve seen worse. Of course, I was skindiving at the time.

With half the drum cut away I should be able to dismantle the wheel, even if I have to leave the remaining half of a drum attached to the axle and go into the gear box from the back. I have a spare bearing carrier and spacer–ring, and my buddy sent me a set of replacement bearings, and I already had a seal–kit in the spares I brought from home. With the replacement brake drum and axle, I should be able to reassemble a working, wobble–free rear wheel. Should. If. Maybe.

I'll have to unbolt the locking nut with a chisel since the cheapest 1–5/8" socket I can find was a whopping $22. I'll have to unbolt the gear box from the spring plate and pop loose the can over the locking nut but I'm pretty sure I can get at it even with half the drum still attached to the axle. I'll also have to open the brake line and remove the wheel cylinder but that's not much work. I've already slacked off the emergency brake and pulled it out to give me room to pound on the remaining half of the drum. So far, all the pounding has done is break the handle of my big ball peen hammer. That puppy is seriously stuck.

In fact, the work looks pretty much downhill from here. Some basic mechanical chores, adjust my toe–in and I'll be on my way. Except for the rain. And the brakes. That is, an abundance of the former and a serious lack of the latter.

I rigged a tent of plastic sheeting over Grendel's dented butt. This is the 5–mil plastic sheeting I used to wrapped my engine before stowing it in the trunk of the car I was to deliver a few lifetimes ago. I folded the stuff carefully and have kept it safe, knowing it rains up here now and then. But while the plastic is a good 12 feet long it's only four feet wide. I have two panels of it. I overlapped the panels, attached them to the rain gutter with clothes pins and draped them over some bailing wire stays I erected between Grendel and a nearby fence. The plastic makes a reasonably dry if somewhat narrow shelter, under which I've built a floor from scraps of wood and cardboard boxes. And while it keeps me dry it isn't very warm, and the weather is getting downright cold, the kind of cold that makes my southern California face hurt when I step outside.

The other problem I have to worry about has just cropped up. Actually, it was there all the while but I've just discovered it. The steel line to the rear brakes is crushed just behind the master cylinder. Deliberately crushed, as if to shut off the leaking right rear wheel cylinder, the one I replaced at Shelton, along with the steel pipe to the wheel, which had been crushed in a similar fashion. Before flying out of Shelton on my Grendelbroomstick I did a quick bleed–job, putting down the oozy nature of the fluid flow to a lack of energy on the part of the person I'd dragooned into pumping the pedal.

Now I see it wasn't lack of energy but lack of flow. Sometime in Grendel's checkered past someone tried to block off the rear brakes, using a pair of dykes to crush the brake line. As with all her other repairs, they botched the job — some fluid still flows through the line but it isn't enough to fully actuate both cylinders quickly. And with the line partially blocked, the fluid will return with equal sluggishness, meaning Grendel has been dragging her toes.

I would like to replace the damaged line before starting south but a quick tour of the local parts houses got me the usual Metric Response — sucking–in of breath accompanied by a sad shake of the head, as when asking for Mastodon Nose at a Chinese restaurant. Suck, shake, "So solly. No have."

I wonder if these parts people have taken a close look at a modern American car? A good many of them are fitted with metric–dimensioned brake components. I tested this possibility with the counterperson at the last parts house I visited and got: "Oh, you mean AMERICAN metric stuff." I nodded eagerly, willing to accept Albanian 'metric–stuff' if that's all they had. But he sucked air through his teeth and slowly shook his head. "Don't carry it. We probably will, once there's a demand for it." I had an insane urge to pound on the counter and shout "I DEMAND you carry American–metric stuff!" Maybe that's all he needed, someone to shout at him now and then. Maybe that's all any of us need. Management by Volume. I wandered off, looking for someone to shout "Go HOME!" in my face. No luck.

I mosied back to the house in the slow, cold rain, patting Grendel's nose as I passed by. It wasn't her fault. Come to think of it, it wasn't my fault either, unless trusting people is a fault. Maybe it is, in today's America.

Grendel's Good Friday

Fri Oct 6 21:46:06 1995

Grendel's Good Friday

Ode to a Purple Thumb

I'm in the house, typing when I should be working. There is no rain, the day looks as though it will be a good one. It's not yet ten a.m. and I've already put in nearly three hours. Things are going well.

Two days ago I struck the knuckle at the base of my left thumb with a hammer, a common thing when working on your knees in the dirt. Yesterday, when removing the stuck drum, I struck it again, a much harder blow and with a bigger hammer. Already exquisitely sensitive, the pain was blinding. It left me in a cold sweat and wanting to throw up. I now have a livid sausage–tight appendage where my thumb used to be, so tender it can't press the space bar of the keyboard, so swollen it moves with great difficulty and sends a gulp of nausea into your throat.

The next step in dismantling Grendel's left rear wheel calls for me to lay on my side under the vehicle and drive–out the axle with a drift. Given the position I'll be working in and the amount of force needed to drive it out and the mushroomed condition of my too–long undressed drift, I'll hit my thumb again. I've come in to swallow more Tylenol, drink a cup of coffee and bind up my thumb with tape, girding my loins as it were. I'll wear gloves and hope I hit the thing no more than once. It isn't broken but I can feel things moving around in there, like marbles in a greasy tobacco pouch.

I'm approaching the Limiting Factor in the Grendel Adventure. I'm surprised to find it is me. I thought my wife and family would pull me home with logical complaints of things more worth doing but they've propped me up, more understanding than I ever would have imagined. The money was a big IF but some was found. None to squander on twenty–two dollar sockets but enough to get me home. The tools have failed right and left, there's a trail of them behind me like crumbs in the forest, but others have come to hand. In the end, it's my own body that is letting me down. I'm a bit ashamed of it. I once ran the Marathon and swam from Malibu to the Santa Monica pier. You'd think it could stand being thumped with a hammer now and then.

I'll rest a while here, paint a bullseye on my thrumb with iodine, go out and take another whack at it.
Evening

It began to rain about noon, got into it after about an hour and really hosed down the place, and me. Now it's clearing, now that I've come in and cleaned up and am warm and dry. I've yet to adjust to this rain business.

Even so it has been a good day, starting out with a minor victory pulling the sealing can off the locking nut.

The stub axles on early buses are part of an outboard gearbox, intended to let a 25hp engine move a heavier load than a bug full of people. The gears are massive spur–cut things, each supported with equally large ball– or roller bearings on either side of the gear. The larger gear is an intergal part of the stub axle. The axles inboard bearing fits into a machined seat and is retained by an internal snap–ring. The outboard bearing is a roller–bearing that fits into a machined seat and is retained by the bolted–on bearing retainer visible when doing a brake job. The axle's lateral motion is limited by the locking nut that secures the axle to the hub of the inboard bearing from behind. The locking nut is just a mild steel nut with a lip around the thread. After the nut is installed, securing the axle in the bearing, the lip is tapped into a recess in the stub axle, locking the nut in place. To seal the access to the nut, a metal plug rather like a freeze plug except for being installed with the cup–side down, is pressed into the recess around the locking nut. Since the plug, which is more than 2" in diameter, is also an oil seal, it is liberally coated with Permatex before being driven home.

The trick is getting the metal seal out so you can play with the nut. The can is perfectly smooth, no lips or notches to grip.

At the dealership we punched a hole in them, levered them out and threw them away. That was in the mid–1950's. Today, you can't afford to throw them away, you have to reuse them, which means making smaller holes, ones you can easily patch.

To pull Grendel's plug I drilled four small holes around the edge of the plug and installed #6 sheet metal screws. To pull the plug I tried to pull the screws with a carpenter's hammer. It worked and the plug popped out on the first try. I'll be able to seal the small holes with solder or braze.

Once I had access to the locking nut I tried to spin it free with a chisel but found I couldn't do it laying on my side. Perhaps if the bus were higher or if I were using a different form of support — I have a pile of wooden blocks under the tranny mount. And part of the problem was my wounded thumb. I gave up, disgusted. Drove down to the FLAPS prepared to pay $22 for a suitable socket.

The store was empty. It was a Friday morning, a few minutes after eight and there was no one in the place, neither clerks nor customers. Then a heavy–set girl came out of the office, asked cautiously if she could help me. She was hesitant, unsure of herself, lifted her hands in distaste when she found the metal frame holding the parts catalog — a six–foot rack of manuals — was grimy, as all good parts catalogs should be. It was either her first day on the job or she was filling in. I looked about, raised my brows. "Fellowship breakfast," she in a disgusted tone that said it was an all–male fraternal bonding bullshit waste of time. I smiled at her. Then I grinned and let that widen into a positive leer. I was alone in an auto–parts store with an inexperienced female clerk.

"I'll take one of your inch and five–eighths sockets, please." She started for the rack of half–inch drive tools but a small shake of my head gave her the clue and she went to the 3/4" rack, found the proper socket and brought it back beaming. "And a 20 inch long section of metric–to–metric brake line, the kind with the bubble flare." That stumped her and she made a tentative move toward the catalog rack. "It's probably hanging with the other brake lines," I said, looking off toward the street, disinterested. "Long, thin metal pipes?" That got a smile and she skipped off toward the back of the place, inviting me to come along. I followed so close I would of had to marry the girl if she'd stopped suddenly.

With the brake line in hand I gave her a stunning smile and shook back my mane of long, blond hair. It was dim and private, the counter forty feet away down the aisles of racked parts. "Now I'm going to show you something," I said huskily, "That you've never seen before." She gave me a nervous giggle and tried to back away.

I waved the length of brake line like a wand and described a cabinet or drawer of parts that looked like the fitting on the end of the brake line. She frowned. She had see it but couldn't remember where. She tried one aisle then another before snapping her fingers and leading me to a jumbled rack of pull–out drawers. In a minute I had a metric–to–metric bubble–flare coupler in my hand. "Somewhere in here there's an adaptor that will fit in this end." I let her look at the coupler and we began searching together, she in one drawer, me in another. She found it in a bottom drawer, jumped up delighted with her success. Her own store of parts jiggled wildly. She was very pleased with herself. Being the counterperson at a parts house was turning out to be easier and more fun than she imagined. "Now we need the SAE fitting that goes into THIS end of the adaptor." She found it in less than a minute and blushed in sunset hues when I praised her.

The SAE double–flare tool was more of a challange. I described its approximate shape. The store had racks of K–D tools, I guessed it would be a K–D product. She checked several drawers before asking me to look through the dusty debris of things unsold, some racked so long their packaging was faded. The tool kit was near the bottom of the drawer.

When I added a pair of snap–ring pliers to the pile the bill came to nearly a hundred dollars, thanks to the overpriced socket, the fifty dollar flaring tool and the twenty dollar pair of snap–ring pliers. She was ecstatic, "This will be my biggest sale all week! I usually just do the phones," she admitted. She gifted me with a ball–point pen and a baseball cap while we waited for the plastic to go through the computer. When I thanked her, telling her how much I admired a woman who really knew auto parts, she impulsively threw in a key–ring pocket screwdriver tool. "Normally, we only give them out when the sale is over two hundred dollars…" and blushed. I hurried out of the place without looking back, afraid she would offer her phone number or shout out "I get off at five!" Lucky girl.

Removing a VW bus axle without pulling the brake drum is a topological trick akin to a woman removing her bra without taking off her blouse. They do it all the time but it still looks like a trick. The trick with the stub axle is to remove all of the bolts holding the reduction gearbox together then drive the thing apart by pounding on the unbolted end of the axle from the back, working through the opening normally sealed by the can. That is the task I went back to after writing the first part of this message, my ode to a purple thumb.

The pounding went slowly. Cautiously would be more apt. Even so, I whacked the thumb again. But it was the sort of job that you know will get done if you just keep at it. I kept at it and the gearbox popped apart about eleven a.m., just in time for me to miss getting a ride downtown. What I wanted now was a hydraulic press, and I knew where one was. But the stub axle, half a brake drum, backing plate and part of the gear box weighed about forty pounds, more than I wanted to carry without a pack–frame. I had lunch while I waited for my host to return with the car.

Three bucks. That's what the machine shop charged to press the axle out of the split drum. It was a standard charge, posted right there on the wall. 'Hyd. Press. $3 minimum' It took them less than a minute. Then I had to wait for my host to return, having dropped me while he ran some Friday errands.

Back at the house I began cleaning the dismantled gearbox but soon realized it was so contaminated with metal particles that I couldn't get it clean without boiling it out. The wobble was due to the failure of both lower bearings, the outer–roller being so loose a fit it came to pieces when the shaft was pressed out of the hub. The inner was retained by a large snap right that I popped out with my new snap–ring pliers. It too was worn into a rattly mess. The upper bearings weren't quite so bad which was a bit of luck since I had no way to pull the inner bearing without driving the axle out of the tube.

Shortly after returning from the machine shop it began to rain. A little later the temperature took a sudden plunge and a keen little wind sprang up. I was able to keep my tools and the work area dry but couldn't avoid leaving some part of my body exposed. By three o'clock I'd made a good start on rebuilding the gearbox but my boots were squishing and my levis clung damply to my legs. By five o'clock I had the inboard half of the gearbox cleaned and the new bearings installed and a gasket made. I had cleaned up one of the gearbox covers from the junkyard and will use it instead of the contaminated original. But by then I was so wet and cold I was shaking. My thumb looked like a monsterous raisin. I knocked off, wiped down my tools, came inside and climbed into a hot shower.

This was a good day. If it were warmer or if I were younger or if someone was shooting at me, I could probably have Grendel back on four wheels by midnight. But it's cold, old and quiet. I'll give it another go tomorrow.

Grendel, Saturday II

Sat Oct 7 23:07:28 1995

Grendel, Saturday II

I've been here so long the neighbor kids think it's my home. They ask neat questions like, "Can'tcha' fixit?", "Whadidya do to your thumb?" and — perceptive as hell "Are those the only clothes you own?" They also offer biting commentary: "My dad sez your bus is an eyesore." A minute later: "What's an eyesore?"

My favorite was: "When are you going to yell again?" During a moment of anguish, immediately following Post–Thumb Trauma I refered to something as a 'salt–water sucking sonofabitch' and other things, too. I've expanded the local vocabulary. The kids try out the new words on each other, providing their own interpretations and variations. I've become a part of their tribal lore.

It is Saturday. No school and blessedly, no rain. The sun is out. So are the neighborhood kids. I prefer the company of the neighborhood cats. I know they're laughing but they do it quietly, perched there on the back of the driver's seat. I laugh at them too as I scuff their ears and scratch them between the eyes. One morning real soon now they will find Grendel gone, the parking space raked and clean.

I began work about 0700, anxious to seat the axle into the new bearings. But I couldn't bang on things until someone banged first. Shortly after eight someone down the block fired up a lawnmower and I took it as permission to bang away. Took maybe three minutes of carefully aimed blows, big ball peen on little ball peen inverted, to ease the axle into the inner bearing. Then came the fiddly bits. It was a quarter past eleven when I had the backing plate and gearbox reassembled. Except I forgot to install the can over the locking nut. Discovered my forgetfulness when I tried filling the gearbox with oil. Stopped, cleaned things up, started over.

By four–thirty Grendel had all four feet on the ground. Why so long? Mostly me. But the 12x1.5mm bolts holding the spring–plate to the gearbox were rounded. Chased the threads of both bolt & bore. Without a vise, doing the bolts was surprisingly difficult. Once the drum was on and the axle–nut torqued to spec, I adjusted the brakes. Did it twice, hoping to center the shoes. The junkyard drum, like all the others, is worn out. Mounted the wheel, torqued the bolts to 70 ft/lb. Went around and checked the other three. Wheels and suspension will not be a worry on the ride home.

I shifted the jack and blocks to the front torsion beam, made a work station so I would be comfortable for the brake–line repair, something I wasn't looking forward to. I'm about wore out, able to work only a few minutes at a time. The section of brake line I would have to repair runs along the driver's side frame member, curving above the torsion tubes. I would need to get the tubing cutter and double–flare tool into the space since I couldn't bend the line down to gain space. It looked like a real mare's nest. I figured out what had to be done, focused on the first step and got busy.

By not breaking for supper, I was finished splicing the brake–line by seven thirty. With pressure on the system, the SAE double–flare I'd fabricated insisted on oozing until I grabbed it with a pair of visegrips and gave it another quarter turn. No ooze.

Bled the brakes. Checked the adjustment. Bled them some more. I have about half–travel on the pedal; it goes down about three inches then stops hard, as if the pedal had just hit pavement. No weep, no ooze, no slow descent to the floor. Good brakes, given the worn drums.

But no brake lights. It appears the brake–light switch has failed. It has two, will work with one. I've a hunch one hasn't been working for years and the other failed when the system finally saw something approaching full pressure.

And no heat. That one at least is now a no–brainer; connect a few wires, add some insulation to the central duct, let the hot wind blow all over my toe.

And no wiper. Oh, it has a wiper but the wiper has no blade, 10" wiper blades having proven to be as rare as small–hub grinding wheels for Makitas.

And no turn signals. Emergency flashers but no turn sigs.

All little things. I gave it about 12 hours today. Tomorrow should see me driving. I've been away from home a month, have incurred numerous obligations. I must buy a few parting gifts, make some courtesy calls. I'll head south as soon as I can, probably Monday or Tuesday.

Grendel, Sunday III

Mon Oct 9 01:34:00 1995

Grendel, Sunday III

It's about eight thirty in the evening, Sunday, the eighth of October. Clouds are scudding across the face of the moon like something out of a Japanese print. I left my home thirty–four days ago for what was meant to be a quick trip, a week, ten days at the most. Today is my third Sunday in the home of friends. They are religious people, she more than he but the bond of love is strong between them; he is her Ruth and a better man for it. Their religion is highly structured, this day of some particular importance that saw them leave early to return yet some hours from now. Having no particular religion I am a heathen in her eyes, a profane swab who landed on their doorstep, a Christian duty for them to perform, which they did without question. But she is wrong about me. The sea is like a foxhole in that neither contains any athiests. Agnostics perhaps but the typical sailor pauses more often to give Thanks than the most devout Muslem, for the sea is more empty than any desert. And you can't walk home.

Grendel is the ship that will carry me home, if not in style at least with some degree of comfort. She consented to blow a little warm air on my shoe today, thanks to wiring the heat exchangers open and hammering loose the collision–damaged vent in the cockpit. I cut strips of construction paper, a foot wide by two feet long, squirted foam sealant on them and plastered them onto the 3" vent pipe I've used to replace Grendel's missing main heater duct. The foam will expand and insulate the fragile aluminum ducting. With the faithful engine rumbling at high idle I can detect a baby's breath of warmth from the defrosters. Were I freezing to death it might prolong the agony a minute or two but it may help keep the glass clear when I encounter rain, as I'm sure to do now that autumn is upon us.

The street where Grendel is parked is lined with towering American Walnut trees, densely green in their Clovis–spearpoint leaves when I arrived, yellow now, the leaves fast falling into damp windrows. I spent some time raking them, moving Grendel cautiously back and forth to get at those drifted against her wheels. The chore brings back memories of my youth and crunching piles of sycamore leaves and thin lines of blue smoke standing into the windless November sky above a little town in California's central valley, where autumn comes later than here. I'll carry autumn south as I go. Jack Frost and the Grendelmonster.

Grendel now has a fuel gauge. I had fashioned one of wood, was planning on spending my first day's journey cautiously measuring her fuel consumption. The gauge is a blessing.

Grendel also has a horn. The wire, a bit of fine gauge speaker wire, was broken at one end, loose at the other, the fitting corroded. I replaced the wire with some hefty 14 gauge aircraft stuff, steel–wooled away the corrosion, tinned the connector with solder, made everything shipshape. Noisy horn, another legal requirement met.

Still no turn signals nor brake lights. The brake light switch is promised for Tuesday morning. But I now know when the headlights are on high. Don't ask me how I did it; it didn't work at first despite a new bulb and checking the circuit and scrubbing everything with steel wool. Then it was working when I conducted a test on another circuit, another of Grendel's belly–laughs. I stopped a moment to smile, thanked the Boss Mechanic, happy for any help at all.

Packing things up, dividing the load into Hold and Cabin baggage. The hold will be well filled with split drums and destroyed spindles, promised displays for other veedubers on the Vanagon list.

Still to do: Check my toe–in. Rebuilding the spindle has surely thrown things out of alignment. And I must drain and refill the transmission. Heaven only knows how long that lube has been in there. I can check the toe–in myself but I've no way to dispose of lubricant nor any means of refilling the tranny once it's drained. That's a chore that will have to wait until I have brake lights.

Gave it a solid 12 hours today. Little things but needful, like sealing the gap below the cargo doors. Not only is the sill rusted away and sagging, the lower flange of the doors is gone. Used the last of the foam, shut the doors with pieces of waxed paper to keep the foam from welding them closed. Sand it down, give it a shot of paint, mebbe sell it as Good Conditon.

And I still have to replace the brake return spring. I'd better put that at the top of my list for tomorrow. And hope it doesn't rain. But I've got a hunch it will.

Grendel, Monday III

Mon Oct 9 23:52:06 1995

Grendel, Monday III

Bob, the odd–job man.

Monday dawned gray and cold, sprinkles of rain shaking down when the clouds piled up, bumped hips in their rush to the east. Both brake–light switches are duds but at least in southern California they are commonly available duds. The local auto–parts stores carry only the metric–threaded switches for later model VW's and Audi's, insist they will work on 'any' Volkswagen, back up their claim by telling me that's all they've been selling for years.

Picky ol' Bob, insisting on a brake switch with an eighth–inch pipe thread when everyone else uses M10 stuff. And ruins their master cylinder in the process. Are the parts–store people simply stupid? I think not. They get

$12 for an 'Audi' brake–light switch; a real VW brake switch is about two bucks.

I spent the day doing odd jobs. I put the package tray back in — I'd removed it to get at the wiring. The passenger–side fastener had gone west, been replaced by a Tinnerman nut and a humungous sheet metal screw. I banged out most of the major dents, scrubbed it down, scraped off the most offensive of the slogans and stickers, put it back in. The missing fastener was a trial due to the bends in the tray and localized damage at the fastener site; Grendel has taken a couple of good hits on the nose, damaging both the package tray and the heater duct.

I got the other two fasteners in then made up a 1/4–20 bolt with a couple of fender washers and shoved it thorugh the hole. Sitting with my butt in the rusted hole on the passenger's side of the front deck, I used my left shoulder to bend the tray into place, my right hand to hold the bolt. Closing my eyes, I imagined a pair of magic fingers putting the necessary washers onto the other end of the bolt, threading on a nut and spinning it tight, focused on it until the fingers got it right. It's like watching a training film in your head.

I don't know how that works. I don't know how it COULD work, since your left arm doesn't bend like that. (Try it.) But when I got done thinking about it the nut was on and my arm was sore. It's a handy trick, however it works.

Did the steering column. Did the speedo cable. I thot I'd have trouble snaking it through the hole but I was too tired to try it myself. I let it find its own way through, crawled under and pulled it the rest of the way. I had trouble fitting it into the axle. Lubed it with waterless handcleaner, pushed it through. Installed the circlip, squeezed it tight. Drove the dust cover on firmly with a section of exhaust pipe.

The day passed quickly. It always does when you don't pay attention. I was running on automatic, as tired as I've ever been. The rain kept coming in little showers, keeping things wet. Just before supper it started coming down steadily.

I checked the heater ducts again. I think something is blocking the duct near the 'Y' but it's hard to tell with the engine running, impossible with it off.

Did the back–up light. It only works intermittantly due to a bad something. I've cleaned it and rewired it but it continues to play the fool, sometimes working, sometimes not. Rap it and it usually changes its state, a random–action flip–flop. I don't like things I can't trust and back–up lights are useful things. If it's there, I want it to work and work reliably. I cut up some angle iron for brackets, drill a few holes, mount a tractor light over the blocked–off back–up light opening on the driver's side, wire it up. Works every time.

Bright, too.

One last chore is the license plate lamp. It too is intermittant, probably due to no hinges on the engine compartment lid. I make up a new ground lead, drill a hole, insert a #6 sheet metal screw with an internally toothed washer, give it a smear of copper–based anti–sieze to insure a good electrical contact where the washer bits into the steel, a bit that would otherwise loosen in time due to corrosion. No light.

I'm working by the glow of my static timing light. The rain is coming down pretty good. Today I've heard the rain described as 'real' and 'good', not by the same person. Indeed, I've heard it described in almost biblical terms but I haven't heard it described honestly, which is wet, cold and hard. An uncomfortable rain to be kneeling in with your head twisted around, peering up at a light fixture that refuses to work. I take it out, climb in the bus, start the engine, turn on the trouble light and make up a complete new set of leads. Black & white striped #16 for the primary, solid green for the ground. Two eyelets on the ground lead, one for the compartment door, the other for the body. Polish the lamp base with steel wool. Add a dot of solder to the base, another to the ground, sand the contact in the fixture, install the lamp with a light rub of anti–sieze. Test it using jumpers. It works, nice and bright. Climb back out into the rain. I've lost my hat somewhere. The raindrops feel like ice cubes on my bare head, there are droplets on my glasses. Shamble to the back of the bus, genuflect before the engine, soaking up the heat of it, hearing the hiss of rain on the tail pipe. Install the fixture, install the grounding screws, connect the primary. No light. The rain is heavier just then, pounding on my sodden shirt. I came north with three light shirts, one heavy flannel to be worn if the weather turned coolish on my quick trip that has now taken more than a month. It is definitely coolish tonight. The rain is dripping off my nose and I am close to tears, confounded by my failure.

I dismantle the fixture, disconnect it, squelch back to the cab and get in. The faint warmth from the demisters feels like a furnace, my hands are blotchy red and it's a minute before I can trust them to take the fixture apart. Check each lead, burnish them with steel wool, put it together, test it. It works perfectly. I shake it and rap it against the floorboards. It doesn't flicker. I sit, waiting for the rain to die down, trying to think of what I've failed to do. It's a simple circuit and I know there is power to it because the tail lights work. I climb out into the rain, pause dumbly, searching for the test lamp. Go around and search the box of electrical stuff on the passenger–side floorboards before recalling the test lamp is illuminating the engine compartment. Go back there and kneel down again. My levis are wet and my knees burn where they rest on the gravel. Take the fixture out of my shirt, the screwdriver from my pocket, reinstall the light fixture and connect it. It does not work. Unclip the test lamp, intending to test the lead to the license plate lamp. And find myself in total darkness. There is no light at all. I've forgotten to turn on the lights.

I wiped down my tools, put them away, came in and stood beneath the steaming water until my skin was puckered and red. Later, I smoked a pipe while wondering if I should even mention my stupidity. Decide it's part of the story, as much as the flower on Grendel's nose or the rusted holes in her floor or the water oozing in around the windscreen. We are both in Good Condition now, a pair of wrecks about to fly south for the winter.

Grendel, Tuesday III

Wed Oct 11 01:41:45 1995

Grendel, Tuesday III

Rain. All through the night and into the early afternoon.

The brake light switch arrived as promised but there was only one of them; only one had been ordered. I thought I ordered two; I can't clearly recall.

I installed it in the rain, wet but not rained upon under Grendel's bulk. The blue–eyed cat joined me, head–dived against my watch–cap, finally sat and watched the rain. It seldom rains in Egypt.

With the switch installed I was ready to bleed the brakes but had no one to pump the pedal. Began tracing the brake–light wiring. It runs into the loom of wires that was burned, vanishes. I've picked it out of the loom running through the fore & aft frame member, know it's good from there back.

I track the wily wire into the mess behind the turn–signal relay and suddenly realize that failure of one will affect the other — early buses use a two–light system, the brake light also serving as the turn signal.

My host arrives home for lunch and helps me bleed the brakes, happy that three of them bleed properly, unaware of the portent of the one that does not. The driver's side front flows neither oil nor air when I open the bleeder valve, yet I can hear the upper cylinder actuating. This is the one wheel I've not rebuilt. Grendel is paying me back for my neglect.

But it's the brake lights that bother me. And the turn signals. I put on my thinking cap, scratch a schematic on the back of a receipt, mosey down toward the harbor and the nearest FLAPS. I ask for and receive (surprise!), a double–pole, double–throw center–off switch, a heavy–duty two–terminal flasher unit and a pair of after–market tail lights, the kind with a two–filament bulb. The bill is about twenty–five bucks.

Back at the house I dig through my spares, find all my wire, select a roll of #14 and two of #16. Tie the ends together and nail them to the fence, start backing up, paying out the wire until I reach Grendel's stern. Hang a right, keep backing down until I run out of blue wire, hoping it will be long enough. Put the cast off brake drum on the wires to keep them from coiling up, go back to the fence and start looming them together with electrical tape, my last roll of the stuff.

Twist, twist, twist, wiping the rain from the wire as I wrap it with tape, shielding it from the sprinkle with my head and shoulders. Twist, twist until I reach the brake drum. It takes a while.

The main fore & aft wiring harness for the VW bus runs through the passenger–side frame member, up and over the torsion tubes, a well protected place but difficult to pull new wire through. I try pushing a piece of bailing wire through the frame but it fails to clear something. Try it from the other end but it hangs up. I'm laying on the damp ground in my damp clothes, head and shoulders protected, under the bus, legs getting sprinkled on.

Is heavy gauge stainless steel safety wire stiffer than bailing wire? It takes a while to unspool enough but once it is straight it proves stiff enough, if pushed through from the middle of the frame member. I lash the loom of wires to it, pull them through, do the same with the rear half of the frame member. I now have three new wires running from the front to the rear of the bus.

It takes over an hour to loom the wires and get them threaded through the frame. Up front, I make up connectors and put the #14 wire onto the brake switches. Use the safety wire to find a path up into the cabin, pull the ends of the #16 wires up near the turn signal relay. It all takes time and I'm getting wetter.

Climb into Grendel, turn on the trouble light and start the engine. Out of the wind it feels warm, even if it isn't. In a few minutes Grendel is blowing a faint breath of warmth around my feet. I think I've blocked my new heater duct with the foam meant to insulate it. If so, it's going to stay blocked until I get home. I start making a new turn signal.

A DPDT switch has six terminals. It's really two switches in one housing. I will wire the hot lead from Grendel's defunct turn–signal relay to the center terminal on one half of the switch, wire the switched power from either side to the flasher. The output of the flasher goes to the center terminal on the other half of the switch. Push the switch to the left, the second–half left terminal will have the flasher's signal, push it right, the right will have it. Simple flasher system. I do the wiring and begin gnawing a hole in the dash. There's already a hole there but it's too small to accept the threaded neck of the switch. My gnawing tool is a small drill and Swiss files. It takes longer to make the hole than it did to wire the switch but I'm out of the wind, thinking of Baja and beaches without footprints.

When I found Grendel's tail light fixtures to be damaged I removed them and installed a pair of boat trailer light fixtures in the holes, first making up cover plates to close the openings. Now I dismounted all that and figured out how to mount the second pair of tail lights, the ones I'd just purchased. The only way they would fit without drilling holes in the body was to reposition the first pair and mount the second pair above them. I drilled the necessary holes in the cover plates, kneeling in Grendel's cargo bay, drilling atop a block of wood. It was dark before I was through; I knocked off about eight pm, went in to eat and warm up, get dressed for working in the rain, which was coming down again.

To install the fixtures and wire them I worked sitting on a piece of plywood, the wind blowing down my neck, dressed in a garbage bag and wearing a turban. Some folks would call it a towel wrapped around my head but it was really a turban covered with a small white plastic garbage bag. The neighbors arrive home from somewhere late, mutter to one another, go into their house without speaking to the strangely bundled creature squating behind Grendel's engine. I have the trouble light and my timing light inside the engine compartment, protected from the rain, as are my tools. I'd be there too if I could figure out how.

The work took about two hours. When I was done I was so cold I had to roll onto my knees before I could stand. I loaded everything into Grendel, wiped down my tools and sat dripping as I tested the circuits. The two #16 wires were for the rear turn signals. I connected them to the front turn signals and to the output of the DPST switch. Got it right the first try; left was left, right was right. And brake lights, too. The turn signals were wired to the bright filament of the upper fixture, the brakes to the lower, running lights to the low–power filaments of both. The result is perhaps the most visible '67 Volkswagen bus on the planet. Clunky as hell of course, but it works. I mounted the switch horizontally; flick it to the left for a left turn, right for right, center for off. No self–canceling, no indicator lamp. I'll do it right when I'm home and dry.

Tomorrow I'll insulate all of the connections, tighten down the fixtures, check things out. But I've a hunch Grendel is about ready to roll. I need to fill the tranny and check the toe–in but other than that, she will pass any highway safety inspection. Even mine.

Grendel, Wednesday III

Wed Oct 11 23:31:42 1995

Grendel, Wednesday III

It rained all day and I was out in it. Grendel is running. She carried me back to the Rain Forest where I obtained a new gear shift and shifter plate. Grendel's shifter plate is worn so thin it is deformed and the stop on the gear shift is completely worn away on one side. The newer parts were rusty but cleaned up okay. I installed them tonight after supper, by which time it had stopped raining and turned cold. Took it for a test run. The gear shift is now tight and precise enough for me to detect some slop in the shifter–rod running to the tranny. I'll check it tomorrow.

I went by the local Jiffy Lube where the boss–boy told me "Your vehicle was assembled with the transmission too close to the cross–member. Our tool doesn't fit." I showed him how to use the LONG end of his 'tool', a 17mm Allen wrench. Then they removed only the differential drain plug. I pointed out there were two. Then they ran the lube in too fast, spilled it all over the place. I explained about giving it time to flow into the differential housing. A 'jiffy' in this case was forty–two minutes. Twenty bucks. For just the tranny lube. As I said earlier, competence is not a keen issue in this area.

I want to rig an indicator for the turn signals I've made. Or install a horn. Drove all over with my turn signals on today, feeling belatedly stupid each time I discovered it only to do it again at the next turning.

Also rescued a cockpit floor mat from the leaf mold. It will cut down on the drafts; there are still several holes in the floor I haven't patched. The cargo doors are now a draft/rattle–free fit, thanks to running a bead of foam around them, covering it with waxed paper and letting it harden. Custom–fit.

The foamed insulation on the vent pipe has proven to be a good fix, light, strong and durable. My double tail lights are bright and water–tight, the brake and turn brighter still. I've added some reflectors to comply with the California vehicle code. I've started loading up. There's a lot of stuff to carry away.

I'll probably leave tomorrow if the wind is from the north. Tail–winds are good things. I still don't have a wiper–blade I can count on. I need a 'TRICO' 10" replacement blade. Everyone in town carries 'ARCO' or a house brand that isn't compatible with the TRICO arm I've gotten to work. Arm, as in just one.

I've received a couple of friendly hints that Grendel is in good enough shape to survive the trip home. They're probably right. Then again, getting half–way home isn't quite the same as winning half the first prize. Getting half-way home is the same as losing. I don't like losing.

I'll be on the road three days. I'm confident the engine will give no problem, and reasonably certain the suspension, brakes and steering will handle the run. What I'm doing now is buying insurance, checking things for the third time, testing Grendel's ability to stop and climb and shift.

It's not the fastest car that wins the race, it's the one that finishes first. You've got to finish to win. I may not win but I'll finish the course.

Grendel's belly ache

Fri Oct 13 21:39:32 1995

Grendel's belly ache

Grendel crept out onto the highway this morning at 8:23. It was raining a sad, cold rain that continued for the next two hours as we fled south.

The engine ran fine. The tranny did not. Each time we stopped for gas Grendel squatted down and pissed a pie–plate sized pool of tranny lube on the concrete. When she stopped pissing I crawled under and fed her some more lube. She liked it but got progressively noisier as the day went on, culminating with an ominous shriek of tortured bearings as we struggled over a pass in southern Oregon.
I'm in Grant's Pass, Oregon. It is cold and getting colder, weather unsuited for summer shirts and cotton socks. And I'm tired.

Tomorrow I'll try to find a flat spot in the sun, see what I can do in the way of repairs. I'm not very hopeful.

The Long Run for Home

Mon, 16 Oct 1995 19:53:25

Getting Grendel Home, 1 of 2 The Long Run for Home

It wasn't departure, it was flight. The weather was foul, Grendel skittish on the steep down grades and sudden curves, the way walled with trees, shoulders narrow or non–existant. What was described as 'freeway' was another example of Puget Sound Humor, a maze of orange warning barrels and three lanes squeezing suddenly into one with ominous '20mph' warnings. But it lead south and I took the chance. Too soon, as I would discover.

Crossing a bridge with a metal–grid road–way, the vibration shook loose my outside mirror and it flopped down. I caught it before it fell off the bar but there was no way to fix it without stopping and no place to stop just then. When there was room to stop, there was still the rain. I was less than two hours into my trip, about to be halted by a clumsily installed mirror. I held it in my lap, evidence should I be stopped by the police. I would leap out brandishing the mirror, an act that would get you shot in San Diego. Maybe I would tell him my tale and plead insanity. One of those.

South of Tacoma I ran out of the rain and stopped for fuel, more worried with the mirror and dirty windows than the vehicle. It was a stable ride, the engine as faithful as a beating heart. I was annoyed with spatters of oil on the rear glass, used Bon Ami to remove them to the amusement of others buying gas.

Oil on the REAR glass? I hunkered down, opened the engine compartment. All okay. Peeked underneath to see if the flapper valve had come off the road–draft tube. Saw the pool of oil, rich and green, another drop descending as I watched. Grendel was bleeding.

I pulled over near the pay–phones, sat weighing my options. The smart move was to turn back, pull the engine, find out what was leaking. While thinking about it I repaired the mirror clamp using a longer 1/4–20 bolt, lock– and flat–washers, made a proper job of it. I didn't even know if it was engine oil or tranny lube. I checked the engine oil. It was up to the mark. Grendel's new tires put her belly too low to the road to allow me to squirm under. I got out the floor jack, used a block of wood under the rear jacking point, raised her up, made up a stand of wood blocks to fit under the lower shock mount. She was still dripping, the drops coming from the axle rearward. I thought it must have blown the near tranny seal I'd installed at Shelton before installing the engine. I got the tools, crawled under, wiping her down, getting gear lube all over me. Pulled the filler plug, poked in a finger. No oil. Squirmed out, sat thinking of ways to get oil into the tranny without a lube pump. My solution was to rig a baby bottle. A plastic talcum powder container from my shower bag provided the bottle, the thumb off one of my gloves the nipple. Filled the bottle, wired on the leather nipple, squirmed under, got the nipple into the filler hole and some of the oil inside. It wasn't a very big bottle and the shape of it prevented the entire contents from being used. It took three refills, about half of it going into the tranny, most of the rest all over me and the tranny, a very messy job. Cleaned up with waterless handcleaner before inflicting myself on the gas station restroom. Washed up, changed my shirt, still confounded as to which of my options was best.

How bad was the leak? How long had it been it leaking? WHAT was leaking? Was the tranny cracked? If the seal was blown, why did I still have a clutch?

I bought a newspaper, spead it out over Grendel's shame, reading the headlines and an agony column while the sports section soaked up the oil. It really is a small planet and with no spares in sight I tend to tread softly.

South was joy. North was defeat. I tweaked the faithful heart, snicked into gear, worried the brakes as I got back onto the highway, headed south.

I needed to know how bad a leak I was dealing with. The Volkswagen tranny holds exactly the same quantity of lubricant as the engine: eighty–five fluid ounces. 5.3 pints. Not a bunch.

It was Friday, a day of mixed clouds and sun, the highway thronged with RV's and logging trucks, all blasting past me at a rate of knots. I was running 55 indicated, about 51 actual. Making good time. I pulled off at the next town of any size, hunted up an auto–parts store, bought a lube pump. Checked my receipt from the gas station, calculated the distance I'd traveled, continued until I'd racked up 100 miles, pulled off at the next cross–over offering services, parked in a corner of a restaurant's parking lot, went through the routine with the jack and blocks and tranny wrench, discovered the hose of the oil pump would slip out unless held in place. It took seventeen strokes of the pump before the tranny overflowed and the oil ran down my arm. I'd forgotten to change into my dirty shirt.

Lube oil pumps deliver about one fluid ounce per stroke. I don't know if that's a standard but that's what I measured during a bout of insatiable curiosity. One stroke, one ounce. And a pint's a pound the world 'round, according to Miss Rose Segetti, my Fourth Grade teacher. That's for water, of course. But had I asked I'm sure Miss Segetti could have told me how much a pint of 90 weight tranny lube weighs. Miss Segetti knew everything. I've still got a lot to learn and Grendel was about to teach me a lesson I'll never forget.

Running at an indicated 55 miles per hour, Grendel was leaking about a pint of oil every hundred miles. And I thought I was hearing some sounds from the tranny. I buttoned things up, cleaned up, put on my last clean shirt and headed south, this time at 45mph indicated, about 43mph actual. I did the tranny lube trick once more before leaving the Evergreen State. Eleven ounces. Slower was better and this time I'd remembered to wear one of the soiled shirts. I continued south feeling smug. I could get home. I would spew a gallon of tranny lube over the next thousand miles of road, and since each refill took about twenty mintues, my average speed would drop to about 37 mph. I was about 1000 miles from home. It was a do–able thing. I kept heading south.

The Noise began suddenly, as Grendel and I were passing Government Island in the middle of the Colombia River. I immediately reduced speed and the Noise went away. I wanted to stop but I was on I–205, by–passing Portland. Traffic was a mess compounded my our slow speed and the fact I was a stranger to the road. I hung in there up several painful grades, reached a park–like section and pulled off. The noise continued with the vehicle at rest. It had to be the mainshaft. I tried the clutch. There was only a minor change in the sound. Which meant it couldn't be the mainshaft. I was confused. Then the Noise became quieter, almost stopped. Cautiously, I eased back onto the highway, my mind shuffling through everything I knew of tranny noises like a card sharp looking for a missing ace. I didn't find it. I was playing with a deck of 51. The result was near panic.

Crawling across Oregon I again witnessed a customer being verbally abused by an imbecilic gas–station attendant while his co–worker cheered him on. The customer was from Washington, had tried to pump his own gas. Smart–mouthing out–of–staters appears to be a common sport at Oregon gas stations. The man got back into his car and went to the BP station across the street. The incident occured at the Chevron station on the east side of I–5 just south of Eugene.

The Noise came and went, sometimes loud, something not but never completely silent. Each time I thought I had it figured out it would present some new data that failed the test of logic. My panic mounted as the Noise became unmistakably louder. One of the data elements was Grendel's variable appitite, one time taking only eight ounces, the next gulping twenty–four. The oil was coming from both side plates which argued for a problem with the differential bearings. But they they are the largest and most robust bearings in the entire vehicle, and make a bold ballsy sound when they fail. The Noise was higher pitched, more intermittant, different from any tranny noise I'd ever heard yet strangely familiar.

Approaching Grant's Pass, 566 miles from my starting point, the Noise rose to a shriek. I dove off the freeway and discovered my faultering brakes were virtually non–existant. I whipped into the first motel I saw, came to a stop by ramming the wheels into the curb and, thankfully, not jumping it and crashing into a brick wall.

If you have to break down you could do a lot worse than Grant's Pass. It's a nice town with friendly people in the only Oregon county named for a woman, Josephine County. I know these things because Grant's Pass, Oregon owes much of its history to men who followed the sea, although they left it quickly enough to search for gold in country of the Rogue River.

But it wasn't a good spot for me to break down, which I was doing in every respect. My money had run out, the past month had already tried the limits of my physical endurance, today's fourteen hours of driving had pushed me over the edge. After registering I feel asleep while taking a tub bath, hoping to warm my ice cold feet.

Grendel was breaking down in a way I would probably be unable to repair since it was doubtful that I could find a replacement tranny I could afford, or that I would have the strength to install it. And the brakes. I wasn't even sure I could get out of the motel parking lot without crashing into something, and because of the slight slope, I couldn't jack up Grendel and adjust the brakes where she was parked, I needed level ground, rare stuff in Grant's Pass where the main drag zips downhill to the Rogue River.

Despite my exhaustion I slept poorly, awakened about 3 am by a nightmare. I was laying in a pool of sweat, the bedding sodden even to the pillow. I got up and took a long shower, trying to come up with a solution to my dilemma, going so far as to look for other Hoovers in the phone book, thinking of surprising them with a 3 am call from their long–lost Cousin Bob.

I lay down, aching with fatigue but unable to sleep. The night was perfectly quiet, even the steady train of logging trucks having abandoned the neaby freeway. I may have dozed because it was 5:20 when I suddenly realized the night was TOTALLY quiet, no traffic at all. I leapt up, dressed, threw my stuff together and dashed out to Grendel. No cars meant no traffic! No traffic meant I didn't really need brakes!

The temperature was in the low thirties, Grendel's windows dewed but not frosted. I used the slope to get Grendel out of her parking slot, nudged her toward the street with my shoulder, jumped in as we rolled silently down 6th Street, popped the clutch to shock Grendel's faithful heart alive.

I was looking for a parking lot, somewhere to adjust my brakes and give Grendel another shot of tranny lube. My nearest haven was the home of my son in Modesto, nearly 500 miles to the south. I doubted I could make it that far but Redding meant Bus Boys and possible help while Sacramento meant Thom, who would surely be willing to loan me the tranny from his Porsche. But if Grendel crashed, she crashed. I was out of ideas and money. My ace in the hole was knowing I could call my son, who would drive up and help me salvage what I could from Grendel before abandoning her to her fate, which may or may not include the possibility of future salvage.

Just down 6th from the motel was a hospital, the extensive parking lots empty. Despite harsh warning signs aimed at people like me, I pulled in, found a discrete and level corner and prepared to adjust Grendel's brakes.

My floor jack accepted the first half–dozen strokes reluctantly. When the weight of Grendel's haunches came on the pump, it blew its seal, shooting a thread of icy hydraulic fluid onto my levis. I'd forgotten that the cold effects hydraulics even more than it does people. Unable to raise Grendel's weight off her wheels, I was unable to adjust her brakes. And without a suitable jack any extensive tranny repair was out of the question. My options had dwindled to two: Quit or go on. I slumped down on the damp tarmac and stared at the useless jack, savoring the foul taste of defeat.

Getting Grendel Home, 2 of 2

Mon Oct 16 18:53:04 1995

Getting Grendel Home, 2 of 2 The Long Run Home, conclusion.

Just across the parking lot was a pair of phone booths. I trudged over, intending to call my son but did not. I would try to reach Medford, call from there instead of awakening him. There was a phone book and I used the yellow pages to learn the location of the nearest auto–parts store. Based on the map in the phone book and my minute knowledge of Grant's Pass, the store was less than a mile away, all downhill. I stowed the ruined jack in Grendel's cargo bay and drove to the auto–parts store, dealing with the few cars and stop lights by traveling at little more than a walking pace. At the store, the parking lot had some slope to it but it wasn't too bad. I spotted a reasonably level space and pulled into it. It was about a quarter past six in the morning and a cold fog was coming up from the river. Even the miniscule heat from the engine was denied me by The Noise. The store opened at eight. I passed the time trying to think out the problem. I had the feeling I'd missed a clue but I was too cold to reason clearly. I drank the dregs from my thermos, nibbled on a bagle. The traffic increased, Grendel garnering a host of stares, most amused, some angry.

When the store opened the first thing I noticed was the smell of fresh–brewed coffee, a convenience for their early–morning customers. I take my coffee black but that morning I loaded the styrofoam cup with sugar and creamer, added a little hot coffee, sucked down the syrupy mess while the clerks watched blank–faced, finally inquired if they might help me. "Floor jack?" I asked. Shake of the head. But a slow point of the finger toward some bottle jacks on a shelf, high up, in keeping with their prices. I bought an 8–ton model, a gallon of tranny lube. WARM tranny lube, having learned my lesson with the floor jack. Ninty–weight tranny lube is like molasses when cold.

The bottle jack was powerful but not very handy, Grendel having no conveniently flat jacking–points. I used blocks of wood and lots of luck to get the brakes adjusted. I didn't have enough small blocks to chock the wheels and use as jacking points, had to keep shuffling them around for each wheel, afraid to try a two wheel lift due to the slope of the lot. With the left rear in the air, I built a safety stand, skivvied under, pulled the filler plug, gave Grendel an agonizing twenty–one strokes before she sicked–up, spat lube down my wrist and arm and shirt sleeve as my frozen fingers fumbled to get the plug back in.

The brakes come up amazingly well. They pulled a bit to the left and I could feel a definite rough spot but they were good enough to allow me to deal with the traffic. Saturdays are busy in Grant's Pass.

I refueled at the Chevron near the fairgrounds. Surprisingly, the attendant appeared sentient. I'd now dealt with four Oregonian gas station attendants, found seventy–five percent of them to be idiots, not good odds for the Beaver State. I filled my thermos at the gas station mini–mart, had a sketchy wash in their bathroom. Another surprise was the Noise, less than the night before, possibly even less than it had been during the day. I put it down to the cold, to a full charge of oil, to prayers answered and incantations chanted as I pulled out of the station and tackled the first grade on the south–bound road. It was a few minutes before ten.

I was traversing the Siskayou Range, a hundred miles of mountains cut by river gorges, with I–5 soaring over the one only to plunge back to the other. Grendel was carrying her rated max of 1500 pounds, mostly junkyard parts I was hoping to sell for a profit in southern California. We walked up the grades in 3rd, trying to stay above 30mph but failing on a few of the longer slopes.

In Oregon, the slowest of the slow are expected to use the shoulder of the roadway. Midway up one grade I came upon a car parked in my lane, a woman standing beside it. The woman had her hood up and a 'Help' sign in the rear window. I saw her well ahead, watched dozens of cars and trucks pass her as Grendel toiled up the grade. I pulled around her and stopped.

She was an older woman, made a bit nervous by my rough appearance but willing to accept my help. Her car was a little Nissan, an older one with the engine fore & aft instead of traverse. Gray. I don't know the models but it was a two–door sedan. She said it had lost power and then simply stopped. She said some lights had come on but she couldn't remember if they came on before or after the engine stopped. SHE HAD BEEN THERE NEARLY AN HOUR.

The radiator appeared dry. The oil was off the stick. The engine was still very warm to the touch. I had two quarts of 30W oil. It took them both before showing on the stick, just above the one–quart–low mark. I poured my coffee into the radiator. I had a 20 ounce Pepsi but no water in Grendel. With a mental shrug, I fed the Pepsi to her radiator. I told the old lady that I thought the thing had just over–heated. She readily agreed, saying it had been running hot lately. When I told her to start the engine it fired right up, settled down to a nice idle. She said it seemed quieter. I told her I would be along in a few minutes, for her to stop if she had trouble, but to get to water with all reasonable speed. She was folding up her 'Help' sign, nodding, anxious to be off, said no word of thanks. She passed me as I trudged back to Grendel. I never saw her again.

Grendel continued to make an assortment of dreadful noises. I oiled her twice during the sixty miles between Grant's Pass and the California border, each time imagining the fresh oil made her less noisy. Seven ounces the first time, only five the second, hardly worth the trouble. I was averaging a bit less than 30 mph but reaching California provided an enormous boost to my spirits. I was born in San Francisco; I was back in my home state and that was good enough for now. The first bit of road after crossing the stateline was some of the worst I'd encountered but it got better and I knew there were occasional road–side phones in California — rare in both Oregon and Washington, and that the California Highway Patrol actual did a pretty good job of patrollng the highways. I had crossed Washington and Oregon without seeing a single police car. I saw three within minutes of arriving in California. I waved at the two that passed me. One waved back. Fifty–fifty ain't too bad. Better than Oregonian gas station attendants.

The Noise was definitely getting louder. I was running a bare 40 mph, stopping to refill the tranny about once an hour. But I wasn't using much lube. It was very confusing. Then came The Big Bang.

It happened in Weed, where I stopped to buy more tranny lube. There wasn't any positive reason to buy more, I still had most of a frozen gallon and some remained in one of the two quarts I'd bought in Grant's Pass, the parts–store not having any gallon jugs of the stuff, looking at me as if I were mad when I asked. Tranny lube in GALLONS?

There's all kinds of luck besides good and bad, my stop at Weed falling somewhere in that gray area in between the two. I crept off the freeway, stopped at the NAPA parts place, got Larry to sell me a gallon of 90W. Beside the display was a rack of lube pumps that had a barbed fitting on the filler hose, allowing you to lock the thing in the filler hole and not pump half the lube down your arm. I bought one. Outside, Grendel started reluctantly, a first for her. The engine had been the only reliable part of the vehicle, the one thing I could take entirely for granted since it was my own creation. I pulled up at the towns only stop light, waited for a logging truck to make the turn, started through the intersection when there was an incredible racket from the engine room, an enorumous BANG!… and the red light came on. Fan belt. But not like any fan belt I'd ever heard.

It was like a revelation from God. Before I got Grendel to a vacant lot just beside the car wash, Understanding washed over me. The Noise wasn't coming from the tranny, it had been coming from the alternator. Or the fan pulley. Or some damn thing. But not the tranny. When I rolled out of the motel in the pre– dawn nearly eight hours before, THERE HAD BEEN NO NOISE. The tranny had been rotating but not the engine, since I didn't pop the clutch until we were doing a few miles an hour. The leak had made me so sure the noise was coming from the tranny, and my own faith in my skills made me so confident in the engine, that I failed to interpret what Grendel had been telling me.

Sitting in that narrow but marvelously convenient vacant lot, I cried. I'm not sure why, I just couldn't help it. Water came out of my eyes and my chin wouldn't keep still and I was so damn mad at myself… yet relieved, too. It's still pretty mixed up in my mind. I've never let things get out of hand like that before and it took several minutes for me to calm down, climb out and assess the damage.

The alternator pulley had eaten the Woodruff key and ground a nice noisy burr into the nose of the alternator. The bearing was intact and the shaft still firm but that sonofabitch had to have been grinding away for at least seven hundred miles, ever since I installed the alternator on the engine at Shelton under less than ideal conditions. When I dismantled the engine for the trip north I put the Woodruff key and the spacer into a baggy, packing it with the other small parts in a white cardboard box, where I found it waiting when I put the engine back together. But there was no evidence of the spacer. I'd mounted the pulley without the spacer. The noise and the worry and the fear had all been the product of my own hands.
The past is prolog. I'd screwed up. To unscrew things I would have to perform the Hat Trick. This particular Hat Trick was to locate a Volkswagen alternator pulley in Weed, California on a Saturday afternoon in October. I hiked back to the NAPA store and braced Larry with the problem. He wasn't hopeful. He knew of only one wrecking yard that had Volkswagens and it was some distance out of town. He gave me involved directions: Back onto the freeway to the next off–ramp, under the freeway to the end of the road, hang a right to the fork, then a left, then watch for the sign: Black Butte Auto Dismantling. Couldn't miss it. Oh, the last part of that was unpaved roads, out through the pines. It sounded chillingly like Shelton.

I bought a spare fan belt — I had one but expected to ruin it doing what I had to do, which was jam the pulley onto the shaft with a wedge of bailing wire in the bore and tighten everything down after greasing the hub to let it spin in the burr it had already created. I shrieked my way onto the freeway, accelerated to about twenty, threw in the clutch and coasted, engine off. Did that twice to reach the off–ramp. It was called Mountain View, the mountain in view being Mount Shasta, the view being more than magnificent. I barely noticed.

Black Butte Auto Dismantling looked like something run by the Joad family, eerily like the situation in Shelton, even to the name of the man: Eric.

“No, ain’t got nothing like that. I sells every Volkswagen generator I get my hands on, pulley and all. Regulators, too.” But he didn’t mind if I looked around. I grabbed a 21mm wrench, a screwdriver and began hiking, the wrecking yard covering more than ten acres.

It held only six Volkswagens. In one, I found a blower with the armature of a 12v generator attached, but no pulley. I also found a new Bosch voltage regular under the front seat and a pair of nearly new needle–nosed pliers. Then I found a 1965 bus complete except for glass and front axles, right down to the 6v generator on the engine. And the pulley. I removed it, laughing like a fool. The shaft diameter is the same as on the alternator. But I stopped laughing when I couldn’t get the inner flange of the pulley free of the shaft. I hiked back to find Eric and beg the use of a puller, offering up the things I’d discovered to show my good intentions. He wouldn’t let me use his puller but he drove over to the bus and prepared to remove the pulley himself. As he set up the puller I gave him a sketchy outline of my activities over the past month, hoping to impress the importance of my need. He ended up listening spellbound, his hands still. When I finished my tale he popped the pulley off, firing the Woodruff key into space, where it now orbits the planet Logon. But there was another Woodruff key. On the fan– end of the generator shaft. And I’d just lugged one of those up to the office. He gave me the puller with a shake of his head, saying “Good luck.” He knew the contents of his yard, had known of the armature but didn’t think the rusty hub would come free. And he was pretty sure the 6v pulley wouldn’t fit a 12v alternator. I didn’t dispute his opinion, thankful for his trust in allowing me to use the puller.

Looming over us was Mount Shasta, a remarkably beautiful example of a shield volcano, it’s upper slopes rosy in the afternoon light, glaciers and permanent snow fields mantling its heights. It isn’t as impressive as Hood, Rainier or the caldera of Mount St. Helens, but it is somehow a more imminent peak, more personal. I can’t explain why, it was just the feeling I had as I hiked back toward the office with a nearly complete pulley in one hand, the preious puller in the other. I walked right into the path of the junkyard dog, a chained bitch. She made a rush at me that I wasn’t even aware of, my gaze glued on the mountain, wondering why the colors seemed to change as I watched. When I failed to leap aside, the dog stopped, sat down perplexed. Then I realized what I’d done, leapt aside and she made another lunge, brought up by the limit of her chain. Two women who saw the incident thought it very funny. Piney woods, junkyards, guys named Eric. Even junkyard dogs. When I got to Grendel it was all I could do to climb inside, sit shaking, spilling tobacco all over myself as I tried to fill my pipe. I felt the weight of the mountain against my back, pushing me south.

The puller, a hammer and a liberal dose of Liquid Wrench won me the Woodruff key but the keyway in the alternator shaft was buggered all to hell and the keyway in the 6v pulley was notched; it wouldn't accept the key. My Swiss files were somewhere under the load. I dug them out. My emery paper was in a box full of tail light fixtures. I dug IT out. Then came the fun of machining my abused alternator's shaft back into something close to a circle and filing the pulley's keyway to accept the key. The sun slid down the sky and they'd already told me they would close a bit early, it being a Saturday and all.

I got the alternator's shaft to accept the pulley. Then I got the alternator's keyway to accept the key by swaging hammered wafers of bailing wire into the buggered part of the moon–shaped keyway slot, leaving the Woodruff key verticle. I put it together three times, the final assembly with a dose of high powered Sleeve Retainer, thoughtfully included in the shipment of front wheel cylinders by my friend Roland Wilhelmy two weeks before and unused until now. The belt I installed was the spare I'd purchased at the NAPA store in Weed, the last thirty–five and a half inch belt he had on hand, the short run to the junkyard having trashed my spare belt. By three fifteen I was done, the engine ran, The Noise had vanished. The ladies allowed me to use the bathroom in the office to clean up. I made a proper job of it, thanked them sincerely. They were sun–burned, happily splitting stove wood, covering it with a ragged blue tarp. Winter had already touched the highlands.

Eric would not accept payment, saying my finding the regulator and his mislaid needle–nosed pliers was more than payment enough. Something went wrong with my throat and I was forced to turn away, giving him only a curt nod of thanks. As I stumbled toward Grendel he called out, "Good luck, fella." I felt I'd already had some.

I allowed Grendel to find her own way down the stony dirty road, refueled at the Mountain View Chevron station, refilled my thermos with good coffee, that morning's fill now somewhere in Oregon cooling a thankless Nissan. I won my way over the last pass and came down from the hills, the engine running quiet and strong, a faint whine from the tranny but no other symptoms of note. The clutch was good, the brakes better, the heater now a definite blast, unneeded in the warmth of the valley, dealt with by open windows and a working overhead ventilator. A woman in a late model Vanagon overhauled me. I waved as she passed, an automatic thing. She waved back, a first for the trip. I took it as a good omen.

I ran down the track of the sun, watched it set beyond the Coastal Range, stopped to buy a pair of spare fan belts in Redding about six pm, kept rolling

Grendel south, stopping every two hours to pump in more lubricant, backing up on the kerbing at the rest stops to gain enough room to squeeze under Grendel's belly, do the deadly deed, washing up in the cold–water basin of the rest stop bathroom.

Night found Grendel's headlights wanting; I'd adjusted them too far toward the shoulder, another error of caution. But they were bright enough and the moon was supposed to rise about ten thirty. When it didn't I felt I was in a different world. I'm well attuned to the phases of the moon, the way some people can always point toward the north. The moon has been a faithful companion on many a night flight and voyage. It should have been there but it wasn't and I found the lack profoundly disturbing, made worse by my inability to understand. When a lemon–wedge of moon rose over the mountains about eleven fifteen I realized the Grendel Affair had cost me an entire day somewhere, perhaps when I'd been ill with pneumonia.

I continued south thorugh the soft California night, my world governed by three dials. The speedometer was immobile on 45, the fuel gauge a glacial creep, my watch a languid semaphore. Every two hours I would stop to top up the tranny. At Woodland I refueled. At 1:35 am I arrived at my son's home having taken seventeen hours to travel the 454 miles between Grant's Pass and Modesto.

Home is still four hundred miles to the south and there is no doubt I will drive Grendel there, as I set out to do more than a month ago. It's a do–able thing.

Grendel: Home & Dry

Wed, 18 Oct 1995 20:20:11

Grendel: Home & Dry

In Washington I worked on Grendel for four weeks before commiting her to the run south. During those nearly three hundred hours of labor I gave her brakes and lights and signals and steering and heat and wheels and tires and a single, ragged windshield wiper. But I also gave her a bad alternator. In return, she gifted me with a wounded transmission that would see me groveling in the oil beneath her ten minutes out of every hour for the duration of my journey, even after I discovered my failure and corrected it.

During the trip she displayed myopic vision and an uneven wear pattern on her new–but–used tires. Then there were the worn–but–should–make–it parts I promised I would replace at the first opportunity. Modesto provided that chance and I tried to keep my promise.

Sunday, my son and I cleaned the cockpit, removing the rug and rubber mat beneath, giving me access to the gear shift which had come adrift. I checked it again, tightened it down, put the mats back in after cleaning them and checking the brake fluid level. In Washington I'd discarded the panels of carpeting glued insecurely to the doors; there were no inner panels. Monday I continued the process of restoring Grendel's dignity with liberal applications of soap and water, a nicety ignored in the swampy climate of the north. Here the day was fair and dry, parts cleaned dried quickly and stayed that way.

Monday morning, October 16th, my son and I went to the Harbor Freight outlet for a new 2–1/4 ton floor jack and a small three–jaw puller then scoured the junkyards for early Volkswagen vans, we didn't find any but I took a good pulley from a late model bug and the axle nuts and washers from a 1968 bus. Richer in parts but poorer in pocket, I spent the warm afternoon making minor repairs, continued into the aqua light of evening, targeted by mosquitos attracted to my work light, abused by a neighbor's dog who felt I'd chosen a poor place to work. And besides, the light was keeping him awake.

I could not heal Grendel's bleeding wound, which appeared to be the failure of the axle tube retainer gaskets but I did what I could to make her comfortable, whispering promises of a new life if she would carry me home.

I checked the link pins and found they needed adjustment, as did the toe in. Lacking a camber protractor, I was limited in what I could do but after adjusting the link pins the toe–in was a whopping two inches, explaining the uneven tire wear; it should have been about an eighth of an inch. I adjusted it using a pair of cedar laths, rolling Grendel back and forth on the level portion of my son's concrete driveway until I was satisfied that the error was within reason.

I adjusted the brakes yet again. The rough drums had been ground smooth by the new shoes and accepted a tooth or two of further tightening. The front wheel bearings with their ragged washers and old fashioned dual nuts and locking tabs received careful attention and the installation of new washers and later–model nuts, the ones secured with an Allen–head machine screw.

The left king pin consented to six strokes of lube from the grease gun, the other fittings one or two, spitting out the old as they took in the new. The thousand miles had been an easy jaunt for the steering knuckles.

The small day's work left me strangely tired, the trip had taken an unseen toll. When I played football in high school I weighed 185. After twenty years in the Navy I weighed 195 and have stayed near that figure in the twenty years since. I now weighed 180 and found the warm Modesto evening chilly, decided to leave the heater wired open. I would be making an early start and it would be cold.

My son, a truck driver for a commercial nursery, is an early riser. By six a.m. I was bidding him farewell as he went off to deliver a load of trees to Sacramento. I pulled out about twenty mintues later heading in the opposite direction, my home in Vista being 436 miles to the south.

Grendel handled much better thanks to the link–pin and spindle adjustment. And for the first time I didn't have to struggle to find reverse. But her heater couldn't cope with the pre–dawn cold. Or I couldn't. One of those. I rolled south wearing a heavy shirt, a towel across my knees. I had made an attempt to re–aim the headlights but hadn't liked the result, yet they proved better than before, although the lamp on the passenger– side could use a bit more adjustment.

Two hours south of Modesto I pulled off highway 99, found a level stretch beside the railroad tracks and did the Oil Routine, by now almost a habit. With the new floor jack it was a breeze and I was back on the road in twelve minutes. The tranny took only four ounces, the smallest amount so far. I assumed my retorquing of the axle tube retainer plate had reduced the flow of the leak and raised my speed to 55.

Four hours out of Modesto I was just north of Bakersfield and Grendel took only eight ounces. My original plan had been to avoid the steep Grapevine, taking Tehachapi Pass east into the desert, continue south down Cajon Pass so as to approach San Diego on I–15 thus avoiding both mountains and the clotted arteries of the Los Angeles basin, although doing so would cost me an extra two hours. But with Grendel running so well and losing so little oil I decided to take the shorter route, crossing the 120 mile wide Los Angeles basin on I–5.

Grendel crossed the 4,100 foot summit of Tejon Pass with style but at the top she took an alarming twenty–one ounces of tranny lube. Worried that I'd made a bad decision, I tried to keep her speed down on the long descending grades but it proved impossible without riding the brakes. Rolling on compression, she maintained between 55 and 60 miles per hour. Worse was yet to come. Twice I had to boost her to 70 to stay clear of traffic as we became a part of the serpent of vehicles slithering through the smoggy basin. The tranny noise increased, a sure sign of low oil level but there are no rest stops in Los Angeles and pulling off the freeway onto surface streets is like tumbling into a maze. By the time I found a suitable place to refill the tranny I might never find my way back to the freeway. I kept on south.

I was nearly home before I came to another rest stop, the one on Camp Pendleton a few miles north of Oceanside. Less than twenty miles from home I considered not taking the trouble to stop. But I couldn't push Grendel even one mile, let alone twenty and the tranny noise nudged me toward caution.

Grendel gulped 27 ounces of lube, more than a quarter of her capacity. She immediately quieted down.

I stopped for the mail at the foot of the drive, parked Grendel in the grove below the house. The 436 mile run from Modesto had taken ten hours and thirty–eight minutes, a respectable pace for a twenty–eight year old Transporter. In good condition. The engine had accumlated 1,536 miles since being installed at Shelton, during which it consumed a pint of oil. Mileage varied during the trip from a high of about 32 mpg @ 40 mph traveling down the Willamette Valley in Oregon, to a low of 27.1 during the last stage of the trip when my speed ranged between 55 and 70 mph.

If these figures seem high it may be due to odometer error and the use of P185/70–14 tires. But here is a typical example of the fuel consumption method I used: I refueled at Tulare, mileage = 1173. I didn't need fuel again until I arrived in Vista, taking on 10.51 gallons, filling the tank to the same point each time. The mileage at that time was 1,459 (i.e., 286 miles traveled). Grendel's odometer read 99,933 when I drove her away from Shelton, Washington; 00012 when I began the run for home. Anyone wishing to verify the fuel consumption can calculate the map distance between Tulare and Vista.

Loading myself with baggage and presents, I trudged up the hill. I'd stopped at a florist in town for some flowers but my wife was still at work. They'll make a nice surprise for her when she comes home. My quick week–or–ten–day trip to Seattle had taken six weeks, less one day.

All journeys end when we reach our destination but the journeying remains a thing apart, unique unto itself. Most of us make life's journeys without understanding that the journeying is a separate thing. I hope this tale has given you a glimpse of both.

Epilogue

Now the question is does Bob know that Grendel has a mom and who's gonna tell him? :-)

While most authorities place the anonymous authorship of Beowolf's epic poem in northern England in the fifth century, it quickly spread, appearing — in a variety of forms — throughout northern Europe, Scandanavia and even Iceland by the middle of the sixth century.

Most of us are aware of the English version. Finland has its own unique tale of Beowolf while Iceland has at least five Beowolf sagas to choose from.

The version I found most appealing and most in tune with my acquisition of a sadly abused 1967 Microbus from the Pacific Northwest, is one of the Icelandic versions of the tale in which Beowolf becomes enchanted by Grendel after struggling with her for so long, eventually falling under a spell in which he sees the hag as a beautiful woman — and does the usual thing. Bewitched by the hag, Beowolf carries her from the dank swamps of the north to his hilltop village in the sunny south and there they live together, much to the dismay of Beowolf's neighbors. But the longer they are together a curious change takes place. Grendel becomes younger and more beautiful while Beowolf becomes old, infirm and feeble-minded. In the end, the people stone them to death.

The instant I saw the name 'Grendel,' proposed by a member of this list, I recalled the Icelandic version of the saga and realized there could be no name more apt for the old bus. And yes, I am growing old and feeble-minded even as she is becoming young and beautiful :-)

-Bob

The Inuvik Run

The Inuvik Run — Prelude

Two weeks ago I returned from a fifteen day trip to Kansas City. Tomorrow I set out on a four thousand mile run to Inuvik, a village in the Mackenzie River delta. Followed by the four thousand mile trip home. I expect to be away a month or more.

The Mackenzie River empties into the Beaufort Sea, otherwise known as the Arctic Ocean. Inuvik, which is pronounced with the emphasis on the second syllable, is located at 68 degrees North Latitude, 133 degrees West Longitude. I am presently just north of San Diego, California, about 33 N, 117 W. In plain English, that's a hell of a trip.

In preparing for this run more has gone wrong than right. For one thing, I don't have a surfboard to take along. Nor will I be able to rent a board once I arrive; I have just learned Inuvik does not have a single surf shop. Most of the folks making the run, and there are a gaggle of them, are planning to fly out of Inuvik for a day of aerial sight–seeing and a visit to Tuktoyaktuk, which is pronounced exactly as it is spelled. For me, this is a low–budget trip. I'd planned to spend the day surfing. No board means no surfing. I guess I'll just hang out at the beach.

Maps are another failing. For some reason, British Columbia does not want me to have a map of their province. I asked but did not receive, not once but thrice. On the other hand, the Northwest Territories, which has only two roads, sent me a map for each. I'm advised a map of the Yukon may yet arrive, its delay due to bureaucratic snarls rather than unfriendliness. It should prove handy if I ever go insane and want to drive there again. I figure the odds are about the same as finding lips on a chicken.

Instead, I have a very pretty map of Canada, borrowed from a Collier's Encyclopedia, 1949 edition. Unfortunately, Inuvik did not exist in 1949 nor did the Dempster Highway. Or perhaps they did and I just can't see them. The map, about eight by ten inches, is kind of small.

And I've lost the itinerary for the trip. It was in my lap–top, which died and went to heaven on my way to Kansas City. Tobin Copley, the fellow to blame for the trip, sent me another copy but I managed to erase it while trying to print it. Which makes me wonder if an itinerary is really necessary. There's only one road for most of the run, and only a handful of towns. I figured I'd pick up another copy when I got to Vancouver but now it looks like I can't get to Vancouver in time for the starting gun due to a side–trip I must make enroute, dropping off an engine, making sure it runs and mechanical stuff like that. Which also means I'll miss the drunken Bon Voyage party.

Without an itinerary my plan is to take a few–short cuts, shoot one section of rapids and get ahead of the convoy. I'll fall in behind when they roll past, assuming I can get ahead of them. Since they'll all be fighting massive hangovers, odds are no one will notice my tardy arrival.

The only other problems are the bus and what to wear and a place to sleep and something to eat and money for gas. I won't mention painting the house, which I was supposed to do after returning from KC and before leaving for Inuvik but haven't. My wife is not happy about that.

The problem with the groceries is that while I'm spent a lot of time south of the Line I've never lived rough north of it. Down south, you get along fine so long as you have some fishing tackle, a lime squeezer and a bottle of stuffed olives. You can drop by the local Conasupo for anything else you need, except Black Bear. Oso Negro is a staple in the Bajanese diet.

Judging from my map, there aren't a lot of places to go shopping in the Nortwest Territories. And I'll bet none of them have Oso Negro. Probably don't even carry Crow. I'd better make a note to pack some Cuervo and a gallon or two of Oso Negro. Cuervo is handy in case of snake bite. Pour a little Cuervo on them, they'll leave you alone. Them snakes can't stand the stuff.

My biggest worry is the 1965 Microbus. It started making a funny noise when I hauled the trash cans down to the road last Sunday. I thought it was just the cans banging around but the noise is still there, maybe a little louder than before. I haven't driven it much since then. I'm hoping I can figure out what it is before I get to Canada, as I understand parts for antique buses are hard to come by.

As for clothes, I've got my levis, boots and a couple of shirts. Plus my jams of course, and my flip–flops. They said I should bring something for the bugs. I packed a can of Raid. The best defense is a good offense. Can of Raid and a Zippo, you can chase off a bear.

Money is always a problem on a run like this, what with gas being so expensive nowadays. I'd better pack my Baja Gas Station. That's a shiny red one–gallon gas can. That one gallon can of gas has carried me from Cabo to LA and back again. You just stand there by your rig holding up the can with a hopeful look on your face. Folks stop, fill up the can, chat a while, wish you good luck. Takes ten cans to fill the tank, which sometimes means standing there all afternoon, waving the damn thing at the tourists. But once the tank is filled, drive on!

I'm sort of embarrassed by my failure to properly prepare for this run but I've been busier than a one armed paper–hanger. Before I can head for Inuvik I've promised to deliver an engine to a fellow. He's up in northern California, five hundred miles or so north of me. I'd hoped to deliver the engine last week, come home and pack up for the trip. Once the engine is out of the cargo bay there would be room for a bed and groceries and clothes but I ran out of time and figured, what the hell — with five hundred miles of northing under my belt I might as well go ahead and tackle the other seventy–five hundred. Win, lose or draw, it beats having to paint the house. But I sure feel strange, traveling without a surfboard on the roof. Surfboards are handy things.

I just noticed a thing here on the back of my map. Sez 'Land of the Midnight Sun'. Better pack my shades. If I can't surf I can always work on my tan.

The Inuvik Run — Starting Out

July 17th

Traveling solo has its good and bad points. On the plus side, I enjoy my own company but on the down side is the fact you can't travel very far on any given day, not if you are driver, cook, housekeeper, mechanic, laundryman and so forth. And especially not when you are traveling in a thirty–one year old Volkswagen Microbus.

The first day I traveled an easy four hundred miles to my son's house in Modesto, had a good meal with him, discussed the trip and dossed down in the bus. He didn't like the idea of me sleeping in his driveway but I needed to do so as part of the drill. If some aspect of the bus prevented me getting enough rest, the trip would have to be abandoned.

The second day carried me a little farther than the first and taught me a little more. In preparation for the trip I removed the passenger seat, replacing it with some built–in shelves and a computer rack mounting an old AT platform I'd configured for low power operation allowing me to run it off the auxiliary battery via an invertor. The computer would allow me to keep a daily record of the trip but was not fitted with a telecommunications interface. During the second day's run I began to see the most logical arrangement of items on the newly installed shelves and worked out a method of bracing the key-board and video monitor to hold them more securely in position.

After traveling 853 miles in 13.1 engine hours I called it a day and made camp in the parking lot of a Wal–Mart store in Oregon.

About noon of the third day I crossed the Canadian border at Abbotsford.

The Canadians were not glad to see me. According to friends in law enforcement the majority of drugs entering Canada from the US do so in commercial trucks, motorhomes and RV's. My friends scoffed at the idea of anyone carrying drugs in an old Volkswagen bus, other than Deadheads and the like. "You might be hassled by an ignorant sheriff but no real peace office is going to waste time on a retired Navy man driving an old Volkswagen." Apparently the typical drug smuggler is a Mom & Pop team driving an expensive RV towing a second vehicle in which the drugs are concealed. After crossing the border they simply replace the drug–laden vehicle for an identical copy, swapping across the license plates thus insuring a high degree of deniability for the mules, who can claim the swap took place without their knowledge.

Obviously my friends are not familiar with Canadian border guards. Or the Canadians are not familiar with bulletins issued by the DEA. Asking only a question or two the border guards told me where to park and commenced taking the bus apart. I got out my camera and was politely told to put it away, no pictures allowed.

In the inspection bay next to the bus the border guards were dismantling a late model sedan, going so far as to remove the front seat, discovering such contraband items as children's toys, an assortment of styrofoam cups and some mummified french fries from McDonalds. When they were done, the front seat no longer worked properly, thanks to a number of wires broken during its removal. I gave the car's owner a cheerful smile and said "Welcome to Canada," in a loud voice, winning me a host of baleful stares from my hosts, who had worked their way thru my luggage and were industriously emptying out my tool boxes, of which I had several, all chock full of nice clean tools, neatly packed and wrapped with rags to prevent rattles.

The bus is fitted with two very obvious saddle tanks, five inches deep, fourteen inches wide and four feet long. No one bothered to see if the tanks were full of fuel or even if they were really fuel tanks, and the engine compartment left them completely baffled. Apparently confused by the lack of a glove box or passenger seat, the searchers focused on my personal luggage and tool boxes, as if searching for handguns instead of drugs. Even so, they failed to discover any of the several weapons I had on board.

It took the frustrated border guards nearly an hour to realize they were not going to make the bust of the century. They tossed things back in the bus and wandered back to their coffee cups and dreams of glory, leaving me to repack my bags and tools and composure. Welcome to Canada indeed.

I followed Highway 1 to Hope, British Columbia, the little town where the first 'Rambo' film was made. At Hope I hung a left and continued north on Highway 97, which originates in Weed, California. In the states, Highway 97 is a secondary road that meanders through the outback of Washington, Oregon and California but in Canada it is a major thoroughfare called 'The Cariboo Highway'(sic). Highway 97, or BC–1 follows the railroad tracks up the Fraser River canyon and railroad tracks do not ascend steep grades. It's a good route for an old bus.

I spent my first night in Canada at the Cargill road–side rest stop between Cache Creek and Clinton after a run of 522 miles, well short of Quesnel, my intended goal. The delay at the border was simply too long to make up. If I ever come to Canada again I'll know to allow an additional two hours for the border crossing.

–Bob

(After the trip comments.)

With regard to weapons, I did not lie nor make an illegal declaration when crossing the Canadian border. Had the guards asked the proper questions I would of answered them honestly.

Parts of two of the weapons I carried were in plain view and even handled by the inspectors during their search. Since they made no comment it's fair to assume I violated no laws, other than in spirit.

I am not a scoff–law. But neither am I a victim–in–waiting. In preparing for the trip I learned that due to a late winter and wet spring there had been more than the usual number of bear attacks in the area of Canada where I would be camping. Ample proof of this was provided by newspaper articles in the towns I visited during the trip.

The bears were here first; I'm just a visitor. Should I encounter a bear, for me the most appropriate response is to find another campsite. But there was a slim possibility that due to injury or mechanical failure I might be forced to confront a bear head–on. I provided for that contingency.

Despite all the laws and courts and cops, ultimately each of us is responsible for our own safety. The country in which you're traveling is immaterial although the rule is especially true in sparsely settled regions. Be it a British Columbian bear, a Miami mugger or a Baja rattlesnake, you can die just as quickly. In preparing for the trip I gave as much consideration to my personal safety as I did to the preparation of my vehicle. I feel that to have done anything less would have been foolish.

The Inuvik Run — In the Woods

July 20th

It is my second day in Canada.

I'm at the British Columbia Provincial Park on Ten Mile Lake, a few miles north of the town of Quesnel. Quesnel is pronounced 'QuiNELL'. Ten Mile Lake is neither ten miles from Quesnel nor ten miles in length. Now that Canada has dropped the English system of measurement, places such as Ten Mile Lake and Hundred Mile House stand out from more recent place–names such as Twelve Kilometer Taco Stand.

Quesnel and much of the rest of the upper Fraser River valley enjoyed several days of torrential rain that stopped the day I arrived. The Provincial Park is situated on a boggy bit of land that shows strong evidence of the recent rain, with many rills trickling thru the brush surrounding the campsites and numerous puddles, all occupied by zillions of voracious mosquitos.

Each campsite has a table and fire ring. There are three water faucets for 50+ campsites. Each fire ring is provided with a mound of soggy birch. A large bin near the water spigot holds additional firewood, all sopping wet. Occupied campsites can be located by the sullen pall of smoke oozing from the firepit toward the lake.

I have an interesting landlady, a skinny Scandinavian type with a shining helmet of blond hair. I noticed her walking ahead of me when I was carrying water back to my campsite. She has long, lean legs and a graceful dancer's walk. I was delighted when she did a precise right–face at my campsite, strode up to the bus and peered boldly inside. I put on my best grin and rattled my bucket. She charged me twelve bucks Canuck and strode off. I didn't notice the biker tattoo on her arm until she handed me my change. I think I've been away from home too long.

As Provincial Parks parks go, Ten Mile Lake is definitely Upscale, having hot showers — for a price — and flush toilets. There are 110vac outlets in the bathrooms, suitable for electric shavers or charging lap–top computers and a short hike will take you to a telephone were a bit of work with your Swiss Army knife and Radio Shack jumpers will provide you with an RJ–11 interface.

My change was three one–dollar coins. On the face of the coin is Queen Elizabeth, age about fourteen. On the obverse is a loon. The coins are twelve–sided and are called, appropriately, "loonies". I developed a keen interest in loonies shortly after making camp when I discovered it takes a loonie to get four minutes of hot water in the shower. An enterprising young man on a trail bike saw me peering at the sign on the shower–room door while hopelessly pawing through an assortment of Mexican and American coins. He offered to sell me one loonie for four American quarters. I made a counter–offer of a one–thousand peso coin, one of the old ones, for ten loonies. We shared a little grin, one wheeler–dealer to another. Such talents are surely wasted in the backwoods of British Columbia.

What with all the driving over the past couple of days, this was my first chance to get after my laundry and prepare a decent meal — steak and onions, mashed potatoes with gravy, corn on the cob and cheese biscuits. To get a fire going I prowled the woods in back of my campsite until I found a blow–down, split the little end and hacked out enough kindling to ignite the soggy birch provided by the park. But birch doesn't leave any coals to speak of, burning up like newspaper once it's alite. I ended up unpacking the Coleman, using the fire ring only to heat water for washing up and to do the baking.

Later…

I got my loonies worth. I'm so clean I squeak.

The building housing the showers is in a conspicuous location at the junction of two roads, very easy to find. Yet there seemed to be an awful lot of giggling confusion going on near the building. When I asked who was next it turned out to be the funniest thing anyone had ever heard. After a lot of giggling with their hands over their mouths, it was decided that I was next.

The reason for the giggles became clear when the door opened and a young couple came out. They didn't look especially clean and she'd managed to bathe without getting her hair wet.

There are a lot teenagers in the camp. Either Canadian families tend to be large or large families tend to be campers or… or some damn thing. In any case, there are a lot of youngsters. And they get dirty and have to take showers. The kids gather in groups around the shower building, boys over there, girls over here, giggling and kidding and daring each other to share a shower like kids urging each other to ask someone for a dance. Eventually the offer is made and… and Canada grows!

Grumpy, old and alien, I showered alone.

I hope my batteries hold up. I'm playing the stereo (Stones, Mama's and the Poppa's) which runs off the engine's battery, and using the computer, which runs off the auxiliary. Neither battery is new and it's going to be a long trip with lots of time spent locked in the cabin to avoid the mosquitos.

The sun did its temperature trick again, a drop of at least twenty degrees the instant the sun dipped below the mountains to the south. It dips into the forties overnight, pushes eighty during the day, a ‘long’ thermometer in weatherman–speak.

The moon is waxing toward full. I think it’s about three days past new and that’s bad. Mosquitos love moonlight. So do giggling young campers desperately in need of a bath.

Since leaving California I’ve seen about a dozen VW vans, mostly breadloafs. No splitties at all. Wave–ratio is running about one in four, not real good. I’m worried about missing the group when they come thru tomorrow night.

Ten Mile Lake has a resident loon. Most lakes do up in this part of the world. I haven’t heard the call of a loon since I was a kid. The sound triggered a vivid recollection of the first time I heard a loon’s wild laughter. The memory has been upstairs in the memory locker for half a century yet replayed itself with perfect fidelity.

So far it’s been a nice trip. I’m 1,783 miles from home. My tranny has started to growl and I need to do my link pins and change my oil and give her a lube but we’re still mobile. The engine is running sweetly and I haven’t had any tire problems I couldn’t fix. Except for the border crossing it has been a good run, so far.

The Inuvik Run — Waiting by the Lake

July 22nd

I’ve somehow managed to miss the group. I’ve monitored channel 2 on the CB and heard only one group of travelers. If it was the Volkswagen crowd they could not hear me. This evening I took down the tarp — there have been spates of rain — and made a cautious dash south past Quesnel, hoping to hear the group, checking other campgrounds along the way. Nothing. Tomorrow I will continue north but if I don’t find them in or near Prince George, I will head home.

In the campsite across from me is a pair of ladies about my age, sisters, one widowed the other never wed — information volunteered within minutes of our introduction, which occurred by having first one lady then the other come over to my camp to say hello. They are stocky, attractive women, farm girls grown big. Their complexions are weathered, their hands roughened from honest work. I like them. Each has given me bold, speculative stares. And smiled when I caught them at it.

I used my bow–saw to cut up a blow–down and split them out a pile of dry wood, rare stuff in this swampy park. They gifted me with a dish of boiled new potatoes "We grew them ourselves" then started a fire and invited me to join them. They have been captivated by the sight of me scrubbing my skivvies, baking biscuits, repacking a wheel bearing and other domestic chores. They come from 'the other side of Clinton' and raise hay. We had an enlightening discussion on hay. They use roller–bales whereas my experience, very dated, is limited to square bales. But we got on like a house afire when it came to the details of keeping farm machinery running. They have a pickup–mounted camper and are at Ten Mile Lake because the widow and her late husband always traveled south for their camping excursions; they have never been to Ten Mile Lake before and seemed pleased as punch to be there, despite the soggy conditions.

We quickly run out of things to say. The sisters decide they will take a walk. "There's so much to see!" I returned to my chores.

I spent the day working on the bus. The tranny is growling at me although it is full of oil. I suspect it is the side–gears. When I replaced the tranny prior to the Big Sur run in February I used the best set of side–gears and fulcrum plates I had available. They were a little worn, as was were the shims I used. But they were better than the parts I replaced and the tranny was delightfully quiet during the thirteen hundred miles of the run to Big Sur and the three thousand mile jaunt to Kansas City. But eight hundred miles into the Inuvik run I began hearing a growl with a frequency related to wheel speed. I checked the outboard gear–boxes and they are as quiet as they ever were. The side gears are the next most likely candidates.

I spent some of the day sketching birds the likes of which I've never seen. I regret not bringing my watercolors. I also spent some time trying to identify a bird with a truly unique call… that turned out to be a squirrel, the only one I've seen here at the park.

The absence of squirrels is more than offset by an abundance of mosquitos. There are something like 3,000 varieties of mosquito in the world and while eating breakfast I was able to identify eight different types just on my left hand. They fly up your nose. Jogging or any activity that calls for heavy breathing is sure to ingest a few.

The bus is getting messy. Things are migrating away from their travel locations to their ready–use locations and I forget to herd them back.

Later

The maiden sister visited me rather late, saying she would be content to sit and share my music, which can not be heard beyond the limit of my campsite. She is wearing a touch of makeup and smells very nice. Her widowed sister is older, she explains, needing to keep more regular hours. The difference in their ages is no more than a year.

She was very curious about the comupter, at which I was working, and my sleeping accommodations and did I have a toilet. She prowled around the camper, surprised that there was so much room, more than enough for two, and yes, there was even a toilet. She admired the roof rack, wondering how I managed to climb up to it. I showed her the little aluminum ladder and she acted as if she'd never seen anything so marvelous. Then she spotted my license plate — I only have one, on the rear — and asked in a stricken voice "You're American?" When I owned up to it she lost interest in my music and me and the roomy accommodations and scurried back to her camper. A few minutes later her sister, fully clothed and awake, came over to retrieve the plate of boiled potatoes.

Welcome to Canada. I'm smiling as I say it. They are nice ladies, growing a bit lonely waiting for the hay to mature.

I'm worried that I'll not be able to link up with the others. I've no interest in traveling to Inuvik alone. If I fail to meet them the effort expended on the trip will be for nought.

The Inuvik Run — Together Again

July 23rd

At Ten Mile Lake I broke camp early, but not as early as the hay– growing sisters from the other side of Clinton, who pulled out while I was fixing a cholesterol–laden breakfast of bacon and eggs. They didn't wave, didn't look my way. I had become the Invisible American.

I said good–bye to the mosquitos and swung back south through Quesnel. I checked campgrounds east and west of Quesnel on Highway 26 but no one had seen anything of the missing trekkers.

It seems impossible I could of missed the Inuvikers but then, the itinerary was never that firm. Their intended route from Vancouver was to follow Highway 99 over the mountains, intersecting with Highway 97 between Cache Creek and Clinton, near where I'd camped my first night in Canada. From there to Prince George there is only one major road, although it is paralleled by a number of unpaved tracks taking you to towns like Horsefly and Likely; there are plenty of ways for them to have by–passed Quesnel.

But it was unlikely they would by–pass Prince George, where the VW dealer was going to give them a free oil change. I set a course for Prince George and put my foot down.

At this latitude surface maintenance of the tarmac roads must be done during the summer, which unfortunately coincides with their season of greatest use. Prince George is about 65 miles from Quesnel and there was only one stretch of roadwork to contend with. I made the run in just over an hour.

The people at the Volkswagen dealership were very nice, a Canadian trait I wish they could export. They stood ready to service a flock of Type II's, expecting them to arrive between 11:00 and noon. Indeed, while I was chatting with the Service Manager, Ron & John wheeled up and we all peered down the road for the others. But they were not there. It seems the trekkers had made no attempt to reach Quesnel, abandoning the itinerary to take advantage of a free campsite near Williams Lake, 75 miles south of Quesnel, where according to Ron Coyote they were still in the process of waking up when he lit out on my trail, shouting for me on channel 2 as he flew thru Quesnel. Ron has one of those wet Volkswagens that goes like scat, when it goes. Had I been doing 55 instead of 65 he would of caught me on the road.

The Service Manager was surprised when I used my own oil and filter to do my own oil change, asking only to use his waste–oil dump. Shit happens. Over the years shoddy workmanship at Volkswagen dealers have cost me two engines and an outboard gear box. Now, I do all of my own maintenance. Shit still happens but at least I don't need a lawyer to make things right.

The Volkswagen dealer in Prince George has a nice shop. Maintenance bays up front, handy to the street, body shop in the rear with lots of fenced parking, engine overhaul and parts–store over behind the salesroom, all of this under one roof. I did my maintenance in the parking lot so as not to take up space that could be earning them money.

Besides driving a water–pumper, Ron Coyote communicates using a slab of Apple pie, a thing so ridiculously narrow–minded its built–in modem could not cope with the multi–line phone at the VW dealership. The Apple doesn't even have a floppy drive, meaning I can't use it to upload this trip log. It also doesn't work very well but certainly better than my failed Toshiba.

After changing my oil I swept out the van then scrubbed my oil drain pan, which is also my dish pan. And my bath tub.

Noon rolled around and no Inuvikers. With only two service bays it was going to take at least three hours for them to have their vehicles serviced meaning they wouldn't hit the road until 1500 at the earliest, after which they would all whiz off down Highway 97 at 100 km/hr for the four–hour run to our next camp, leaving me to struggle along behind. I decided to struggle along ahead instead.

According to Ron the itinerary listed the next stop as Moberly Lake, a couple hundred miles up the road from Prince George. The instructions for getting there were pretty simple — all travel instructions in British Columbia are pretty simple since they don't have a lot of roads. But Moberly Lake isn't on Highway 97, it's on Highway 29, a few miles beyond where it runs into 97 at Chetwynd. I mumbled the directions to myself so I wouldn't get lost: "Go to Chetwynd, hang a right," and that's what I did, after arranging to met Ron and the others at the Provincial Park, which is where I am now.

But the four hour trip took six hours, thanks to Pine Pass, twenty miles of unpaved road and a fellow in a Pontiac Firebird that shoulda stood in bed. Northbound traffic (me) had to wait an hour for the on–coming traffic to clear the single unpaved lane thru the pass, which has no road to speak of, although one is under construction. We then had to spend another hour watching the fellow in the Firebird slither and slew and bang and hang his way all over the road, wheels spinning, paint job vanishing…

A crazy guy in a big Jimmy just behind the Firebird finally passed the Firebird in the rough, stuck his foot in it and hauled ass thru the muddy ankle–deep gravel. I jumped out of the line and followed. When the Jimmy hit pavement he was a bit surprised to find me clinging to his bumper. The old bus can go fast when it has to, and does about the same speed on–pavement as off.

Back on the tarmac, the Jimmy took it out of four–wheel drive and vanished at a rate of knots. I shifted into fourth, stuck some Beetles in the stereo and drove on. It was half an hour before the other traffic began catching up. The Firebird went past like blowing a booger out your nose. His car was reasonably clean, those stuck behind plastered with the gooey gray clay he'd been flinging in all directions.

Pine Pass carries you over the Hart Range, a spur of the Rocky Mountains. In Prince George I was in the watershed of the Fraser River but once across Pine Pass the waters were flowing north. That marks a milestone in the trip and it does so when I'm almost exactly half–way between San Diego and Inuvik, about 2,100 miles by the odometer.

It is now after 1900. I've got a hunch the Inuvikers won't show again, that they'll wander off to some other target of opportunity as they did the night before. Should that happen I've no idea how to get back in touch with them.

It will be a bit embarrassing if they fail to arrive since I've chased a couple of would–be campers out of sites adjacent to mine, assuming we would want to camp as a group. At least it's a nice camp, a smarter camp than Ten Mile Lake. It isn't built in a bog and the stores of firewood dotted around the park have shed roofs. There are no flush toilets but plenty of outhouses. I haven't found the showers as yet.

–Bob

(After trip comments.)

I didn't find the showers because there are none at Moberly Lake. I had mis–read the accommodations table for the list of campsites.

The Inuvikers eventually arrived, although after my usual bed– time. Even so, I was up to greet them. I was monitoring the CB and knew they were on their way, having picked up their chatter as they crested Pine Pass nearly 90 miles away, although none of them heard my transmissions until they reached Chetwynd, about twenty miles from Moberly Lake. Throughout the trip I would be able to hear their transmissions considerably farther than they could hear mine.

When the convoy arrived at the lake I used the radio to lead them to my campsite. They filled up the surrounding sites and began to party. There was a flurry of introductions as I met people known only thru the internet. In the dark I was unable to fasten names to faces or faces to buses and was still trying to do so nearly a month later. Then someone needed to borrow my grease gun, someone else borrowed my ax and another asked might I happen to have a pair of vise grips… a pattern of post–campsite arrival that was to persist throughout the trip. – rsh

The Inuvik Run – Fort Nelson

July 24th

The group eventually arrived at Moberly Lake and we camped together. This was my first opportunity to meet some of the Inuvikerrs. I'd been feeling sort of down about missing them at Quesnel but their arrival, concrete evidence there are others as crazy as me, left me feeling pleased. Several greeted me, several did not. In the dark I could not get all the names and faces straight.

After meeting the group I sensed a lack of consolidarity among them. During only two days on the road the group appears to have polarized into three distinct camps.

The group does not follow typical convoy–enroute procedures, which is to start early, travel as a unit, and to camp early. Traveling as a group is nothing more than common sense, allowing mutual support should one of the vehicles have problems. Keeping to a schedule of early departure and arrival brings you to your destination before the stores have closed, allows time to maintain the vehicles, prepare meals, do laundry and so forth. The older members of the group seem to understand the need for these things, the younger ones do not. It places an unfair burden on a few.

I turned in about midnight. Knowing I wouldn't be able to keep up, I departed Moberly Lake at 0640 the next morning while the trekkies were still asleep, expecting them to catch up to me before I reached Fort Nelson.

Conditions were wet, cold and rainy for the first hundred miles. On paper, Highway 29 appears to be a neat short–cut around Dawson Creek, mile zero of the Alcan Highway. But Highway 29 is a poor choice if you're driving a 1965 Microbus. The scenery as always was marvelous despite the low cloud base and rain. But many of the grades found me struggling along in second gear.

At several of the scenic overlooks I took the time to set up the tripod, allowing me to take pictures of myself and the bus against the magnificent backdrop. The views are indescribable. I doubt even a photo will serve to convey their grandeur.

Despite the grades and a quick back–track into Fort St. John to visit a bank — a wasted trip since I'd forgotten I was now in a different time zone. I arrived in Fort Nelson at 1530, covering 336 miles in nine hours and fifty minutes. Given the conditions, that's a pretty good run since the engine–hour meter logged only 7.2 hours running time.

Not knowing where we were planning to stay and guessing the rest of the band wouldn't arrive until after five, I refueled, performed the necessary maintenance chores then explored the town. There wasn't much to see. There is a supermarket — 'Overwaite' that was well stocked and busy. They had a bakery and I loaded up with hard rolls, having run out of bagels at Ten Mile Lake. Hard rolls or bagels keep better than sliced bread.

My baggage includes more than a dozen books. Chores done, I sat reading, monitoring the CB and periodically broadcasting "Looking for Inuvikers" over CB–2. About six P.M. the call was answered by Ron Coyote but the rest of the convoy would not arrive for several hours.

I won't tell you where we stayed. It was a pit, thanks to the ill mannered American geezers whose idea of a vacation is to drive their sixty foot motorhome to Fort Nelson in order to watch sitcoms on cable TV.

As before, some of the group asked to borrow tools. I'm surprised they are so ill–prepared. There appears to be only two axes among the group, mine and Jack Stafford's. Did we publish an inventory of recommended tools & equipment? I can't recall. If we did not, we should have.

–Bob

(After trip comments:)

During the course of the trip I read all of the books I carried with me and bought more along the way, giving away the ones I had read. Standards in my library and not given away were the Bible, the collected works of Poe, a tome on aerodynamics I've been hacking my way through, and Chaucer, an old friend whose tales are the perfect compliment for our eclectic band of travelers.

Overwaite markets, instantly dubbed 'Overweight' by the trekkies, are found throughout British Columbia, although the Safeway in Lake Williams had a better bakery.

My scenic photos will have to wait for another trip. On arriving at the Arctic Circle I discovered the leader of the film was torn – – I had been shooting blanks. Since the return trip followed a different route it was not possible to re–shoot the views of the Peace River valley. – rsh

The Inuvik Run — Doing the Split

July 25th – Laird Hot Springs

It is twenty–five past ten in the evening. The sun has set but the sky is white, a curiously bright twilight without the usual rosy reds, it is just… white. People are strolling about, there is no darkness in the literal sense yet there is no sun.

I am near sixty degrees north latitude, parked in space number 14 at the Laird Hot Springs Provincial Park in the northern–most slice of British Columbia, 2,672 miles north from San Diego. I'm sitting in the bus because if I sat outside the mosquitos would be in my nose and ears and mouth. The mosquitos of Ten Mile Lake showed some respect for bug juice but these hot–spring mosquitos are an entirely different proposition. They pay absolutely no attention to the advertised claims of Johnson & Johnson, Cutter, or any of the other makers of insect repellent, which is a real disappointment. Bug spray is expensive and bug bites are painful. I am poorer by several dollars yet covered with itchy lumps and scabby little wounds.

From Fort Nelson the itinerary had us traveling to Laird Hot Springs, a mere 260 miles but none of it truly flat. Since the run was so short I decided to stay with the group rather than leave early. The next morning I waited until everyone was on the road then fell in as Tail–End Charlie.

This was the most pleasant run I've had since leaving San Diego. For the first time, I traveled with the Inuvik group as a convoy and it was fun. By goosing the old bus on the down–grades I was able to keep up with the convoy. Well, sorta keep up. That lasted until noon.

The convoy stopped for lunch at Muncho Lake in a remarkably pretty alpine valley. The convoy splintered there, some pressing on to the hot springs while others chose to take a swim. The lake is about 3,000 feet above sea level and while the air was cool the sun was blazing hot. The waters of the lake however were liquid green ice. I decided to pass on the swim. I ate my lunch of sardines, apples and crackers, sitting in the sun reading a book. Seeing no signs of movement from the picnickers, after lunch I hit the road. Eddie Heintz and his dad soon appeared in my rear view mirror and I moved over to let them pass.

Between Muncho Lake and Laird Hot Springs we had to avoid caribou, a solitary bison and whole flocks of mountain sheep, attracted onto the roadway by the chemicals used to de–ice the concrete bridges and other portions of the road. We also saw a small band of wild horses, the stallion neatly herding his pregnant mares off the roadway with well placed nips then stationing himself between us and them and we rolled past. The animals were in good condition with no sign of lameness or split hooves. There are shaggy Siberian ponys that live north of sixty but I had no idea wild American horses, which are of Spanish–Arabian descent, could survive so far north.

By the time I arrived at Liard Hot Springs most of the group was hanging on my bumper, their later–model vans having no trouble making up my slim lead. We had reserved spots months before and my space was clearly marked.

Most of us took a dip in the hot springs. We started at the Beta Pool, a murky pond smelling strongly of sulphur. The grayish water was about one hundred degrees Fahrenheit. The Beta Pool is about fifty feet across and deep enough for swimming.

The women in our little convoy are young and pretty whereas the typical camper at Laird Hot Springs is elderly, usually driving a sixty foot motor home that cost as much as Nova Scotia. Many of these septuagenarians have grandchildren in tow. When Yvette and Jorge decided to take the plunge in the Beta Pool there was a gaggle of teenage boys already there, most daring each other to get into the hot, sulphur–smelling water. Yvette removed the towel from around her shoulders, displaying the top of a micro– mini bikini. She then removed the modest bloomers she wore over the rest. Two things were immediately evident. Her bikini was of a type and size suitable only for very slim young ladies who make a habit of shaving in an interesting place. The other things that were immediately evident were the pronounced bulges in the bathing suits of half a dozen tow–headed teenage boys, all of whom sought refuge from their embarrassing condition by thundering into the pool en mass, submerging themselves neck–deep in the steaming water and remained there, red as lobsters for the whole time Yvette was at the pool. As we left, the boys were helping each other out of the water to collapse on the wooden boardwalk in a parboiled state.

Lower down the hill is a hotter spring of crystalline water. The hot stuff is contained by a small dam over which it spills in a natural shower. Below the dam the clear hot water mixes with the murky run–off from the Beta Pool and frigid water from other springs. Most of the Inuvikerrs where there and it was very pleasant. A few of us tried the hotter water. It proved cooler than a Japanese bath and very refreshing, were it not for the horseflies, black flies and mosquitos.

Laird Hot Springs is a remarkable place, worth a second visit. Although located north of the 59th parallel the constant supply of warm water from the springs supports an incredible variety of temperate–climate and even tropical plants. And an equally enormous mosquito population.

Tomorrow the plan calls for taking the unpaved Klondike Highway between Watson Lake and Carmacks. Back when the itinerary was first discussed I opined that given the age and condition of my bus I thought it best to stick to paved roads whenever possible. I have to drive the unpaved Dempster, there's no other way to get to Inuvik. But there is pavement all the way to Dawson. Driving the 373 unpaved miles of the Klondike Highway would increase the risk of mechanical failure for little return — it's all new country to me, one route as spectacular as another. So tomorrow I pull out of Laird Hot Springs heading not for the lead mines at Keno but the Safeway in Whitehorse, about 412 miles away.

–Bob

(After trip comments:)

The women in our convey were all young and pretty, every one of them. Age and appearance has nothing to do with it. – rsh

The Inuvik Run — At Whitehorse

July 26th

Departed Laird Hot Springs about 0600. Arrived in Whitehorse in convoy with Ron Coyote, who left Laird at the same time and quickly ran out of sight only to periodically reappear in my rear–view mirror, the result of making stops along the way. When I drive, I drive. 418 miles, 8.2 hrs.

Dennis departed earlier than me to insure arriving in time for his girlfriend to catch her flight back to the states. Ron and I arrived at the Whitehorse airport in time to see her off then the three of us convoyed into town and camped at the Sourdough RV park, another pit. Fifteen bucks Canuck for a slot in a gravel parking lot. Hook–ups can be hand at extra cost. The only saving grace is hot showers and flush toilets.

Coyote's reason for coming to Whitehorse instead of taking the Campbell Highway to Faro has to do with his recalcitrant Apple lap–top. My car–battery–powered IBM–AT continues to work just fine. Fingers: Crossed.

In traveling to Whitehorse I'm skirting the borders of Beringia, a mythical land some twenty million years old and one of the reasons I chose to make this trip. Beringia is that part of North America that despite its high latitude was not buried under a mile–thick glacier during the last Ice Age, the same continent– wide mass of ice that created the American steppes and polished Canada right down to its planetary basement–rock. Yet even though the Yukon Territory was just next door to the glacier, it was not covered in ice. This provided the land–route for the second migration of humans and animals from the Asian mainland, the folks we now call Indians; Aborigines in Canuck–speak.

You can't do much field geology whizzing past at fifty miles per hour but this is my first opportunity to see with my own eyes what I've heretofore experienced only in books. And yes, even at fifty miles an hour the visual experience is enough to cause things to click into focus. It is a very exciting time for me.

I spent the shank of the evening helping Dennis install a CB radio in his Westy, loaning my baking pan as a temporary magnetic ground plane. We glued the baking pan in the forward recess of the fiberglass top, snaked the wires thru the gap in the door seal instead of drilling holes. He has a couple of other needed repairs that we'll get to tomorrow. While he did laundry, including some of mine, I fixed chow. At home I am not allowed near the washing machine. I am not allowed to Sort. I am not allowed to touch Bleach. The ability to do laundry without turning white things pink and losing socks is a missing gene in my make– up. But I can cook, sorta. I prepared ravioli with garlic toast and buttered canned corn, followed by hot cocoa. Dennis had no complaints.

After pulling into the RV park and taking our spaces, Dennis went downtown to buy a CB at Radio Shack. While he was gone a Canadian couple arrived and after a jockeying around, backed into his space. I explained that it was taken and they said, yes it was, by them, since I had taken THEIR space. And they had the receipt to prove it. Sure enough, their receipt had the number of my space. I told them the clerk must have made a mistake and went to find my receipt. And couldn't find it. After a few minutes they began to set up camp in Dennis' space, assuming I was bullshitting them about the error. I tore the bus apart and finally found the receipt in my log book. They spent some time comparing the two identical receipts then pointed out that the number of the space on my receipt was written in PENCIL whereas theirs was written in ink and perhaps we should all go up to the office to straighten things out. The implication pushed the wrong button. I politely explained how I would straighten THEM out if they didn't pack up their junk and get out of Dennis' space RIGHT NOW. They drove up to the office and later appeared on the far, FAR side of the RV park. Next thing you know they would accuse me of having a printing press in the back of the bus. The number of my space? 13

Like most RV parks, the typical 'camper' is elderly and appears to be a semi–permanent resident. They all seem to know one another. There is a gang of eight geezers that kept me entertained all afternoon. They carry a picnic table about with them as they march from one RV to another, since the spaces here do not have individual picnic tables. Nor fire rings. Nor water faucets. Nor privacy. I am within inches of a public sidewalk, within feet of a main street. And the sun refuses to die a natural death. The patrons of a Pizza Hut peer out their windows into mine. I smile & wave. They ignore me.

When the Gang of Eight go for a hike, the men, all in their sixties, take up positions at the corners of the picnic table, hoisting it up on a command from their Sergeant Major and go shuffling off to their next gig, often only twenty feet away from their last one. Their wives shuffle along behind, also two x two, shuffling so as not to overtake the table–carriers. I've no idea why they don't walk alongside or even — gasp! — go ahead on their own, perhaps to welcome their arrival.

The table–shufflers look a bit like a funeral procession, what with the women carrying various table–top paraphernalia — mosquito lamps, cribbage boards, place mats and so forth. Watching them shuffle back and forth, trying to achieve the perfect position, all the while directed by the four women, was hilarious. Little puffs of dust rose up around the men's feet as they shifted into half–step, backing and filling as if parking a big rig in a narrow loading–bay.

I can't help but wonder if the Gang of Eight has similar lock– step procedures for shopping, doing their laundry, going to the bathroom and making love. When they took up their positions for their third Table Run in as many hours I felt an insane urge to whip out my kazoo and play a bit of Sousa. Or perhaps a polka. Ah one anna two…!

I've been on the road nine days, averaging six hours sleep a night. Things are starting to get silly. And what's wrong with the sun?

–Bob

(after–trip comments:)

I never saw my baking pan again, meaning no more biscuits for the remainder of the trip. It was a pretty good baking pan. No holes and only a little rust. It also serves as my parts–washing pan, should I need to degrease something. (You line it with aluminum foil for baking.)

There were several guitars among the Inuvikerrs but I had the only kazoo. And a Spanish–language dictionary. – rsh

The Inuvik Run – Frenchman's Lake

July 27th

I'm still in Whitehorse.

I've been on the road 9 days, traveled 3,090 miles. The sun set about 2230 last evening but it did not grow dark until 0200. By 0500 the sun was on the rise and so was I. I walked off the kinks through the sleeping town. Saw what might have been a coyote slipping across the deserted street. Hiked back to the bus, made coffee, sat down to write this.

Whitehorse is sleeping now but it is a bustling place during normal working hours. With a good airport and seaport (Skagway), and astraddle the only all–weather highway between Alaska and anywhere else, plus a ready–made attraction for tourists, it is a busy, interesting place to be. That is, to be at. Most of the towns I've visited during this trip are places you yearn to be from.

At Frenchman's Lake

In Whitehorse Dennis said he wanted to work on his bus, having asked the loan of a few of my tools. I waited around for him. And waited. And waited. Finally said to hell with it.

I pulled out of Whitehorse about 1330, drove to Carmacks, hung a right and ready there.

Jorge has suffered an extensive first degree burn on his face and right hand, the result of coaxing wet wood alight with a dose of gasoline. There are some small areas of second degree on his fingers and nostrils. He's playing it very cool. Or very stupid. He could of turned back to Watson Lake or stopped at the mine's clinic at Faro but chose to do neither. Macho–dumb.

I mixed up some electrolyte replenisher and got him to drink it then instructed Yvette in how best to keep the burns clean, giving her my supply of sterile cotton pads. She is stressed out by the situation. Yvette has no experience with a manual transmission; she can not take over as driver should Jorge become incapacitated.

Except for Jack Stafford, who camps with Jorge & Yvette, most everyone else treats Jorge's burns as a joke, offering home remedies along with barbed comments at his expense, as if the issue were the use of gasoline as a fire–starter rather than the possibility of Jorge's permanent injury, or being forced to abandon the trip. I'm chilled by such casual disregard for another human.

Some of the others want to continue their off–pavement odyssey but I've talked Jorge and Jack into accompanying me on the more direct — and paved — road to Dawson, hoping to get Jorge some medical attention before his burns become infected. With the material I have it is impossible to bandage his burns so as to completely exclude the road dust. Despite Yvettes frequent and devoted efforts to clean the burns they will become infected if he does not receive some antibiotics.

It's a little after ten in the evening. Dennis and Ron arrived a short time ago. Ron sez his lap–top is working again. I wouldn't trust the thing as a door stop.

Later…

Rather than work on his vehicle in Whitehorse, Dennis signed on the queue for internet access at the Whitehorse library, then went gold–panning, then bought some tires, then… did something else, all while I'm sitting around with my thumb up my ass, thinking he's going to need my tools. He does, but obviously only at his convenience. He's just borrowed some — and my picnic table — and is fabricating a missing piece of engine tin. But without my help. I've been up nearly eighteen hours. Going to bed. If he keeps me awake

I'm going to mistake him for a bear and take appropriate action.

The Inuvik Run — At Dawson City

July 28th. (At Frenchman's Lake)

Eddie Heintz is our resident Walton. Within instants of his arrival at any place at all he is lashing Canadian waters with Texas zeal. This can be embarrassing if we happen to be in an RV park. The nearest geezer is liable to find a Jitterbug expertly dropped into his cup of Bovril.

At Frenchman's Lake Eddie's spinning gear happened to snag a thing with an under–slung jaw having more teeth than a barracuda. I say snagged because everything else he hooked simple bit thru the line and swam off. Up here steel leaders are the rule. Eddie is using bare monofilament.

Eddie called the ugly thing a pike but it looked like a barracuda to me. Eddie killed the thing and promptly ate it.

Frenchman Lake is a fishing camp. There are some fire rings and picnic tables but the main business here is fishing. There is a launching ramp and dock but no firewood and you must provide your own toilet paper when you make the hike to the outhouse. Drinking water is drawn from the lake, a large sign cautions you to boil it. The boat ramp and small floating dock are in good repair and there's evidence the lake is chock full of trout. And barracuda.

It is five past six and it is cold. I'm the only one awake. I've been up for an hour. Although I am not the oldest member of the convoy I appear to have the oldest kidneys. And the most battered bod. After the fourth day of driving my kidneys nudge me awake every three hours or so. By the time the second nudge rolls around, my back is warning me to get up and stretch out the kinks or take the consequences. I've brought my cane and a lavish supply of Ace bandages, worry that I may have need of them. The worry is not an idle one. Among my many skeletal injuries are a fused vertebrae, a bad knee, a bad elbow and a bad shoulder. On top of that is various damage to the musculature. I've enough scars to play the lead in an Ann Rice flick. My days begin and end with chemical stews.

The driving caught up to me at Moberly Lake, where I awoke so stiff and sore I could barely stand. A few early risers at saw me doing my clumsy tai–chi. I Gathered The Plums and did Cutting The Corn until I was limber enough to risk more violent Occidental exercises. The folks who saw me limbering up wore startled expressions, probably from my state of undress. You can't stretch very well wearing levis and boots but they do tend to foil the mosquitos. Since Moberly Lake I've limited my unkinking exercises to walking, stretching and isometrics, all while fully dressed.

Living is a physical experience, however painful it may be. If you are not physically active, you're not really alive. I am alive! Beat up and gimpy, but alive.

Breakfast was my usual oatmeal with honey, washed down with cocoa instead of coffee. I've been away from home ten days and have run out of real coffee. There is some freeze–dried stuff and I will drink it when I have to but it is too gross to face in the morning, when you need the aroma of coffee as much as the heat and stimulation.

Our numbers have swelled by two. Last evening I met Sue Booth, a geologist turned film maker who chanced across us at Laird Hot Springs. My early to bed, early to rise schedule caused me to miss her at the hot springs. Sue is touring Canada in a blue diesel–powered Vanagon accompanied by a big black dog and an assortment of cameras and video equipment, some of which is mounted on the dashboard of her Vanagon permitting her to film as she drives. She adopted the idea of driving to Inuvik and joined the convoy on their run to Faro. Last evening she came over and introduced herself, mentioning that she too is the proud owner of a 1965 Microbus. I hope it's in better condition than my old wreck. I applauded her wisdom in choosing the diesel powered Westy for her tr ans–Canadian odyssey.

Alaskan Dave, whose Syncro comes equipped with a canoe, is the second recruit. He too has decided to visit Inuvik. Dave was enroute to Anchorage when he came upon the convoy and promptly fell into line. Dave's canoe weighs seventy pounds. He whips it off the top of his Westy to camp, tosses it on again when he's ready to leave. His knees bend and flex. His shoulders have full rotation. I can't stand to watch.

Today's goal is the government campground about ten miles south of Dawson, two hundred and fifty miles north. For me the real object is to get Jorge to a doctor before his burns become infected. Jorge and Yvette will continue on into Dawson, escorted by either Jack or myself, the non–escort tasked with nailing down a campsite for the missing pair. We will spend two days at Dawson, prepping our vehicles for the 476 unpaved miles of the Dempster Highway.

At Dawson.

1826, 28 July 1996. 264 miles traveled.

We did not depart Frenchman's Lake as planned. One of the vehicles, a later model fuel injected van, refused to start. We played mechanic without doing more than getting in each other's way and failed to diagnose the problem. Because the van was parked away from the others at a secluded campsite down a steep and twisty track, it was impossible to haul it out with another bus. Fortunately there was a Canadian camped with us driving a Ford 4x4. We dropped off his trailer, used my tow rope to get a grip on the van and yanked it not only out of the campsite but all the way up the hill to the access road, where the van decided to run just fine, so long as it was bump–started. With five oat– fed Inuvikerrs providing the push, it started just fine.

On our way back to pavement we took a photo–op that will surely be the most spectacular of the trip, with all of the vans lined up side–by–side, their asses about to fall off a cliff into the Yukon several hundred feet below.

Back on pavement, Jorge and Jack turned north for Dawson and the infirmary with most of the others turning south for Carmacks, flush toilets, groceries and gas. Thanks to the saddle tanks I didn't need any gas and turned north. Sue, the new arrival, who gets about forty miles per gallon from her diesel engine, fell in behind.

Sue's blue diesel Vanagon is even slower than me! I've finally found someone who travels at my speed! We plodded the five hours into Dawson together. She has a CB but the transmitter–section is broken, the rig can receive but not transmit, other than to key the carrier on and off. We work out a system of clicks — one means no, two means yes and so forth. I try to teach her Morse code but she isn't interested. When I persist she threatens me with her dog. It is a big dog but gentle and kind, although it could slobber me to death.

Coming into Dawson we blew right past the campground. Never saw a thing. Stopping at the gas station just this side of the bridge, I asked for directions. The lady directed me to a private campground. When I insisted there was a public campground she said she'd never heard of it. Odd? Then she said there was one across the river, saying again she didn't know of any 'Klondike River Provincial Campground'. Of course, we could stay there, at the gas station, which happened to be the office for an attached campground.

Trying to figure out what caused the campground to vanish, I began back–tracking, peering down every side–road as I headed back toward Whitehorse at thirty miles per hour. I'd gone about a mile when the other vans appeared — and zoomed past. They'd seen no sign of the campground either. One of the other vans had a published trip log onboard listing the location of the campground as so–many klicks past the airport. I continued on to the airport and started counting klicks. And bingo! There was the campground, down an unmarked road to our left.

Someone had removed the sign from the posts. The posts were there but the distinctive 5 x 8 foot sign was missing.

Jorge & Yvette and Jack were already there and had saved me a space. The local clinic has shot Jorge full of antibiotics and given him additional handfuls of pain–killers. He wears an especially silly grin. Yvette could carve her initials on his tongue and he wouldn't notice until he tried to spit.

My fuel pump is leaking and one of the saddle–tank vent–lines has come adrift, plus I need to check my toe–in. But we are now only 476 miles from Inuvik!

–Bob

(after–trip comments:)

The cute trick with the campground sign and the forgetfulness of the woman at the RV park/gas station was typical of the sharp practices encountered in Dawson City, an end–of–the–road community.

Later in the trip Sue Booth showed me some pictures of her 1965 Microbus. It is in award–winning condition. Then she casually mentioned that she'd done all of the welding, painting and restoration herself. It's surprising how easy it is to hate certain people :–)

The Inuvik Run — More Dawson

July 29th

2030 — The bus is ready to roll. I am not. Pulled something in my shoulder when adjusting the toe–in, coaxing the bus to roll back and forth on the not too level ground.

Checked out Sue's radio. The mike is okay. Measured some output from the modulator section but nothing from the final's pre–amp. It uses a circuit I'm familiar with, luckily. But I don't have the parts or tools to effect a proper repair.

Helped Eddie with his broken wind–wing, making a cardboard pattern that will allow him to cut pieces of plastic drink bottles to the correct contour.

In the course of her trans–Canada wanderings Sue has amassed a large (heavy!) collection of rock specimens including a stunning example of Labradorite She is a trained geologist but seems unfamiliar with placer mining. I'm an untrained geologist but I can recite whole chapters from 'Metallica,' the Roman–era treatise on winning metals from the earth. It's surprising how little mining has changed in 2,000 years.

Dawson sits at the confluence of the Yukon and Klondike, approached through a moonscape of debris fields left by the dredgers. The world once thought the streets of Dawson were paved with gold. It was a considerable surprise for me to see they are not paved at all.

The turn of the century goldrush, the memory of which is still mined by Dawson, lasted only a year or two, just long enough for Big Money to assess the commercial potential and buy up the more valuable claims. Once that was done they brought in dredges to rape the land, leaving the low–grade deposits for the fevered few who to this day eke a living from Klondike gold. It saddens me to see how little Dawson has derived from the billions carried away.

Placer mining in frozen terrain is a special case. People knew there was gold in this region fifty years before the '98 Stampede but the cost of recovery was more than the gold was worth. It must have taken some powerful economic forces to convince people to work a placer at a cost of about fifteen dollars per ounce when the price of gold was only a dollar more. Little wonder the goldrush lasted only a year or two.

None of the people I spoke with could provide any information about the placer deposits or the dredges, other than what was available in the local give–away flyers. Maps obtained in Whitehorse gave me some idea of what areas are available for mining and a trip to a hill overlooking Dawson gave me a feel for the terrain. Given the present price of gold and using modern pocket–dredger methods, there is still money to made in this area working placer claims.

Some of the gold nuggets I saw for sale in the shops appear to be fabricated. There's nothing illegal in converting one form of raw gold into another, unless it's assay changes along the way. When asked the fineness of certain nuggets the clerks said they didn't know what I meant or that I would have to talk to the owner. No owner was ever available.

It was a nice day. Jorge's burns look horrible but he is mending well.

Tomorrow the Dempster.

–Bob

(After–trip comments:)

I've worked on and surveyed a number of placer claims in the United States and Mexico. I was very interested in the Klondike and Cassiar regions for that reason.

The image of the 49–er with his pick, shovel and gold–pan is no more valid than that of a cowboy with a pistol on his hip. That there were such people there is no doubt but their numbers are minuscule compared to the legends they've spawned. The typical drover did not even own a handgun and the gold–pan is used primarily for prospecting. Once placer gold is found and the extent of the deposit determined, other methods of extraction and concentration are used.

Instead of repairing his wind–wing with clear plastic Eddie simply covered the hole with the cardboard pattern I'd cut. It got him home although it was a little hard to see through.

I was a bench tech at Westcomm for about three years, repairing CB radios, among other things. Rumors that checking out Sue's radio only made it worse are untrue :–) –rsh

The Inuvik Run — Eagle Plains

July 30th

At Eagle Plains. It is raining.

Nine hours thirty minutes to make–good 271 miles. One flat. Very tired. Shoulder feels like a rotten tooth.

(After–trip comments:)

I didn't set up the computer when I arrived at Eagle Plains. I don't recall making the above log entry but there it is in the trip log where I record mileage and fuel consumption. I'd been up until 0300 the night before working on someone else's Volkswagen.

The owner, a young lady discovered in Dawson by other members of the group and towed back to camp with tales of a VW guru who could 'fix anything' (!) had been waiting three weeks (THREE WEEKS!!) for some Dawson twitt to get a valve cover gasket for her Type IV. When I heard that I whistled, clapped my hands, got everyone's attention and shouted "I'll pay twenty dollars gold for the first Type IV valve cover gasket in my hand." Jack Stafford slapped one in my palm an instant ahead of three others, then waited expectantly.

He's still waiting. Jack will believe anything.

I cleaned the valve cover and glued the gasket to it but had to beg help from Dennis to snap the bail into place. (My shoulder was really screwed up.) But the real problem with the Waif's van was the absolute lack of any engine compartment seal, plus an after– market exhaust system smashed up against her body–work and engine– tin that was guaranteed to fry any seal once it was installed.

Using some carpet padding provided by Eddie, I designed a jury– rigged compartment seal and set the Waif to fabricating it, sewing the foam padding together with a sail needle and Dacron thread.

Using sheetmetal provided by Dennis, I bent–up a two–section heat shield to protect the soon–to–be–installed carpet–padding compartment seal. After bending the body–work away from the muffler, I installed the heat–shields using safety wire. The Waif has to make it as far as Vancouver. The whole affair was a lash– up, a make–do–with–what–you–got sorta fix. It should get her home but if she tries to go five miles farther the whole thing will probably explode.

After writing my log entry for the previous day, but before the Waif showed up with the crippled van, I worked on Sue Booth's diesel Vanagon, which overheated climbing the big hill back of Dawson with a load of sightseers onboard. Her coolant recovery tank is cracked and has been for sometime. She has been getting along with a duct–tape patch. Now the patch had failed and she'd blown some of her coolant overboard.

By backing her bus up against mine I was able to plug my 12v soldering iron into the high–amperage outlet I've installed in my engine compartment, thus giving enough cord to reach Sue's coolant tank. After scraping the gunk out of the crack in the polypropylene tank I welded the crack with the soldering iron. While this was going on the Waif showed up, her bus dribbling a trail of oil.

The next morning the others packed up and took off for Inuvik but Sue was worried about overheating. There was a big bubble of air in her coolant expansion tank. I don't know anything about water– cooled Volkswagens but it was pretty obvious hers wasn't pumping much coolant. Parking her bus ass–first down the side of one of the built–up camping pads, we got the radiator high enough above the engine to coax the bubble up the pipe. The radiator is fitted with a valve — a 13mm bolt — allowing you to purge air from the system. When the engine got hot and the bubble vanished up the inclined pipes, I loosened the bolt and was rewarded by a hiss of air followed by a dribble of fluid. Bubble–free, temp in the green, we repacked the tools and headed for the Dempster.

The others were waiting for us in the restaurant where the Dempster joins the Klondike Highway. While they finished their coffee I covered the lenses of my headlights with clear wrapping tape.

Sue wanted to film the crossing the bridge over the Klondike River so she went on ahead. A road grader was smearing a topping–coat of dirt & gravel over the unpaved road and there was a high berm of the stuff down the middle. Sue positioned her van on the left side of the berm so the others would have a clear path and got her camera(s) ready. The vans lined up and at her signal, proceeded across the bridge. I waited for them to get clear then waved Sue to get in front of me, taking up the Tail End Charlie slot.

When Sue crossed the berm it snapped her wheels full–lock and shot her toward the right shoulder. She over–corrected, swerved back too far and hit the berm again going the opposite direction. When her front wheels hit the berm the second time the soft dirt nailed the front end. She was still driving it, still trying to steer into the skid when the rear end broke loose, slinging the van dead across the road. The blue Vanagon shot off the left slide of the road, down the embankment and hit a tree.

I have a neat mental image of a blue van in mid–air, front wheels locked, motionless, dirt streaming from them. The rear wheels are a blur. There is a good three feet of daylight under the front wheels.

Amazingly, there was no major damage and aside from bruises, Sue was uninjured. After the usual Chinese Fire Drill we got her back on the road and underway.

The trekkies, already down the road and out of sight when she ran off the road, said I broadcast a play–by–play account of the event as it happened in a slightly bored Joe Friday monotone. I guess I did since they all heard me doing it but I don’t recall doing it. I only got about three hours of sleep the night before. I spent the day pretty much on autopilot.

The Dempster climbs out of the watershed of the Klondike, through the Oglive Mountains and down into the watershed of the Peel. Eagle Plains is a high plateau between the Peel and the Eagle Rivers, high enough to put you into the cloud base.

Climbing up to the pass thru the Oglive Mountains, another of the watercooled vans needed some repairs to their expansion tank. I did the same butt–to–butt trick in order to use the soldering iron. The air temperature was above freezing but not by much. It took a long time for the soldering iron to get hot enough to melt plastic. Since the engine compartment of the watercooled veedub was buried, and since the cargo space was filled, we transferred the weather– tight part of that van’s cargo to my roof rack. If we had to work on the tank again it would make things easier to get at.

As before, the faster vehicles whizzed on down the road leaving Sue and me to set our own pace. While negotiating an uphill curve, with a vehicle off to the right with a blown tire and an RV coming toward me, a small white sedan approached from astern and made an aggressive lunge toward my rear bumper. I ignored him, there was no room for him to pass, the Dempster is really only 1–1/2 lanes wide. But as I pulled over to make room for the on–coming RV the little sedan darted out to pass, forcing both the RV and me to lurch toward the shoulder.

The driver of the little car could not have misunderstood my move as an invitation to pass since the RV was right there and coming downhill to boot. And unless things have changed since the age of steam, downhill traffic always has the right of way. But not today.

The little car was chock full of people, their bodies rocking in unison as the vehicle dodged the RV and accelerated away in a skidding swerve, peppering my windscreen with a rooster–tail of gravel.

The driver of the RV stabbed his brakes, locked–up the wheels, drifting toward me in a slight skid. There's no such thing as 'flooring' a 1965 Microbus. I did what I could, managing to keep it on the road and miss the RV, who got things straightened out coming to a stop behind me as I continued up the grade. I grabbed the mike and warned the vans ahead they were about to be overtaken by 'An insane family in a white sedan' as the little car flew out of sight at a truly insane rate of speed. It was spinning its wheels, accelerating uphill, throwing so much gravel it formed a hazy cloud behind the car.

The Blackstone and Oglive rivers are major tributaries of the Peel. The Dempster must cross them. Shortly after reaching the Oglive River I saw the little white sedan again, spun off the road in a marsh on the right. Others of the group had already stopped to help. Eddie went back south, to where a road maintenance worker had parked his 4WD Dodge to see about a tow. Jack Stafford raised the local highway maintenance division on CB9. I waded into the marsh to assess the damage.

There were no injuries, other than from the clouds of mosquitos rising up from the marsh. The right front tire was blown, the wheel mangled, either because of the wreck or the cause of it. The steering was hung up on a rock, the tie–rods bent. As I hunkered in the marsh to inspect the damaged wheel I saw a rainbow of oil seeping from under the engine. It was a deader.

The car was a rental out of Whitehorse, the Insane Family a gaggle of Korean tourists intent on driving the 1,232 kilometers to Inuvik in a single day. They'd made it about half way. They were still alive but didn't seem to notice it was purely by luck. I offered mosquito repellent. They already had some. I offered blankets. They didn't want them. I shrugged and climbed back in the bus. There was nothing else we could do since there is no way to loan common sense. (On our return from Inuvik the little white sedan was still there.)

Shortly after passing the Insane Family the group pulled off at a rest stop. When I arrived someone pointed to my right front tire. I had a flat, or nearly so. I dug out the jack and slapped on one of the spares. The group began pulling out before I had the wheel changed.

Climbing onto the plateau between the Peel and Eagle rivers we ran into rain and then hail then more rain. I came upon a small red car canted off the left shoulder. I stopped to see if everything was alright. It was a young German couple, taking pictures of handfuls of hailstones, some more than half an inch in diameter. Using their camera, I took their picture offering mounds of marble– sized hailstones to the lens.

As I climbed higher up the plateau and encountered more rain the condition of the road deteriorated from merely sloppy to nearly impassible, chewed into a quagmire. I caught up to some of the group who had came upon a motorcyclist, down in the road. I stopped on the height of ground in the middle of the road, praying no big–rig was heading north. Others in the group got the biker up and remounted. He lurched past me using his boots as outriggers, skimming thru the mud. He went down again as he reached the grade but caught the bike before it went over, gunned it and leaped on, wobbling wildly. It looked as if he'd busted his clutch lever, or bent it back, the engine revving furiously as he tried to shift. He was all over the road and I waited for him, giving him a stationary target to miss. He made the crest and kept on south. I shut off my flashers and kept on north. The rest of the group was already out of sight.

As I slithered and slewed down the grades a red 4WD pickup with Alaskan plates came up behind and attempted to pass. I could barely control the bus, at times sliding as much as three–quarter broad–side. The Alaskan pickup seemed to think I was having fun, pulled up alongside and wanted to play. When he realized I was fighting the wheel, that the bus was going wherever it damn well pleased, he floored it. He was in four–wheel drive trying to power out of a skid of his own, swerving across my path. His spinning front wheels plastering my windscreen with mud, blocking all forward vision.

During the last moments of landing a DC–3 you have no forward vision. As the tail settles, you're flying blind, unable to see over the nose. So you look out to the side, judging your path relative to the edge of the field. It's only for a moment, probably ten seconds or so, and only scary at night, coming in to an unfamiliar field. I flew the old bus blind for over a minute as the wiper and rain slowly sloshed the windscreen clear, the washer having packed up somewhere between Frenchman's Lake and Dawson.

I caught up to Sue on the last slope coming into Eagle Plains. Her bus has a five speed tranny and can climb a telephone pole in low. She was plowing thru the mud like a tractor, steady, slow and sure. I planted the old bus in her ruts and let her lead me home.

I was dead tired. I wedged the bus in alongside someone else and sat listening to the rain on the roof. I had a flat to fix and was carrying someone else's baggage and needed a bath and a meal and I could barely lift my right arm.

For me, the run from Dawson to Eagle Plains had been the hardest day of the trip. – rsh

The Inuvik Run — At Inuvik

July 31st

No surf.

No surf??

NO SURF!!!

The overcast sky lays flat atop the ground, the cloud base only inches over your head. The sky is the color of lead.

On the thirty–first day of July, 1996, just a few minutes before 9:00 P.M. local time the convoy rolled into the outskirts of Inuvik. Eddie Heintz, called The Original Eddie since Seattle Eddie joined the convoy in Dawson, was dead on the side of the road, having blown the seals on his left rear wheel cylinder and pumped all of his hydraulic fluid overboard. But we were at Inuvik and the thought of a return trip with no brakes was a trivial matter, something we would deal with, as we have dealt with all of the other problems we've encountered.

The 231 mile run from Eagle Plains has taken ten hours, delayed by waiting for the ferry across the Peel River at Ft. McPherson and again crossing the Mackenzie River at Tsiigehtchic. More time went down the tubes due to flats. Additional time vanished down the black hole when we stopped for a group photo at the Arctic Circle, 66–33 N. Inuvik is at 68–21.

The Dempster Highway honors a turn of the century RCMP corporal who followed the route on a dog sled. But the 'highway' part of the name is a subtle joke. For the most part the Dempster is a one–lane graveled road having sloping shoulders wide enough to allow vehicles to pass, assuming the slope is not too steep and the mud is not too deep, the vehicles are traveling slowly and the drivers not screaming too loud.

The Dempster is known to eat tires. Even the most wildly optimistic of Yuppie tourist brochures turned their head to one side, coughed politely and suggested (in fine print) that you carry two spares. In the early months of preparing for the run I paid scant attention. One gravel road is pretty much like another, right? And I've seen my share of gravel roads. The Word came down from a truck driver who travels the Dempster on a regular basis. "It's not paved with gravel. They paved that sonofabitch with arrowheads!" He was serious and I took him at his word, adding two extra spares to my load.

Where it crosses tundra, meaning the majority of its length, the Dempster is not a road, it is a dike, a neatly piled heap of stone and gravel deposited on top of the fragile tundra. Any other form of construction exposes the permafrost below the skin of tundra. And once exposed, the permafrost melts, producing an impassible quagmire capable of swallowing the largest bulldozer with astounding ease.

The Dempster dike is over 300 miles long, forty to sixty feet wide at the base and six to twenty feet thick, the dimensions determined by local conditions. That is one hell of a lot of material. Building roads in the wilderness, you don't have the luxury of ordering–in granite aggrigate from Ling Foo's Road Building Take–away, you are forced to use whatever material is available along the way. North of the Oglive Mountains ignious formations are rare but sedimentary rock is common. The Dempster Highway runs thru areas in which the most common road– building material is remarkably brittle shale. When crushed to form gravel the shale shatters into arrowhead–shaped slivers rather than chunks. It is the shards of shale that have earned the Dempster its reputation for devouring tires.

With fifty–six tires (fourteen vehicles) we suffered five flats or blow–outs. Statistically, we can expect at four more on our way south. Those who ignored the warnings and tackled the Dempster shod with passenger–car tires were soon brought to a halt by flats or blow–outs. Those having spare truck tires loaned them to those without and the convoy limped on, sore– footed and wary.

If the sharp little shards of shale do not end up in your tires they are eventually ground into a particularly cloying dust. Add a dollop of water and you have a marvelously sloppy mud which the highway maintenance crews turn to gumbo by adding a neat layer of clay as a topping. The results have to be seen to be believed.

The Dempster also has a well–earned reputation for accidents, not too surprising when you consider all the factors. Each highway maintenance camp had a grisley collection of crushed and crumpled vehicles on display.

But we've made it. We set out to drive to the top of the world and we are here. I am 4,005 miles from San Diego. The trip has taken 91.4 engine hours, an average of 43.8 miles per hour, rather good when you consider my top speed is little more. I've purchased 194.2 gallons of fuel and have about 15 gallons remaining onboard, giving me an average fuel consumption of 22.3 miles per gallon, although that figure is suspect due to conversion factors and some leakage from the saddle tanks.

We made camp at a provincial campground a few miles outside of Inuvik. The weather is mild, the sky never truly dark. Eddie and Jorge have laagered their buses near mine. There is maintenance to do. Eddie must deal with his blown brake system while Jorge needs to find a replacement set of wheel bearings for his right–front. I must change my oil again, thanks to the dusty conditions encountered between here and Prince George where I last changed it. There is laundry to do and meals to prepare and reports, such as this, to write. For me, the lay–over day in Inuvik will be a busy time.

–Bob

(After–trip comments:)

When I arrived at Inuvik I was, as always, the last vehicle to do so. The others were clustered on the side of the road and Eddie was eagerly flagging me down. He had a brake problem. I thought everyone had stopped beside him because of the problem but it turned out to be some sort of conference about driving in to town in convoy. WHY we should drive through the town as a convoy was not explained. The town hadn't done anything to us.

It was obvious Eddie should not be driving anywhere, except to where we could work on his brakes. He'd blown the seals on a rear cylinder and fluid was dripping from the wheel, contaminating the shoes and rendering the emergency brake useless. With no fluid in the system and mechanical braking on only ONE (!) wheel, the idea of him working his way through a town, however small, was not only dangerous it was stupid.

It had been a long day. Told we would be departing at 0800, I arose early, mended a flat, broke camp, tended to the bus, loaded the roof–rack… and then waited. I was still waiting four hours later. We finally pulled out of Eagle Plains at 1130 and, also as per usual, the faster vehicles dashed off down the road leaving me to follow along.

At Inuvik I waited about fifteen minutes for the group to get their shit together. They'd been parked for some time, long enough for some of them to have driven into town, shopped and come back. I overheard a spirited discussion about where to go for the best vegetarian pizza. People were walking their dogs, others were walking their kids. Some were just hanging out, chatting with one another. I waited some more then drove down to the campground. I was tired and hungry and there were chores to do. – rsh

The Inuvik Run — Departing Inuvik

August 2nd

(The following is from my trip–log notebook.)

“1224, Friday 2 Aug ’96, 91,342 miles – 263.0 hours. Trying to depart Inuvik. Just finished with Jorge’s front wheel bearing. Unable to dismount Eddie’s wheel with my 3/4" breaker bar & 60" cheater but managed to bend both, indicating his wheel is torqued to more than 1200 ft/lbs. Waiting to help Sue with her air filter. I am blocked in. I can not leave until their maintenance is done.”

(The next entry reads:)

“1632, 2–8–96, 91427, 265.6. 85 miles made good in 2.6 engine hours. Waiting for the ferry. Delayed by an ‘interview’. Got underway about 1400.”

(After–trip comments:)

Getting underway from Inuvik proved especially difficult. After helping with the repairs to several vehicles I followed the crowd downtown to the church and sat in the bus reading. Enjoyed a nice chat with an old Indian man who told me one of his friends inherited a bus like mine (‘…with the divided windscreen’) but it failed to survive the first winter due to a frozen battery. He said it was still there in the woods behind his friend’s house. The Indian called it a ‘windscreen’, not a ‘windshield’. I wonder if this is the common Canadian usage?

After waiting for about an hour I wandered over to the grocery store for a belated breakfast of donuts and milk. Coming back from the grocery store I saw the trekkies huddled in a group, waving at me. I waved back. The huddle turned out to be the fabled interview and group photo. And they weren’t waving, they were gesturing for me to hurry. When I was about five feet from the group they faced front and the shutter clicked. After hours of delay they were suddenly in such a rush they couldn’t wait for Tail–end Charlie.

The sudden rush might of made sense except there were more delays to follow, people driving off to refuel or going to the drugstore or a last visit to the bathroom. I climbed back into the bus, drank a liter of milk, ate some donuts and read.

We eventually rolled out of town nose–to–tail for the benefit of the local newspaper photographer, snapping stills of as we puttered by. Once out of town someone discovered they were out of fuel and needed to return to the gas station. Eddie offered to bowser them from his jerry cans. The others drove on. I stopped to back–up Eddie. He had the only bus using my type of rim. Indeed, he was running on one of my spares. It made sense to stay near him and I could always hit the convoy with my more powerful radio should there be a problem.

On the south side of the Fort McPherson ferry crossing we came upon a pair of Volkswagen buses. We stopped and chatted. They were Vanagon list members from Ontario who were unable to match the tour's schedule. They had prepared attractive lapel buttons and gave one to each of us. Since I knew them from the list I made only a cryptic "B. pins. Temp dropping. W. wind freshening." After the trip I saw the note but for the life of me I could not put a name to the initial 'B.'

(The mysterious 'B' — Jack Batemann from Ontario — had made up the pins and driven five thousand miles to deliver them. And I had forgotten the name. I could not upload this part of the trip log without filling in the missing name. I delayed posting this entry for more than a week but was unable to fill in the blanks. I finally posted a public appeal to the Inuvik list and Jack was kind enough to jog my memory.)

During our stay in Inuvik the weather was delightful but as we headed south toward the Arctic Circle we encountered strong gusty winds. We could only watch as the southwestern horizon became ominously dark. We reached Eagle Plains about 2200, shortly before the gas station closed. The weather had closed down with remarkable speed and we were being pelted with showers of rain and rocked by strong winds. Having experienced muddy conditions on our way north I proposed continuing, hoping to reach the valley of the Peel River ahead of the rain. Sue Booth, the other solo driver in our group of four vans, was willing but dead tired and hungry.

During our last stop before Eagle Plains I piled some cans of food around the cargo bay heater outlet. When we got to Eagle Plains I had my choice of beef stew, ravioli or pork & beans, all piping hot. I shared the hot food with Sue who ate some stew and promptly fell asleep with her interior light on. I let her sleep about an hour then knocked on her window. She was dead to the world but it woke up her dog who barked her awake. Sue was still willing to push on so we headed south, down from Eagle Plains, hoping to reach the valley of the Peel River before roads turned to muck.

We didn't make it. The drive was a nightmare of mud and rain. In fact, our decision to push on was probably wrong. Those who stayed the night at Eagle Plains drove south the following day under clearing skies. The rain stopped in the night and by mid–morning the road was wet but not seriously muddy.

My real worry was snow. And ice. Since crossing the pass thru the Richardson Mountains the temperature had been dropping as the weather worsened. The Plains of the Eagle River is a plateau high enough to enjoy freezing temperatures even in August. I wanted to get down off the plateau. My goal was Engineer Creek Campground between the Ogilive and Blackstone Rivers, tributaries of the Peel, about a hundred miles south of Eagle Plains and fifteen hundred feet lower in elevation.

We reached the Provincial Park campground about thirteen hours after departing Inuvik. Eddie and the Freemans continued south toward Dawson but I'd played out my string, having been awake more than twenty hours.

I can't say very much about the campground at Engineer Creek. I can't even be sure that is it's name. But it will be forever fixed in my memory for the size and voraciousness of its mosquitos. As I prepared for bed they clustered on the outside of the glass. Several found their way inside through the overhead vent — which is unscreened — and feasted on me during our six hour stay in the park.

If sleep is fuel, Sue and I took on about a quarter of a tank before pushing on south toward Dawson and showers and mosquitos that could not penetrate three layers of clothing. As I drove, the mosquitos that discovered my unscreened vents eventually came within range of my hand. The inside of the windscreen was soon covered with bloody smears. On the road near the campground are yellow caution signs. They carried no verbal warning, only a picture of a large mosquito carrying away a man.

The Inuvik Run — Dawson Again

3 & 4 August

My log reads: "3 Aug '96, 91847, 279.2. Arrive Dawson" I was too busy or too tired to write more.

Shortly after leaving the Engineer Creek campground Sue had a flat. Caught in deep gravel, she ran on the sidewall before realizing she'd lost a tire. By the time she stopped, the tire was toast. Her tire tools were buried, a common error among the trekkies. My floor jack and tire tools were immediately to hand in the cargo bay and I set about changing her tire. I believe in sexual equality but I also believe in common sense; my changing the tire would save time.

On Sue Booth's diesel vanagon the spare tire is fastened in a fitted well behind the front bumper. (I think all Vanagons use the same arrangement.) When the van took its short flight off the road the landing did some minor damage to the spare tire retainer, a metal pan as large as the tire itself. I had to dig out some tools and bend things back into shape before I could unbolt the retainer.

Once the tire was changed and the damaged tire put in the retainer, I had to use the floor jack to raise the retainer high enough to engage the threads of the fastener. The task requires that you lay on your side in the roadway. From start to finish, it took about an hour to change the wheel.

Just after leaving the campground a Dodge van conversion about the size of a EuroVan but painted up like a Russian jetliner shot past heading north. They were clipping along at seventy — mph, not klicks — having a hell of a fine time. Mag wheels. Tinted windows. Spiffy paint job. California plates. They gave an airy wave and peppered us with gravel as they flew past.

As I was finishing with Sue's tire we saw the California van creeping toward us at a sensible 40mph. Their spiffy paint job was clotted with mud. They asked if we needed help. We didn't but they wanted to chat. They'd encountered one of the bad patches and had a blow–out at speed, eating both the tire and the fancy mag wheel. They were still a bit wired from the event, which was so exciting they decided they'd seen enough of the Dempster. Their heavily laden van was fitted with passenger–car tires. The tires were attractive, if you like that sort of thing. Bold raised letters read 'Grippers' or 'Grabbers', the meaningless horseshit used to sell things to Yuppies. But the fine print on the tires said they were only two–ply. From their profile they looked to be seriously overloaded or underinflated.

The Dempsters unique arrowhead–sharp shale gravel cost me another flat just north of North Fork Pass, my third. I didn't notice the puncture until we were well into the pass, up near the three thousand foot level. I pulled off near the rest stop at the top of the pass. The wind was strong enough to rock the bus. It wasn't snowing but the raindrops had little chunkies in the middle. Sue took advantage of the stop to take her dog for a run across the tundra. By the time I got the tire swapped I was chilled to the bone, my hands a mottled purple.

One of the modifications I made to the bus for the trip is a little shelf behind the front seat to hold the video monitor. On the second day of the trip I moved the monitor to a more secure location on the new shelves built over the passenger–seat area.

Cold, wet and muddy, after changing the tire I crept into the cockpit, started the engine and plugged in an immersion heater. I soon had a big cup of boiling water, into which I poured my last packet of instant cocoa. I stirred it carefully. I was running the engine about two thousand rpm but with the blustery wind and showers of cold rain the cockpit was pretty cold — I was lusting after that cocoa.

Sue Booth trotted up, hair soaked, cheeks, nose and ears crimson from the cold. She made an appealing gesture toward the back of the bus and I nodded. Her diesel is water cooled and has a better heater than my bus but the diesel had been sitting for half an hour whereas my engine was producing at least a little heat. She jumped in back, letting in a blast of cold air. She sat rubbing her hands, telling me how cold it was, stomping the mud off her boots.

As the last step in preparing The cup of cocoa that would save my life, I stirred in some condensed milk, sat the cup aside on the little shelf, used the freed space to dig out a bagel.

“Gee. Thanks!”

My 1965 Microbus is not a walk–thru. The little table is on the back of the front seat. Sue was hunkered on the folded up bunk, trying to get warm. The little table was right in front of her nose. When I sat down the steaming cup she thought I was offering it to her. She scooped it up and took a grateful swig.

My look must of given me away. Either that or my scream of rage. She stammered an apology and tried to give back the cup, licking a guilty rime of cocoa from her upper lip. I insisted I really meant for her to have it, that I much preferred coffee and was in the process of making some. But it didn’t ring true. The cup contained not only my last packet of cocoa, it held the last of my water. And the jar of instant coffee happened to be in the steel box I use for a larder, tucked under the edge of the bunk. Sue was sitting on it.

When a cup of steaming coffee failed to materialize Sue got the sequence worked out and despite trying not to, began to laugh. After a minute, so did I. Huddled with cold, smelling of damp dog, flat tire and wet wool, we passed the cup back and forth until the cocoa was gone. Oddly, it was one of the more pleasant moments of the trip. And one of the funniest.

The Dempster follows the north fork of the Klondike River south from the pass some forty miles to the intersection with the highway. The Klondike River campground where we would again be staying is about ten miles beyond. Dawson City another ten to the west. At the junction we stopped to use the restrooms (Hot water!). To atone for the cocoa, Sue bought me a cup of coffee and we talked about buses. She expressed surprise that my bus was so warm. Her propane regulator is broken so she has no stove in her Vanagon, the inside of which reaches ice–box temperatures shortly after shutting off the engine. I've insulated my bus, even plastering cow–pies of urethane foam to the ceiling. If there's no wind, two candles plus the heat of my body is sufficient to keep the interior temperature in the comfort zone.

At Dawson the big maintenance item for the bus was getting rid of the layers of mud. After repairing my latest flat I spent eight loonies on the pressure washer, blasting mud from the chassis and engine. I didn't bother doing the body until I noticed streaks of mud coming from the rain gutter. On closer inspection I saw my rain gutters were filled level with mud.

I used the Dawson layover to unload the bus, cleaning and repacking the contents for the run home. I hung my bedding out to air then scrubbed dead mosquitos from the inside of the windscreen and swept the interior.

I had changed my oil, done a lube job and adjusted my link pins at Inuvik, there wasn't any maintenance required at Dawson. But I crawled under and checked things out. Having the underside of the bus clean made it a snap to inspect the chassis, fuel tanks and running gear. The thirty–one year old bus showed little evidence of having traveled nearly a thousand miles off pavement. The front suspension needed lubrication, the dust having drawn gobs of lube from the joints, and there was considerable road– rash on the U–frame and rear bumper but overall the Dempster had done little too hurt the old bus. The taped headlights survived, as did the windscreen, save for a single chip, acquired when the Insane Family cut in front of me.

The lack of damage to the windscreen was not by luck alone. Whenever possible I came to a stop when being passed by any vehicle traveling faster than I considered wise. All vehicles threw up some gravel, and a lot of it was bound to hit the nose of the bus. To lessen the hazard, just as the vehicle passed I would make a sharp cut toward the shoulder, putting the windscreen at a very steep angle to any flying stones. Some rocks hit the glass — the sound is distinctive — but the angle and low velocity prevented them from doing any damage. The rocks thrown at me by the Insane Family hit the windscreen head–on and at considerable velocity.

I had three flats doing the Dempster. In preparing for the trip I guesstimated I would suffer one blow–out and three flats. Not having the money for new tires, I fitted the bus with good used truck tires. To deal with the expected flats I carried a plug– gun and 12v air compressor. I was lucky in not having any blowouts and in the nature of the flats, all simple punctures I was able to deal with myself. (Shortly after leaving home I'd picked up a nail so my overall score was four flats for the trip.)

Because I was running on used tires I carried three spares, one more than recommended. Having three spares allowed me to loan one to Eddie when he suffered a blowout. He made the trip, or at least most of it, on passenger–car tires and with only a single spare, which was in pretty sad shape. (He got some better rubber under him at Whitehorse on his way home.) Swapping spares among vehicles was pretty common during the trip but Eddie and I were the only vans using the old–style wheels.

Sue Booth's diesel Vanagon was fitted with fairly new tires of European spec. After suffering the blowout she was unable to find a matching tire and had to settle for a 195/70 as being the closest match. The tire, a Michelin, set her back $150 Canuck, about what I paid for all seven of my used LT–195/75's.

After doing the Dempster the plan was to lay–over in Dawson for a day. The group would split here, some taking the Top of the World Highway into Alaska, returning to Whitehorse down the Alcan. Sissies like me would retrace our steps down the Klondike Highway. Most of the people heading for Alaska stayed across the river in Dawson, everyone else staying at the Klondike River campground where we'd stayed before.

The shared experience of the Dempster wrought a significant change in our little group. During this second stay in Dawson there was a feeling of greater camaraderie as we congregated around a single campfire. We prepared communal meals and sang silly songs, making an effort to teach Jorge & Yvette the old Kingston Trio ballad about getting Charlie off the MTA, first having to explain what MTA meant, Puerto Rico having no subways. It was a good time. Even the weather cooperated, turning colder, reducing the mosquito population.

–Bob

The Inuvik Run — Second Whitehorse

5 & 6 August

0810 5 Aug 1996 — Departed Dawson for Whitehorse. Grocery stop at Partridge Farm. Overcast and cool. Spent the time sketching.

Encountered light rain near Pelly Crossing. The rain stayed with us all the way into Whitehorse, heavy at times as we motored along the marge of Lake Laberge.

Camped at Wolf Creek Campground, prepared for another two–day stay as we wait for the group that took the Top of the World Highway into Alaska from Dawson.

The group will splinter here, some heading for Skagway to catch the ferry home. Sue Booth is bound for Fairbanks. Alaskan Dave split after a day in Inuvik. Dennis will probably stay in Alaska, not coming back with the group. I've no idea what happened to Seattle Eddy. Made camp in a light rain.

In a neat quid pro quo I try to find a replacement for Sue Booth's propane regulator while she adds my duds to hers at the local laundromat. She returns my clean clothes all neatly folded but I've been unable to find a replacement regulator; she will head for Alaska without a stove or means of heating her camper. To repay her laundress duties I install a reading light over her bunk.

The group continues the custom of taking supper together. My contrabuition was:

Beans la Boom

Makes enough for two hungry people or four sissies.

1 pound seasoned beef sausage 1 large white onion 1 clove garlic 1 package Lipton's dried French Onion Soup mix 1 medium can of pork & beans 1 medium can of refried beans 1 cup spicy barbacue sauce about half a cup of tart brown mustard Ground black pepper Couple of glugs of cheap plonk

Slice up the sausage and start it browning in your skillet. Keep stirring.

Dump the pork & beans into your coffee can* and start heating them up. When hot, add the Lipton French Onion Soup mix. Keep stirring. Slosh in some wine if it looks too dry. When the soup mix is absorbed by the beans, open the can of refried beans and add them to the pork & beans. Keep stirring. Slosh in a little wine.

When the sausage is browned (not too dry), dump it into a pie pan. Slice up the onion and start it browning in the skillet. There should be a little grease from the sausage. Peel & smash the clove of garlic and throw it in with the onions. Add a little black pepper. Keep stirring. When the onions are browned throw in a little wine and add the barbacue sauce and the mustard. Keep stirring. Mebbe you should add a little more wine. Fold the sausage back into the skillet with the browned onions and sauce. Keep stirring. When everything is hot and all the gunk is scraped off the skillet, pour the mess into the coffee can with the beans.

Be careful not to add any salt. The sausage, beans and dried soup mix already have too much salt in them. Add more wine as needed.

*Note on camp cooking: I have two skillets, a big one and a little one, plus a pair of pie pans. The skillets are my only permanent cookware. The pie pans serve as lids and plates and anything else a pie pan is suitable for. All of my pots are tin cans. The big pot is a three–pound coffee can. I have about a dozen cans in six sizes, from the big coffee can down to a Vienna sausage can. I use the cans for a trip or two then throw them away, replacing them as needed. If you pick the right sizes they will nest together.

To bake on your Coleman stove, select a baking pan a little smaller than the surface of the stove. Light the burners and put the baking pan atop a pair of small cans to hold it above the burners. Put two layers of aluminum foil under the baking pan to act as a heat shield and diffuser. Then build an enclosure over the baking pan using aluminum foil fastened to the back & sides of the Coleman stove. Leave a vent at the top rear. Use two or three layers of foil for the enclosure (the heavy stuff works best). If the enclosure feels like it's losing too much heat, add another layer.

The secret here is having a baking pan that's just the right size, one that allows about an inch of space on all sides. Too big a pan, the bottom gets too hot.

A pan of bisquits takes about 20 minutes with both burners on low. Fancy stuff, like cakes or muffins takes a little longer. Bread takes about 40 minutes. For roasts, beans and other things that need to be cooked slowly at low heat it's best to use a Dutch oven and coals from the campfire.

Camp notes:

It rained off & on during our two–day stay at Wolf Creek but the group had enough tarps to keep themselves dry. The communal meals were happy affairs, especially when we dug into the pies and fresh roasting ears from Partridge Farm.

The Beans la Boom lived up to their name.

I use a plastic oil drain pan as my dishpan. It is also my bath tub. I have a large (LARGE!) stainless steel bowl for rinsing the dishes or taking a serious bath. I contribute both to the communal dishwashing, failing to mention their other uses.

Bob Heintz has an enameled coffee pot the size of demijon. Each morning it attracts a circle of zombie–like caffine addicts standing like supplicants, cup in hand.

I am one of the few smokers in the group. I've brought four pipes with me, generally have one smoldering. If awake and puffing, I seem to be bothered less by mosquitos than the non–smokers..

–Bob

The Inuvik Run — Boya Lake

Wednesday 7 August 1996

0920 — Depart Wolf Creek Campground for Boya Lake. 1610 — Arrived Boya Lake. 313 miles in 6 hours 50 minutes. None of the others are here.

I've no idea where the others have gone. Passed Tobin & Gary at a rest stop. Bought fuel at the junction of the Cassiar & Alcan. While standing in line to pay for my gas a woman tugged on my sleeve, asked if I owned 'that old Volkswagen'. When I admitted my guilt she said 'Would you mind moving it? We want to buy gas.' At the time she asked the question the girl behind the counter had my credit card and was doing the paper work. I told the woman — obviously an American — I'd be right with her.

No, I mean would you move it RIGHT NOW.'

The place was crowded. There were several people in line behind me, all waiting patiently to pay for their fuel. Their vehicles were parked at the pumps they had used. People waiting to refuel were sitting in their vehicles.

I said I'd be just a moment. But that wasn't good enough for the American Lady. She started tugging at my sleeve again. I wheeled around and gave her the verbal equivalent of a twenty–one gun salute that blasted her to shocked attention and right out the door, where she scurried to rejoin her jowly middle–aged husband in the cab of their GMC pickup towing a forty–foot fifth wheel.

After my outburst the place was dead silent, everyone intently examining post cards, bags of Cheetos and the like. The girl behind the counter handed me my credit card and gave me the bill to sign. She smiled at me. "I guess she expected me to run along side while you signed this."

I found it necessary to check my oil again. And re–do the windows. Then check the air pressure. I'm old. I move slow. It was half an hour before I was done. The jowly driver of the fifth wheeler sat jazzing his engine the whole time, his brow–beaten wife sitting as far from him as the cab allowed. I felt ashamed for abusing her but it was obvious she was used to it. I've a hunch she hadn't sought me out on her own volution.

Boya Lake is the cleanest campground I've encountered on the trip. The scenery is magnificent, the weather threatening rain but the sky is clear to the east. I set up camp and begin splitting firewood. Over the next few hours the remaining Inuvikerrs straggled in.

Tobin is having electrical problems. Jack has loaned him his spare alternator but the problem — failure to charge — persists. If the problem is in the wiring there's the possibility he's fried the replacement alternator as well. I offer my multi–meter. He shakes his head.

Jorge & Yvette, Jack, and Eddie gravitate to my fire. We discuss the next days run. The itinerary calls for them to travel to Telegraph Creek, a ghost town on the end of an unpaved road. I've had enough gravel roads and opt to continue south alone. We talk about a mythical 'next' run. Baja is mentioned, probably by me.

Krista comes by. She wants Jack to lend her his voltage regulator. He gives me a startled look, which I mirror. He does not have a spare. She persists. We are a bit shocked by her insistance. Jack has already given up his spare alternator. Until the Mango's electrical problem is properly diagnosed, bolting on Jack's one and only regulator could leave both vehicles disabled.

There are enough auxiliary batteries among the group to keep Tobin's bus running forever, recharging them in the other vehicles — assuming we run in convoy.

Tobin comes by to find out why Jack won't give up his regulator. First Jack and then I explain the potential for damaging the unit. I get the feeling Tobin doesn't appreciate the risks. He asks several questions about the function of an alternator and the purpose of the voltage regulator but shows no interest in the battery idea. Later, I drop by for a private word with him but he seems preoccupied. I have a voltage regulator among my spares that might work with his alternator by winding a ballast resister out of bailing wire but he doesn't seem to want my help. It is getting dark. I have two trouble lights that would make the work easier but he says he doesn't need them. I leave him to it.

My bedtime rolls around and I pointedly bid the others good night, offering to help transfer the campfire to another fire pit. They think I'm joking and continue to sit around my campfire burning my firewood and keeping me awake. I go down to the lake, fill my five gallon bucket with water and douse the fire with a volcanic eruption of smoke, soot and cinders. They get the idea.

– Bob

The Inuvik Run — Stewart, BC

0842 Thursday 8 August 1996 — Depart Boya Lake traveling south on my own. (Log entry)

I awoke early, fixed a nice breakfast, broke camp, loaded, cleaned up the campsite. I was ready to roll by 0730. Waited for the others to wake up. Snores. Filled out a comment card for the campground, thanking whoever was responsible for the well raked campsites and generous supply of firewood. Pulled out on my own at about a quarter to nine, heading south.

(Log entry) 1800 — Arrived at Stewart, British Columbia. 343 miles made good.

I had been looking forward to the run down the Cassier, which passes through gold country. I'd planned to stop at several points but conditions made that impossible. The Cassiar Highway is unpaved for about half its length. Weather during the run was rainy and cold. On the unpaved portions the mud was a hazard, reducing my speed to about twenty miles per hour. Had I known the road was so bad I would of stayed on the Alcan through Fort Nelson and Prince George.

Like the Alcan, the Cassiar came into being during World War II, providing an alternate land–route around the Alaskan panhandle. But it remains only partially paved. The paving is found near the towns. Road conditions varied from excellent to very bad. On the paved parts I was able to maintain my normal 50–55mph but in the mud I was lucky to do thirty. The road climbs up onto the Stikine Plateau and crosses the Skeena Mountains. The Coast Range is to the west, the peaks capped with glaciers and permanent snow fields. Between the veils of rain the scenery was spectacular but could not be enjoyed when slithering through the gumbo of mud or truddling across the narrow Bailey bridges.

The goal for the day was Stewart, British Columbia, adjacent to Hyder, Alaska and the bear–watching post near the Salmon glacier. On arrival in Stewart I scouted the recommended campsite, one of the free sites maintained by the forest service. It was a pit, made worse by the heavy rain. Took a swing thru town. There were a couple of RV parks in town, one very nice the other… not so nice. I went back to the turn–out near the forest service campground, parked in view of the road, made some hot coffee and settled down with a book. After a time the rain let up. A little later Eddie and Jack steamed into view. They had no news of the others but thought Jorge and Yvette were behind them. They checked out the campsite, shuddered, and followed me into town to refuel.

At the gas station Eddie learned there is no border control at Hyder. Indeed, no controls of any kind. Hyder, Alaska is really just a part of Canada. It uses Canadian money, Canadian telephones and Canadian schools. Eddie began telling the cashier about his difficulties crossing into Canada and his fears of being hassled if he went into Alaska and tried to come back. As he added details the girl's eyes became round. You could almost see her hair stand on end. She was a lot less friendly when he finished.

We convoyed into Alaska just to be able to say we'd been there. After a dinner of fish and chips Eddie and his dad headed up toward Salmon glacier to see the bears while Jack and I drove back into Stewart, hoping to flag down Jorge on the road. The RCMP was waiting for us, as was Jorge, motoring toward Hyder as we headed toward Stewart. The Mounties followed us back into town, oozing past as we stopped at the Tourist Information Center. The Center was closed, the parking lot placarded with dire warnings not to camp there. There were picnic tables and a nice lawn but there was also the Mounties in their little Bronco, motoring past with stern looks.

I volunteered to wait for Eddie & his dad while Jorge and Jack scouted out the camping possibilities. I was reading Chaucer with one eye, the other tracking the RCMP Bronco. After passing me for the third or fourth time the Bronco made a neat U–turn and vanished up a side street… only to reappear, an inch at a time… from between two buildings! Seeing the nose of the Bronco creeeep into view was one of the funniest things I've ever seen in my life. Deputy Dawg was staking me out, waiting to pounce the instant I began smoking dope, sticking needles in my arm and accosting the local virgins.

Eddie & his dad reappeared as it was getting dark. The RCMP pulled out of the alley to Show the Flag while we chatted on the CB. Jack and Jorge returned, convinced the forestry service camp was a bad idea. We convoyed over to the first of the RV parks to check on accomodations. They made it clear we weren't welcome. We tried the other park. Before I could state our business — indeed, before I even reached the office, an old man came running out shouting "You're too late!"

“Too late for what, sir?” (I really did say ‘sir.’ I’m especially polite to assholes.)

That caught him unprepared and he began to stammer. We were too late to find a space. The camp was full. (There were several vacant spaces in view.) And too late for tomorrow, too, as a big, big convoy of RV’ers was due. And other stuff, that he would explain as soon as he could think of it. His hands were shaking, his eyes full of fear. In the office behind him a woman was on the phone, her body bent forward in a tense curve, speaking rapidly.

The old man was still shoveling Canadian bullshit down our throats when I turned to the others and suggested we get the hell out of Dodge.

There was only one campsite at the forest service camp. We packed all four vans into the available space, Jack behind me on one side of the table, Jorge & Yvette on the other, Eddie & his dad closing the laager by parking across our sterns. The tired clouds wept dreary rain. Dry is an alien term in this part of British Columbia. Ditto for warm.

By rigging tarps between the vehicles we made a protected area over the table where we cooked a scratch meal.

A couple of vehicles — including the ubiquitous Mounty Bronco — found it necessary to visit the forest service camp during the evening. But none had the balls to approach nearer than a hundred feet. Instead, the local hoodlums parked on the turn–out across the lake and showed us how loud they could play their radios.

Yvette thought it was hilarious that four Volkswagen vans could so terrorize a community. She kept playing out the old man dashing onto the porch shouting “You’re too late!” Her infectious laughter soon had the others smiling and the evening seemed less dismal. I’m not as forgiving as Yvette. There is a sickness of spirit in Stewart, British Columbia.

–Bob

The Inuvik Run — The Lake Region

9 August

(Log entry) At Chubb Lake. 496 miles in 10.1 hours. Tired. Mosquitos pretty bad.

The dismal campsite at Stewart was the last time I would see Jack and Jorge & Yvette. Their itinerary called for them to travel to Prince Rupert and take the ferry from there to Vancouver Island. Eddie & his dad and I would take the poor people's route overland to Prince George, retracing our route south to Clinton then following BC1 to Hope.

I had planned to restock my larder at Stewart and do some maintenance, possibly laying over a day to visit the glacier and take pictures of the bears. The red–neck nature of the town ruled that out and we broke camp early.

We ran out of the rain shortly before reaching the junction of the Cassiar and Highway 16, which would take us east across the Lake Region of British Columbia to Prince George and the Cariboo (sic) Highway.

Near Vanderhoof we pulled into a rest area so I could do an oil change and take care of minor maintenance. The weather was good, road conditions were excellent and we had been making good time. We stopped again at Prince George, refueling and calling home. It was a mild Friday evening. From Prince George we continued south on the Cariboo to Strathnaver where we turned off the highway in search of another free camp site, this one at Chubb Lake. We found the lake then the camp and were grateful. The 496 miles from Stewart was the longest one–day run of the trip.

– Bob

The Inuvik Run — Hope then Home

10 thru 16 August

(Log entry) 1937, 10 Aug 96 — At Hope, BC. 368 miles in 7.6 hours. Camping in town. Fierce winds.

Leaving Chubb Lake I tried to follow one of my famous short–cuts, having misread the forest service map. Given a week or two we probably would of arrived in Quesnel. After too many miles of dirt road Bob Heintz took over the navigation and got us back on pavement. From there we had an uneventful run down the Fraser River canyon, which I'd ascended twenty days ago heading north.

Hope is an interesting little town, someplace I'd like to revisit. We camped right in town in a park–like setting on the shore of the river, just across the street from an ice cream shop and just down from a mini–market. The camp site was nothing special but the people were nice and the water was hot in the showers.

The next day Eddie and his dad ran into Vancouver to collect gear they'd stowed at Tobin's place. We met at the border and crossed together. There were no hassles coming home.

Just north of Seattle I began to experience problems with my tranny and made a precautionary stop, waving Eddie and his dad on. We said our farewells via CB.

The tranny problem proved to be a failing throw–out bearing. I stayed with friends in the Seattle area while I pulled the engine and replaced the noisy bearing then buckled down and made the 1,365 mile run home in two days, clipping off 725 miles the first day, 640 the second. The old bus will roll if you let it.

It took me four hours to cross the LA basin making my final days run two hours longer than the day before even though I traveled a shorter distance. Once clear of the LA traffic I called my wife on the cell phone to warn her of my arrival. I growled up the drive at a quarter past eight. June had the outside lights on and helped me carry in my duffle. I gave her the little jadeite carving I'd picked up in Whitehorse, a tiny owl. She likes owls.

She condemned my clothes to the laundry as I sorted through a bale of mail. "So how was it?" she asked.

I had to think about it. I'd taken pictures and made some sketches and met some people and worked hard to keep my thirty year old machine running. The photos would give her a literal answer but that wasn't what she was asking. I'd set out on the 17th of July. It was now the 16th of August. I'd driven solo 7,938 miles to the top of the world and home again. How was it?

"Kind of long," I smiled. "Interesting but… long."

– Bob

The KC Run

Prologue

Sun, 16 Jun 1996

Greenbuss sits stunned, spraddle–legged by a ton of cargo. Three hundred pounds of gasoline distend her belly, a firebomb worthy of the Slaughter House Five. In the cargo bay are twenty pounds of oil, pressure flasks of oxygen, acetylene and propane. I light my pipe, fire–up the engine and sit puffing while the 1600cc powerplant warms its hands over the internal fire. When the little engine sez its ready we go acreeping up the back drive, do a reverse–turn and head for my test track, a stretch of city streets, county roads and a high–speed strip of I–15.

High speed is a joke in Greenbuss with her heavy load. Her big engine is on the bench in the shop, victim of heaven knows what – – possibly nothing at all save hypercaution on my part. The big engine handled the load with disarming ease, accelerating up grades I now struggle to stay above thirty and fail. But on the flat she rolls just fine. I let her roll while I listen to the wheel bearings.

With the big engine punting Greenbuss with effortless ease I'd planned to reach Kansas City via Colorado, to park at the crest of Independence Pass along the way and snap a picture of the green bus and me to hang beside the one of us at Bad Water.

Independence Pass is 12,095 feet above sea level, Bad Water 282 feet below.

When it comes to engines I prefer to leave nothing to chance. The object is to arrive in Kansas City in a timely fashion, not do another Grendel. A few days ago the big engine developed a sound I could not identify. And I'm already two weeks late on the Kansas City run. With no time to play mechanic, I yanked the big engine and plugged in a trusty stocker. The change will add a day to the run but with today's astronomical price of gas the savings in fuel will offset the cost of an added night on the road. The change also ruled out climbing twelve thousand foot mountains while sitting down.

As I struggle up the moderate grade by Lawrence Welk's place the little engine tells me that with a ton of cargo onboard I will have to emulate the Joads and take the low road, dust–bowl bound.

Backtracking the Okie Trail to Kansas City is a neat trick since Route 66 or its modern–day analog, does not go through Kansas City. But if you hang a Louie at Okie City and pick up the Kansas Turnpike at Wichita, Kansas City will be just over the Topeka–event horizon. It‘s not as elegant as climbing Independence Pass but it will get me there, assuming nothing goes bump in the night.

I‘m testing my front wheel bearings. I‘ve been testing things for two weeks and have run out of meaningful things to worry about. Each time I increased the load I‘d fly Greenbuss over my test track, getting rid of rattles and checking her performance which degraded steadily as the load grew past three quarters of a ton. Now that I‘ve hit the one–ton mark I‘m down to worrying about things that don‘t care, unable to find fault because there is none. With the little engine Greenbuss is slow but stone reliable. And I won‘t need to stop for fuel this side of the Kansas line.

That isn‘t to say life is without interest. There is a funny little click when I turn the steering wheel a certain way. The link arm between the steering box and the tie–rod lever is bent. I don‘t have a replacement and knowing the cause of the click — the ball of the tie–rod end is over–riding the groove it‘s worn in the socket — I ignore it. Or try to. There is also the heady scent of gasoline in the air. I have 45 gallons of fuel onboard, the three tanks relieved by five vent–lines. The smell is less at speed, more when I struggle up a grade. It too I ignore. Except when I light my pipe.

The wheel bearings are fine, as I knew they were. I‘ve greased them and adjusted them and checked the toe–in and adjusted the brakes — I‘m fresh out of excuses. I cut the run short. It‘s past midnight and I‘m tired.

Tomorrow I‘ll fill my thermos, throw some clothes in a bag and head for Kansas City. I don‘t know the exact distance. I think it‘s about sixteen hundred miles from San Diego. I‘ll know once I get there.

–Bob

The KC Run – Day One

I planned an early departure but a balky clothes dryer held me captive while it huffed and puffed and blew the clothes dry. In the meantime the cool morning fog seeped into the trees leaving behind a scent of early California morning with a hint of heat to come.

I left the house at 10:30, the bus loggy and slow with its load of fuel and engines and tools and bagles. I piloted her gently down the north–bound on–ramp of I–15 at 10:50 and set out for Kansas City.

Approaching Murrieta I encountered the I–215 by–pass and took it. This was not my planned route. I hadn't thought of using the 215 until I saw the sign. It's a few miles shorter than riding I–15 thru Corona. I suppose I was trying to make up the time lost. And the bus was s–l–o–w. A few miles from the house I had to use 3rd to get over the crest of the Rainbow grade and more time was lost at the illegal–alien check–point, where the SS peered in my windows wondering why a bus with no passengers should be so heavily laden. The guy's eyes riveted on a box of .38 caliber ammunition that happened to be in plain view and it was several minutes before I could convince the young man to go back to annoying tourists and let me get on to Kansas City.

An hour north of the house, although barely forty miles on my way, the left rear tire blew with an explosive Pop! throwing the bus toward the shoulder. There was a kerb–like berm just there and we hit it with enough force to snap the steering wheel out of my hands as the old bus caught a little air.

The new saddle tanks with their 30 gallons of gasoline reduce my mid–frame ground clearance to less than nine inches. When I went airborne I thought the trip was over, that the next sound I heard would be the sizzle of barbecue sauce being applied to my ass. But the old bus flew over the berm, the fuel tanks untouched. We landed in the grass and ground to a stop amidst a cloud of dust, my wrists tingling, hands numb. I jumped out and inspected the tanks but they were undamaged. Not so the steering but I wouldn't discover that for a couple of days.

The tire should not have blown. Although the bus is heavily laden, it's weight is within the load–range of the tires. But they are passenger–car tires, house–branded crap ('Reliant') from Discount Tire Company, a chain–store outfit here in Southern California.

I dug out the jack and changed the tire. Having blown one I took the trouble to inspect the others and found a bulge in the flank of the other rear wheel. Crap. Unreliant. Are you listening, Discount Tire Company?

I was just past Sun City, a place old people come to die. I suppose they sell tires there but it was high noon on a hot Sunday in June and Sun City was closed. My spare was an old truck tire, my other spare a P185, thrown in for insurance. With hundreds of miles of desert to cross, the trip would have to be pushed back another day.

The next town up the pike was Perris. I swung across the highway there, planning to come home. But just as you come off the freeway you can see 'Henry's Tire Shop', a used tired joint. I pulled in and was immediately surrounded by neatly uniformed attendents. Starched white shirts. At a tire shop? A USED tire shop?

Enrique had a pair of light truck tires with some tread still showing. He skinned them onto my rims, tossed the Discount Tires tires into the trash, including the unblown, one with a causul 'Eees no good.' Eighteen minutes and thirty–two bucks later I'm back on I–215, heading for Kansas City.

Wheeled past Norton Air Force Base, home of many a tall tail and an interesting museum containing some of the planes I've flown. And some I've shot down. I was making good time. I tried to convert 60 miles per hour, standard atmosphere and temperature, into Mach number but the highway dumped me into the mixmaster of the five–level interchange at Colton before I could work it out.

The used tires gave the bus a better feel, although the steering seemed a bit light. All the way up Cajon Summit I wondered what it was that made me take 215 instead of going straight–on thru Corona, which has no Enriques in starched white shirts working hard on a Sunday in pursuit of the American Dream.

The high desert was burning, a plume of dirty grey smoke blowing down the wind. It was over a hundred degrees in Victorville but cooler when I ran under the moil of smoke. The bus was running sweetly, averaging better than fifty miles per hour. Every few minutes I transferred a little fuel from the saddle tanks to the main, the transfer accomplished by leaning forward and thumbing a round black button, turning on an electric fuel pump capable of delivering thirty gallons per hour. I would come to hate that button but it seemed like a good idea at the time. It is installed just below a square red button that activates the windshield washer, a device of doubtful worth since I have no windshield wipers, they having gone astray with an undelivered order from J.C.Whitney.

The deeper into the desert I drove, the hotter it became. One hundred and eight at Barstow where I peeled away from Las Vegas– bound I–15 to pick up I–40, celebrated with a mileage marker telling me it was only 2,554 miles to someplace on the east coast where I–40 rolled into the Atlantic. I was more interested in the steadily rising temperature. It was one–ten at Daggett and a withering one–fourteen by the time I reached Newberry Springs.

I was wearing my desert towel which happens to be a real towel although any handy rag will do. You keep it soaked with water and use it to wipe your face and neck. Heading east, the sun was on the passenger–side of the bus and I was reasonably comfortable, wearing boots and khakis. Stripping down to keep cool during hot weather is something of a myth. Your bare skin is liable to absorb more heat.

The bus didn't notice the heat. Climbing the Cajon grade the oil temp rose to 220 and I'd turned on the blower mounted on the auxiliary oil cooler, knocking the temperature down to 180. The fan was still on, the oil temp about 200 in the 114 degree heat. Oil pressure was firmly pegged at 50 psi, engine steady at 3,500 rpm, speed about 55 mph. Things were going good.

Beyond Newberry I encountered a type of sign fairly common in the western United States but virtually unknown to easterners. “NEXT SERVICES 108 MILES.” At that point the mileage and the temperature were almost exactly the same.

Halfway across the blank area on the map I crested a small rise and saw a brown 1982 Volkswagen bus on the shoulder with the deck–lid up and someone working on the engine. When I pulled over and stopped the owner looked surprised, either at my stopping or at another VW bus — his was the first I‘d seen all day.

The fellow‘s name was Rich Fuller and he‘d fried his engine and was in the process of frying himself, although he didn‘t know it. No air–seals on his plugs or oil pressure switch and several holes allowing heated air from under the vehicle to be forced into the engine compartment. The oil was black and burnt. The engine had gotten so hot some plastic parts in the engine compartment were melted.

It was about 3:00 P.M. Because of the tire and the dryer and going slow in the heat I had only made good about 200 miles and was counting on the long desert run to build back my average. But Rich is a nomad, the Westy is his home. He could not abandon it and even if he did, there was no help nearer than fifty miles no matter which way he headed. No one else had stopped and he‘d been there quite a while.

His engine would still turn over so there was a chance he hadn‘t wiped the bearings, meaning we could probably get her running. But she wouldn‘t last long without air seals. I began sitting up camp on the side of the road.

Rich seemed surprised when I sat him down, made him drink some orange juice then began pouring water into him. He was working without a shirt and the temperature was above a hundred and ten. He hadn‘t eaten in quite a while and while he didn‘t realize it, he was seriously dehydrated and surprised himself by downing nearly a quart of water before he felt full. In the desert, the best place to carry water is in your belly.

Rich and I worked on his Volkswagen for about about four hours, fabricating seals and replacing his burned oil. He was running 10W–40, not recommended for high–speed desert driving with an air–cooled engine. I dosed him up with thirty weight, using half my hoard.

Despite our efforts the engine would not run. It had spark and air and fuel, and it seemed to be trying to fire, but it wouldn't catch. The problem appeared valve–related. I suspected burnt valves but Rich thought it might be a rocker–arm stud problem unique to that engine, which he'd overhauled himself and fairly recently too. Then again, it was a fuel injected engine and I don't know beans about FI systems. We muddled and tested and tried everything we could think of, which was mostly cold beer for me and Slurpies for Rich. You get like that after a while in the desert. In the end, we lost our daylight and were left with only one option.

I use a main sheet for a tow cable. To non–sailors that's a big braided nylon rope. I lashed a bridle around my bumper, hooked it to the Westy and took the fifty–two hundred pound vehicle under tow. It was about 8:00 P.M., the temperature mebbe a hundred, probably more. We were pointing east and for that reason alone continued in that direction. Needles was about sixty miles away, on the other side of the 2,770 foot summit of South Pass.

A stock–engined 1965 VW Microbus bus was never meant to tow a five thousand pound Westy. On the other hand, anything can tow anything else if you can get it moving, the only problems are how fast you can go and how long before your engine explodes.

Once we got our signals straightend out — brake off AND out of gear — the Greenbuss took up the slack and we went creeping up the grade. In the heat.

Rich had the tougher job and did it superbly. Rich was my brakes. Using a Westy as the brakes kinda redesigned my bumper and didn't do my steering any good but it got us down the grades and some of them were steep. If Rich gets access to the net perhaps he can provide more insight into what it means to be towed by an old bus. For me, it was just plain hard work. The five thousand pound trailer pretty much went wherever it wished, leaving me to crank the steering wheel in despiration. Each time Rich trod the brakes the lurching jerk snapped the wheel to straight–ahead–centered no matter where it was pointing the instant before. It also shifted my load in several unusual directions. But we were leaving the desert and the friendless highway behind. All else was detail.

We came down the grade into Needles about midnight, some thirteen hours after leaving home. The temperature was 100 degrees. It felt cool. The sixty mile tow was no fun–run but Rich and his home were safely out of the desert.

The engine–hour meter in Greenbuss said I used the engine 7.6 hours since pulling onto the freeway that morning. In that time I made good only 277 of the more than 1,500 miles of my journey to Kansas City, my average speed a blistering 36 miles per hour. Despite the slow speed I'd burned nearly thirty gallons of fuel, running the engine at 3,500 rpm in 2nd and 3rd for the duration of the tow. The tow left my clutch feeling sorta slippy and my steering loose as a goose from all the jerking around.

I decided I'd better tell Bob Polys his engine would arrive a day later than planned. Or mebbe a week. A week would be good. I jacked into a motel phone and discovered my laptop had eaten the hard drive. I called home and brought them up to date and my wife sent Bob Polys a message putting him in the know.

–Bob

The KC Run, Getting There

Day Two saw me heading out of Needles just before dawn after a sketchy five hour nap. I had about fifteen gallons of fuel and wanted to get into the rimrock country before the heat of the day. About noon I stopped for fuel. That morning the engine oil had been down a pint and there was some indications of a leak from the tranny. The oil was okay at noon but the tranny left three fat drops of oil during the time it took to refuel.

Refueling meant more coffee. I still had a couple of bagles and lots of dried fruit. I munched and sipped my way across Arizona and most of New Mexico before calling it a night, pulling into a motel in Moriarity about twelve hours and six hundred miles after leaving Needles.

On the third day I came down from the mountains into the hill country of west Texas, the start of the American steppes. I'd only gotten about four hours sleep when I was awakened by a disturbance in the room next to mine. I packed up and hit the road. It was about 4:00 A.M.

I had a nice tail wind and the road conditions were good, giving me reason to hope I would end the day in Kansas City, about nine hundred miles away. I got coffee in Santa Rosa, waiting for it to perk, the restaurant having just opened. Back on the highway I broke my fast with a bagle, coffee, my last banana and a handful of dried apricots.

Oklahoma was delightfully green and I was making good time. But fate in the form of friendly advice from the truckers took a hand. To avoid Oklahoma City I was advised to take Highway 82 north to Enid and cut over to the interstate from there. Unfortunately, access to highway 82 thru El Reno was under construction and I spent a couple of hours creeping through one small town after another.

Back on the interstate and approaching the Kansas line I learned the Kansas Turnpike is a toll road. Again, truckers offered a variety of comments including a guided tour around the toll road that would get me to Kansas City just as quickly. But no one mentioned the tornados. Or the thunderstorms.

Deep in the hinterlands of Kansas, somewhere south and west of Wichita, we ran into a furious thunderstorm. It was just past sundown and suddenly the trucks I‘d been following were pulling off the road. A tornado warning had been issued and their insurance would not cover any damage if a tornado caught them rolling after a warning had been issued. I sopped my windscreen with Rain–X, installed my lone wiper blade and pushed on.

There was some flooding due to the rain and I was forced to backtrack, always working north and east. I eventually crossed the line of the toll road and took it, pulling off at the next town of any size — Emporia — and calling it a day, some 810 miles and nearly twenty hours on the road.

I checked in to the first motel I saw only to discover it had neither hot water, linens nor towels. It was run by a Hindoo gentleman who insisted I should be patient, that the water would get hot in time, that bedding was being found at that very instant and the towels and wash clothes would be there by the time the water was hot.

I did not lose my temper. Nor did I cock my .45. But it took both anger and visible proof of my willingness to commit mayhem to get my money back. The next motel down the street had linen, bedding, towels and even hot water.

The next morning I ate my last bagle as I cruzed north on I–35. It isn‘t a toll road but then it was only one–lane wide in many sections, thanks to construction work. I motored past Kansas City on I–435, took the Edwardsville off–ramp and was at the Polys house by noon, where I began the task of unloading a ton of cargo and a very nice little engine for the Spyder 550 replicar Bob Polys is building.

The outward–bound part of the KC run covered 1,738 miles, some of it back–tracking around the storm. Coming home would be easier.

–Bob

Kansas Interlude

The reason for personally delivering the Polys engine is a layer cake of complexities some of which won‘t make a lot of sense. So I won‘t bore you with them. But the two main reasons had to do with proper engine cooling, and fabrication of a suitable exhaust system. Both tasks required locking me, the engine and the Spyder chassis in a room for a number of days and we decided it would be easier for me to come to Kansas City than to ship the Spyder to California. I spent twelve enjoyable days as the guest of the Polys family while Bob Polys and I worked on the modifications needed to add practicality to functionality. Bob and his wife Deborah are both engineers and they know their stuff.

The Porsche Spyder 550 was never a cool running machine, nor was its push–rod 1500cc engine very powerful. Our intention was to insure the Polys Sypder would not only produce half again as much horsepower as the original but would do so in a cool, controlled manner.

During my stay we worked out the design details needed to provide better engine cooling without compromising the basic design. Had Professor Porsche lived a few years longer I've a hunch the cooling problems with the original Spyder would of been solved, possibly along the lines Bob Polys and I worked out although surely in a more elegant fashion. Our solution was based on fabricating a completely sealed engine compartment, and playing some aerodynamic tricks to insure proper flow of the exhausted cooling air. At the same time we tackled a host of small details not addressed by the fellow who sells the engine–less replicar, which in all other details sticks very close to the original.

One of the tasks was to build an engine stand that reflected the Spyder's mid–engine configuration, allowing us to work on the exhaust system out of the vehicle as we altered the manifolding so as to permit its convenient removal and installation, a detail overlooked by the kit–car's designer. The job called for a lot of welding but the results justified the effort. When we were done we had a light tube–steel engine stand that could hold the engine upright for test runs or inverted for use as a welding jig on the convoluted exhaust pipe plumbing. Bob Polys will probably hang a few pictures of his creation on his web page should anyone be interested. We also designed and fabricated a load leveler that allows the engine to be positioned properly for installation in the extremely cramped space.

Once the engine was installed in the chassis we were able to determine the optimum compartment arrangement, taking into account the spare tire location and certain environmental and practical–use factors not addressed by the kit–car's designer. To preserve the vehicle's power to weight ratio we used thin–wall chrome–moly tubing to fabricate the necessary struts and braces. Over the coming months Bob Polys will complete the project by doing the necessary composite work to marry the modifications to the fiberglas body.

The Polys Spyder will be slighter heavier than the original Spyder's 550 kilograms but will have a better power to weight ratio thanks to a more powerful engine. The Polys Spyder should also run much cooler than the original, cool enough to serve as a practical daily driver.

–Bob

The KC Run — Heading Home

I had two passengers in the bus when I rolled down the drive of the Polys' home heading for San Diego. Hanna Polys, 4, gifted me with a tiny figurine of a lamb. Her six year old sister Abbie gave me a little black and white puppy. Not a real one, a stuffed toy puppy with 'Babe' on a satin tag sewn to its bottom. The pair formed a tiny menagerie on my dashboard, the lamb taking in everything with wide–eyed curiousity while the puppy dozed, button–eyes closed.

Having enjoyed the benefits of trucker–derived travel advisories I chose to plan the homeward route myself, deciding to head west until I could pick up the Sante Fe railroad and follow it home, a plan that worked well for me in the past when navigating cross– country in light airplanes.

My westward course took me to the vicinity of Salina, Kansas where I picked up Highway 56, which parallels the railway for most of its length. The weather was hot and humid but my course skirted the big anvil–topped clouds abuilding to the south.

Getting a late start on Sunday morning, I motored across the American steppes as far as Liberal, Kansas, freshly washed by a thunderstorm minutes before my arrival. I had supper with Mr. Dillard Smith and his friends, during which matters of international importance were discussed and the Bosnian problem resolved. Then we all had ice cream and promised to do it again the next time I blew thru town. I had never met Mr. Dillard Smith or his friends before I wandered into the restaurant next to the Last Best–Western Motel in Kansas but their kindness to a stranger was one of the high points of the trip.

Monday saw me flit across the Oklahoma panhandle toward Stratiford, Texas, where I've kin long unvisited, divorced from we poorer Hoovers when their thousands of acres of dry land proved to be the cap of a huge dome filled with natural gas. I didn't bother to look them up. Last I heard, they were cruising the Alaskan fjords in their yacht.

Soon after entering Texas the country changed, falling under the rain shadow of mountains to the west too distant to see. Sage brush reappeared as the land became drier, climbing in a slow slant toward the continental divide.

North of Liberal I had cut south to pick up Highway 54 and was now on a long slant toward Tucumcari, New Mexico, scanning the horizon for a landmark mentioned in the accounts of Cortez' lieutenants searching for the fabled Seven Cities of Cibola.

The first mesas appeared, dim blue bergs adrift on the horizon. Shortly after, I spotted the stepped–pyramid shape that lured the Spanish explorers north. It remained in view, growing steadily, for the next two hours and marked the intersection of Highway 54 with Interstate 40 at Tucumcari. Once a sacred place, the mesa atop a mesa is adorned with antennas, feeding laff–tracks and cell–phones to a population that has largely forgotten their roots.

For me, the magic is still there. Were I forced to live anywhere other than California, where I was born, northeastern New Mexico would be high on my list. I don't know why but I feel comfortable there.

Deborah Polys had restocked my larder with the Kansas City version of bagles, strange doughy things useless in a rock fight. A proper bagle is a deadly weapon in skilled hands. I gummed the gooey things, sipped my coffee and was content, rolling west up the incline of the nation at a steady fifty miles per hour.

There's no secret to traveling long distances in a low–powered vehicle, you simply keep it rolling. Of course, having a bladder the size of a seabag helps. Four times during the day a little Geo with California plates squirted past, each time saluting me with growing fervor. Some trucks passed me as many as six times, roaring by at eighty only to dawdle at a restaurant or weigh station, allowing me to catch them up and pass them by, the dependable tortose out–pacing the diesel–powered hare.

I kept it rolling, sipped my coffee, enjoying a tart dried apricot now and then as the sun arced across the sky and setting, pulled me into Flagstaff after a sixteen hour run.

Flagstaff has always seemed a bit strange to me. Odd things happen each time I go there. While refueling the bus a couple of skinny Indian kids said something rude to me in gang–sign then tried to pick a fight when I answered them in kind. I'm not sure what they were smoking they should give it up. Two belligerent teenagers are no match for an armed man unwilling to be spat upon. I've been there, did that. And have the scars to prove it.

If you have to eat in Flagstaff don't do it at the Mason Jar. And the best place to sleep is in your vehicle, at the truck stop west of town.

By the time I reached Flagstaff the engine–hour meter told me it was time for an oil change, which I did at the truck stop, observed by legions of truckers having breakfast in the restaurant. The CB provided a running commentary on my progress from the truckers in their vehicles. “I think he`s gonna overhaul that thing,” when I set up my card table and laid out my tools. I also checked the tranny — eleven ounces down — and the steering, loose but serviceable. The engine had consumed a quart of oil over the last two thousand miles and that worried me. But it`s not a new engine and I`d asked a lot of it during the trip. I tightened my fan belt and checked the spare. Ahead lay the desert and that single fan belt runs the entire cooling system. Finished, tools packed up, table folded and stowed, work–shirt replaced with driving–shirt, I faced the windows of the restaurant and gave the truckers an elaborate bow. Many of them had passed me several times the day before.

Within minutes of leaving Flagstaff the temperature was over 90, climbing steadily as I descended into the basin of the Colorado River. At the rest stop south of Kingman the temperature was an incredible 121, a warm day even by Arizona standards. I saw a Westy there, apparently being rebuilt by a young couple. They had water and shade and seemed to know their business. They gave me an incurious stare but didn‘t return my wave. I rolled on by.

I crossed back into California below the Needles and pulled up at the agricultural inspection station wearing my desert towel, the Stones pounding out ‘I Can‘t Get No Satisfaction‘ on the stereo. The kid in the booth grinned and gave me a victory sign. I was back on my home turf.

Crossing the Mohave during the heat of the day isn‘t smart but I was anxious to get home. I rigged my squirt bottle, an adjunct to the desert towel. You fill a spray bottle with water and keep yourself wetted down. You can‘t open the windows because the air–blast is like a furnace, drying out your eyes and nasal membranes. So you squirt yourself with water, wear your wet towel and keep on rolling, albeit slowly. The oil temp refused to stay below 220 if I ran more than 45 mph so that‘s what I did, all the way to Barstow more than five hours away.

When I left California, the high desert was burning. When I returned, the foothills were burning. Below Cajon Pass the smog and smoke and heat haze limited visibility to less than a mile, a sad change from the desert where peaks a hundred miles distant were sharply defined. But it was cooler here, barely ninety. I dueled my way through the traffic, kicking the speed up to sixty– five to keep from being rammed in the rear, gluing myself in the proper lanes and hanging in there despite attacks from both quarters and astern. It took an hour to cross the basin during which I saw more cars than I‘d seen in the previous two weeks.

Our house is on a hill, in sight of the sea. We have a steep front drive that runs down to the mail box and a easier, unpaved back–road into the property. I motored down the back drive at ten minutes past six, precisely thirteen hours after leaving Flagstaff, 593 miles away. My wife was home and helped me carry in my bags. I guess I looked a little frazzled because she asked “How was the desert?”

“Hot,” I said. She gave me some iced tea and we sat in the patio. Scarface, our big raggedy–eared tomcat, came over and climbed in my lap. It was about seventy with a nice breeze coming in off the sea. “Pretty but hot.”

“Did he like the engine?”

“I think so.” I showed her the pictures Bob Polys had taken during our work on the Spyder then introduced her to my two passengers. She smiled but didn`t say anything.  I`d been gone sixteen days, traveled 3,393 miles in 69.4 hours of engine–time. It was nice to be home.

–Bob

The Tehachapi Run

Monday night I had my Chinese dream. Along with three other recurring nightmares, the Chinese dream is my legacy for two tours in Vietnam. The healing salve of time has left the circatrice of my physical wounds crinkled and white but the mental wounds of those wasted years remain unhealed, the horror forever fresh. I assume there is a lesson in this. Perhaps one day I will understand.

The Chinese dream often occurs when it rains. You can't hear them approach the wire when it rains. They'll turn your Claymores around, aim your own mines back at your. There is a need to be extra alert when it rains. It was raining when I awoke, soaked with sweat, the scream strangled in my throat.

The nightmares come in Technicolor with stereo sound and even the smell of death supplied. Following such night terrors there is a need for reassurance, for on the moment of awakening and for some time after the dream is my reality, all else a myth.

I arm myself, dress and patrol the property. There are no Claymores guarding my driveway. It makes no sense to go prowling in suburbia at three a.m. Yet I'm convinced that the day I do nothing will be the day the dreams comes true.

There's no going back to sleep after the nightmares. They are too vivid, too likely to recur so long as it remains dark. Time enough to nap later, when it is light. Instead, I work in the shop. Sometimes I write. A few times I've scrubbed the kitchen floor, an act of contrition for the woman who loves me and in doing so, is herself punished for a war that never should have happened.

Tonight there's plenty to do in the shop. I'm working on two engines, a stock 1700cc Type IV to power the Rincon Rocket and a very special two liter upright destined for Bob Polys' Porsche Spyder replicar. Both need heads. The T4 heads are simply worn out, needing seats as well as guides. Replacements will have to come from Mark Stephens' shop in Tehachapi, California since I don't trust the methods other shops use to replace the valve seats. The heads for the Spyder engine are a thornier problem. I've been unable to find suitable castings on which to build the big– valve heads needed to make the Spyder engine come alive. The few good castings I've found are two expensive while the others were simply trash, unsuitable for use in a high–performance engine.

A few days ago I'd called Mark Stephens' shop and the foreman mentioned having heads for uprights as well as T4's. Suddenly, at 0320 Tuesday morning I decide to drive to Tehachapi, about four hours away. Such is the logic of nightmares that it seemed like a good idea at the time.

There are but few logistical considerations for such a short trip, coffee to be made, a note scribbled for my long–suffering wife, loading heads and tools and spare gas into the bus, check the oil. In a light rain I motor through the tunnel of the night, down Buena Creek, hang a left at Twin Oaks Valley, climb up the narrow notch of Deer Creek canyon. By 0410 I'm on I–15, heading north.

The bus is running well, the engine a throaty purr. There is some slop in the steering that I'll take care of before starting on the Inuvik trip but if I watch my speed and if the cross–winds aren't too bad, the steering is acceptable. The big engine wants to stretch its muscles but I keep it down, wanting to conserve fuel. There's no one on the road but me and a few trucks. They pass me on the flats but I walk by them on the upgrades. In northern San Diego county, I–15 is a roller–coaster.

Grinding up the long grade near Fallbrook, I ran into heavier rain. My windscreen is coated with Rain–X and I'd not needed the wiper until now. There is enough heat to keep the glass clear and all the gauges are in the green, 50 psi, 190 degrees, 13.5 volts and about 3,500 rpm. The speedo says I'm running just over 55 mph but the tires are larger than stock so it reads a little low.

I've built quite a few engines. I test them not only on the stand but on in the vehicles they power, under actual road conditions. If I follow Gopher Canyon Road to the freeway instead of taking Deer Creek, Indian Truck Trail crosses I–15 exactly 50.2 miles north of my house. After installing an engine I fill the tank at the Chevron station, drive to Indian Truck Trail, turn around, come back to the same pump and top up. The road test takes about two hours and covers city streets, a twisty section of county road, two remarkably steep grades and nice long stretches of freeway. By refueling at the same pump, the hundred mile trip gives me a fair estimate of the engine's appetite. I've made the loop so many times the landmarks are familiar even on a rainy night. But I–15 north of Indian Truck Trail is territory I seldom travel.

I pass Indian Truck Trail shortly after five a.m. The trucks have vanished, having taken the shorter I–215 north. Unfamiliar with the route and in no rush, I'm content to swap certainty for time. And while I'm in no hurry, everyone else is. Even at this early hour the four–lane freeway has become dense with commuters sucked from suburban beds in Temecula, Murrieta and Elsinore by the lemming–urge of a regular paycheck, or a desire to live where the air is not brown and drive–by shootings happen only on weekends. The rain is heavy but traffic is moving about seventy– five miles per hour. I'm doing better than sixty but I'm the slowest thing on the road. A biker rockets past throwing a rooster–tail of spray and seemingly vanishes, as does all else before me. I assume the freeway has taken a sudden dip and have only a moment's warning before running into the waterfall. It is a rain cell of tropical intensity, the deluge so great that even on high the wipers — and the Rain–X — are useless. Water spurts from the overhead console and through the side–glass. I'm in a tin box being pissed on by a thousand angry elephants.

A white station wagon was zooming past at a rate of knots. When it hit the water it lurched, as if a tire had blown and swerved into my lane, decelerating rapidly. No brake lights. Indeed, no lights at all! I couldn't stop. The bus was surfing, the tires barely touching the road. I accelerated, signaled, snapped into the #3 lane, cutting off an angry pair of headlights but missing the white station wagon that continued across traffic to the shoulder and out of sight astern as I moved back into the slow lane. A blue Toyota zipped alongside, flew formation with his cockpit light on to make sure I could see the bird he was flipping me.

The rain cell was as small as it was intense and the stream of traffic punched through with little trouble. Coming out of it, I acquired a mascot, a pair of headlights clinging to my sixty mile per hour coat–tails as the mad rush swirled past. The headlights were close together, the vehicle one of those tiny things driven by people who can't afford a real car. I guessed it to be a commuter unnerved by the encounter with the rain cell, seeking the security of the bus' stately progress as I piloted the blocky vehicle through the storm.

The lights stayed with me as we dropped down into Corona, stayed with me into the mixmaster of the 91 interchange and the signs: LA, thisaway, Barstow, thataway. Suddenly we were alone. No one wanted to go to Barstow at five a.m. on a Tuesday morning. Except me and my mascot.

Coming out of the interchange we picked up more traffic, including trucks. The flow thickened to the clotting point but was again swept away, this time by the I–10, which sucked my mascot off my stern, swirled her up and over and away to some mindless task in Los Angeles, fifty miles and more than two hours away, for the arteries of the Los Angeles basin are clogged to a mind–numbing crawl by six a.m.

Once past the I–10, the old bus began climbing the alluvial fan leading into the mountains and Cajon Pass, the 4,200 foot gateway to the high desert. I passed the Highway 66 off–ramp, a surviving appendix of the famous Route 66 from Chicago to Los Angeles. There is only one good pass through the mountains. For the next fifty miles I would be traveling the modern analog of that Depression Era ribbon of concrete. But I would get no kicks.

Except for me and few trucks, the six lanes pointing north were incongruously empty, unused, a prodigious waste of effort. But coming toward us was a river of white light, a million commuters pouring down the pass. They live in the high desert and drive up to a hundred miles each way to work. Heading home, they will pack all six lanes, desperate to return to their cardboard houses, plastic furniture and evenings of canned laughter from the boob– tube. Such is the modern version of the Good Life. As to why they're willing to travel so far for so little, the high desert communities have become virtual ghost–towns as a result of military base closures. A twenty–five hundred square foot house on a quarter–acre lot can be had for as little as $100,000, dirt cheap by southern California standards.

The grade steepened as we neared the summit and full throttle gave me only fifty miles per hour. I was passing a steady stream of trucks, other vehicles occasionally whizzing past in the outside two lanes. The gauges and my ear said the bus was running fine. I've added extra instruments that I feel are necessary for proper engine management, mounting them in the overhead console of the 1965 bus, positioned so the needles are horizontal during normal operation. I don't read the actual values, merely note the position of the needles when scanning them, an automatic thing.

I'd just flicked an eye toward the instruments when I flew into a cloud. And the cloud was filled with rain. Still on automatic, I reached for the carb heat control, forgetting I was in an old Volkswagen bus and not an airplane. And being in a bus, I was also in near proximity to other things, unseen in the white buckshot hammering against the windscreen. My headlights picked out a reflector on the tail of a truck and I oozed past it cautiously. Visibility was less than twenty meters and the rain was intense. As quickly as we'd flown into it, the cloud blew away and visibility opened up to a mile or more, showing a long line of headlights coming toward me across the inside of a slow descending curve.

The rain slacked off as I crossed the summit. The trucks shook off the water, snorted their way into higher gears and passed me, one by one. My turn–off came up and I arched up and over old Route 66 onto equally old Highway 395.

I stopped at the Outpost Cafe to refuel the bus and me. I like to run off the top of the fuel tank, and to take a break every two hours or so. It was ten minutes after six. Despite the weather, I'd logged one hundred and twelve miles in two hours, a credible run for a thirty year old machine. It took five and a quarter gallons of gas — 21 mpg — to top off the tank. Off to the east a creamy smear of dawn was visible though breaks in the black clouds. It looked like the weather might be clearing. Inside the cafe, elbow to elbow with a counter full of truck drivers, I ordered an omelet. It's hard to screw up an omelet.

Conventional Wisdom says the food is always better and the waitresses always prettier at truck stops. I've driven a truck and know both are lies. Truckers don't stop where the food is good, they stop where there is room to park a sixty foot rig. With a captive audience, the food at truck stops is often warmed–over garbage, slopped down in front of you by an ogre with a hairy mole on her nose named Vera. The waitress, that is. Not the mole.

The Outpost Cafe isn't like that. The young woman who served me, promptly and without error, was pretty and vivacious without the cloying folksiness affected by so many food servers. But the omelet was something of a trial. It was a very good omelet but only slightly smaller than a door mat, a hearty meal for a family of four. I snuck a peek at the truckers on either side, wondering if I was expected to share. The heavy–set Bubba–type on my left was busy talking to his broker on his cell phone, the remains of a plate of ham & eggs before him. The cowboy–type on my right was eating a croissant while working the crossword puzzle in the LA Times. In ink. So much for Conventional Wisdom.

Knowing I wouldn't need to eat again for several days, I staggered back to the bus and coaxed it out onto 395 from the chain of lakes that formed the parking lot of the Outpost Cafe. Highway 395 runs from Mexico to Canada through what to me is the most scenic part of our nation. Despite the current weather Indians call it 'The Land of Little Rain,' others call it The Great American Desert and see little worth in its broad and barren vistas, going there only to set–off the occasional atomic bomb, dump their garbage or build shrines to avarice and greed. But I like the desert and always have, although I didn't know why until after Vietnam. I like the desert because it isn't jungle. And your eye can see as far as it can see. Nobody sneaks up on you in the desert. But today my vista was limited to a gray curtain of rain, visibility reduced to less than a mile.

Within a hundred meters of the cafe I saw the first Joshua Tree, roughneck relative of the lily. It was a welcome sight, one that stirred old memories. When I was a boy I tried to climb one. After all, people call them trees and climbing trees is something boys are required to do as part of their rite of passage. It was a learning experience. We don't have Joshua Trees in the low desert nearer my home. Like the boojums of Baja, Joshua Trees are specialized things, picky about who they associate with and where they put down roots.

The high–desert wind was giving me trouble. I reduced speed but the gusts were still swatting the bus around. The road is just a two–lane ribbon but has generous shoulders. I scooted over when approached from astern, letting the truckers get on with the nation's business. At Kramer's Junction, where highway 58 crosses 395 at a precise ninety degrees, I hung a left and headed west toward Tehachapi and the Pacific Ocean, if I were in surfing mood. The rain, heavy at times, continued. Gray veils descending like torn curtains from smoke–black clouds. But the wind seemed less and I was making good time.

Highway 58 isn't properly a freeway although it's better than some. Mostly divided road with two lanes in each direction, it marks the northern boundary of Edwards Air Force Base, linking such notable towns as Boron, North Edwards and Mojave before snaking into the mountains past the useless forests of dismantled wind machines, the environmentally correct boondoggle that served only to enrichen a few politicians while killing a lot of hawks. Tehachapi sits in a pleasant valley near the summit. The weather was worse here, with heavier rain. I began running into patches of fog as I neared the town. Then I realized it wasn't fog but clouds. Tehachapi Summit is above four thousand feet.

I got to Tehachapi just after 0900 and called Mark Stephens' shop for directions. Bill, the shop foreman and duty telephone– answerer, asked what I was driving. When I said a VW bus he suggested gently I go back home, visit them another day, explaining that the shop is on the end of several miles of unpaved road and the unprecedented amount of rain had made access extremely difficult. "I drive a van myself," Bill said. "And I can't get it in here today."

Having come over two hundred miles it seemed only proper to at least make an attempt to travel the last seven miles. And having been raised on a farm, I'm no stranger to mud.

Pavement took me as far as the oaken forest above Tehachapi, the bare trees desolate and ghost–like, cloud–wrapped in veils of fog. When the pavement ended, so did the road signs and my first attempt lead me to the very summit of the ridge, right through the cloud layer only to find my way blocked by a fallen tree. I had lost my way in the smoke–dense cloud. Turning the bus on the narrow, muddy track took more luck than skill. Coming down, I realized the only tracks were mine. I abandoned the imperfectly copied directions and began following the most recent tracks in the mud, having a number of adventures along the way.

The scrub–oak forests above Tehachapi cover some beautiful country and it were summer this would be a pleasant and scenic drive. But in the cold February rain and ankle–deep mud, it took me an hour to reach the shop. Both the bus and I were a bit the worse for wear at the end of it but the reward was worth the effort. I swapped the old Type 4 heads for a set of Stephens– rebuilts and picked up a pair of absolutely beautiful 44x37 heads for the Spyder engine. Mark Stephens has a lot of racing experience and knows the difference between what works and what looks pretty. I had a nice time chatting with Bill, and a busman's holiday poking about the busy, well equipped shop.

Getting back to Tehachapi proved almost as difficult as getting to the shop. I'd spent an hour at the shop and the rain hadn't let up the whole time. The water was across the unpaved road at two places, deeper now than before. A couple of 4x4's, churning their way to and from the shop had provided a good trail to follow but made navigating the flooded parts more interesting than before. One section wiped me out twice, forcing me to roll back down, find better traction and tackle it at a different angle before I made it to the top. The bus was mud–brown to the doors by the time I was back on pavement. The rain quickly restored the original finish of chalky green and rusty red.

I refueled at Tehachapi and worked out the fuel consumption figures. This too is part of proper engine management. If you see your mileage beginning to dwindle it's pretty good evidence your engine needs attention. But I didn't believe the numbers. They said I'd gotten near forty miles to the gallon out of the last batch of fuel. Thinking I'd misread the odometer at the last stop, I headed east for home on highway 58. As I came down from the hills onto the desert floor it felt as if I'd run into a pillow. The wind was so strong that full throttle gave me barely 50mph and the gusty wind warning signs posted along the highway were not there just for show. The mileage figures for the last run were correct. I'd been blown across the desert by a forty mile per hour tail wind.

Staggering into the wind, the bus and I lurched toward Kramer's Junction. In Mojave, a sign had blown down near the Casa de Gasa and the flags outside the 20 Mule Team Motel were standing rigidly from their poles. An RV was off the road near Boron, a big fifth–wheel rig come to grief at the chicane across the railroad tracks a few miles farther on. But the wind cleared the rain and I could see mountains fifty miles distant that you'd swear were only a few minutes away. Slowing for the turn at Kramer's Junction, a pair of crows flashed past, echelon left, rowing slow wing–beats in the soggy air yet flying faster than kestrels.

The wind had been shifting slowly to the south, gaining in intensity. Turning south at Kramer's Junction put the wind dead on the nose. We did well enough in the wind shadows cast by the rolly terrain but the wind would punch our speed down to forty when we topped the roller–coaster swales. With their higher profile, the wind was effecting the big rigs even worse, as I discovered when I caught up to them. They were running nose to tail, passenger cars and pickups darting out of the procession, looping their way past the string of trucks like pawns on a backgammon board. Without enough power to play the game, I tucked the bus in behind a moving van, enjoying a free ride as we were pulled along in its wake. Traveling in convoy, line astern, our speed was determined by the slowest truck. The thirty miles to the junction with I–15 took nearly an hour. In that time the weather closed down again, driven by a massive wall of dark clouds building to the southwest. The light went out of the sky and a heavy rain began to fall.

I had told my wife I would be home shortly after noon but it was already later than that. I continued south without bothering to refuel, knowing I could get close enough for the jerry can to carry me home. On I–15 above Cajon Pass the intensity and turbulence of the wind caught me by surprise. I could barely maintain 45 mph but even at that the shaky steering needed inputs of as much as forty–five degrees to keep me in my own lane. Tipping over the crest of the summit brought some relief from the wind and my speed quickly built up. But so too did the rain.

Forward visibility shut down as I re–entered the cloud layer, dwindling to less than twenty meters. The slow lane was closed for repairs, traffic bunched up in the remaining three lanes, rain coming in torrents. I ran into a denser rain cell than the one encountered that morning. All around me cars had their emergency flashers going. A few sought refuge on the shoulder only to encounter the markers closing off the outside lane. Soon there were toppled markers littering the roadway. Over in the fast lane a blue Volkswagen screamed past at an insane speed. It was one of those real kewl bugs, lowered, windows tinted black, Cal– looked, shaved and equipped with lots of tail pipes. The deck lid was propped about six inches away from the body, a trick of marginal value on the drag strip, worthless on the street and a definite no–no when driving through a torrential downpour at ninety miles an hour.

Cars littered the shoulder. The rain was coming down so heavily it couldn't flow away fast enough. We were on a six percent grade yet there an inch of water on the roadway. At the 138 off– ramp a white coupe was in the weeds, headlights pointing this way, the driver standing beside it oblivious to the pounding rain, peering at the car quizzically as if waiting for it to right itself.

Incredibly, below the pass the rain was even heavier, obliterating all forward vision. There was two inches of water on the roadway and the shoulder was flooded. The noise of the water on the nose of the bus was deafening. The wiper broke, hammered to one side, lay there twitching until I shut it off. A tour bus lurched into my lane toward the shoulder throwing up a tremendous bow wave. The wave hit my bus, ripping off the air– scoop on the left side, punching me onto the flooded shoulder. Water squirted from the overhead console and dribbled across the dash, oozing in through the lower corners of the windscreen. My feet were wet from water driven up around the pedals and gear shift. I skied along in the wake of the tour bus, managed to avoid it only because its tires squeegeed a track for mine to gain the traction they needed to pull back onto the roadway.

The water blown into the engine compartment by the wave from the bus now appeared on the inside of my windscreen as steam. I rubbed it frantically as I struggled to avoid the gaggle of vehicles that seemed to be as disoriented as me. And there was the blue bug, flooded out, dead, off the shoulder of the fast lane. There IS a God.

We drove out of the storm cell suddenly into a world of water. Trucks had sought the refuge of the shoulder and the world seemed filled with blinking yellow lights, diffuse through the spray, for cars continued to race past at far too fast a speed, like children playing in a mud puddle. I would of stopped if I thought I could do so safely but the splits at the 10 and 91 forced me to run in the number three lane. With traffic on both sides, I felt it best to maintain my course and speed.

By the time we reached Norco the pavement was no longer underwater although brown lakes had appeared in every swale beside the freeway. Traffic was much lighter, too, the weather having performed a kind of natural selection. All of the smaller cars had vanished leaving only trucks and heavier vehicles on the road. And one old Volkswagen bus.

As I climbed out of Corona the sky cleared and for a moment I caught a patch of blue off to the east. But overhead remained a confusion of clouds, slate to sooty blue, stratified or flocculent depending on their elevation, the hills a ragged black border below. In a month this will be a green and flowering land and only the hills will remember rain.

I stopped near Lake Elsinore and drained the jerry can into the tank. Parked well off the road, the bus at a steep angle, water leaked from it in a constant dribble, from the cargo bay and cockpit and even the engine compartment, which showed signs of having been flooded. Yet through it all the engine had never faltered, the faithful throb of its exhaust never changing.

I tightened down the wiper blade where it had spun on the shaft but there was nothing I could do about the missing air scoop. The twin scoops create an over–pressure of about 1psi in the engine compartment, sufficient to maintain a steady flow of air through the oil cooler which is ducted to the low pressure area behind the left rear wheel. With only one air scoop the oil ran ten degrees warmer than usual. I kept an eye on it as I motored home.

Having experienced such heavy rain I was worried about the condition of the shop. With its earthquake–damaged foundation, heavy run–off defeats the berm I've thrown up and water comes inside. But the farther south I traveled, the less evidence there was of any rain at all. At the low spot in Deer Creek canyon there wasn't even a puddle. When I reached the house and carried the heads into the shop, the floor was dry. Out back of the shop the rain gauge had captured less than a tenth of inch since the day before.

I unloaded my tools before parking the bus down in the field below the house and went up to start supper. The 440 mile trip had taken twelve and a half hours.

THE AIRCOOLED ENGINE

CDI Ignition

Cooling System

Engine Case

Engine Miscellaneous

Engine Removal & Assembly

Exhaust & Heating

Fuel System

Heads, Valves and Lifters

Ignition and Electrical

More Power, Bigger Engines

Oil System

Blown Oil
Blown Oil Seal
Bolt-On Filter/Pump
Deep Sump II
Drilling Oil Galleries
Extra Oil Sump
Filter Pumps
Full Flow Oil I
Full Flow Oil II
Full Flow Oil III
More #@!! Filter/Pumps
More Blown Oil
More Drain Plugs
Oil Coolers
Oil Filters
Oil Galleries & Hyd Lifters
Oil Pressure Sender Removal
Oil Pressure, Hydraulic Lifters
Oil Seal
Oil Temp Gauge
Oil Temp Sender
Rebuilt Oil Cooler
Still MORE #@!! Filter/Pumps
Stripped Drain Plugs
Sump Cover Plate

Type IV Engine

2.0 Liter Rods
Painted Type IV?
Type IV Overhaul

CDI Debated

In a message dated 96-02-27 12:30:40 EST, Michael A. Radtke provided an accurate, well-reasoned summary of capacitance discharge ignition modules and inductive discharge ignition modules (other than capacitance charged), in relation to my several articles lauding the advantages of an after-market CDI module over the stock VW ignition system. His well written dissertation concluded with the following:

THE QUESTION: Is CDI alive and well in current automotive design? What was done about the high voltage issue? >

Mike,

Until you raised the question, I had not realized my lack of verbal precision. In my 'sermons' I'm guilty of mixing the terms 'electronic' and 'CDI' when I start waving my arms to convince people to update their Kettering ignition systems.

All of the electronic ignition sytems I've worked on in recent years (Ford, GM and Toyota) are relatively simple inductive discharge systems that differ from the classic Kittering system only in the manner of switching the coil current. Out of curiosity, I've broken open several defunct ignition modules — 'ignitors' in Toyotaese — and found only components consistant with signal amplification and DC switching, no indication of HV inverters or storage capacitors. In so far as I know — which is not as far as many thing — CDI modules are not used by any of the major auto makers. I assumed it was due to the lower cost of IDI systems but the background you provide in your message casts a new light on that conclusion.

Even so, I feel the factors explored in my articles on electronic ignition, and on which I based my recommendation for the installation of the CDI module mentioned in my article, remain valid. And perhaps I should add that I've no association of any kind with that company other than as a satisfied customer.

As to the high voltage issue, it may be a non-problem. Parked down in the field below my house is a '67 VW sitting with the engine exposed to the elements, as it has been since it was created more than 15 years ago. The original vehicle suffered extensive rear-end collision damage. The damaged sheet metal was cut away and a sturdy crash-cage of chrome-moly tubing fabricated to protect the engine. This is a typical 'Baja' conversion.

The engine is fitted with a CDI module and non-metallic silicon/fiberglas spark plug leads. The leads, distributor and module are exposed to the weather. The vehicle has never failed to start, and runs reliably in all weather and temperatures rangeing from zero degrees (two occasions) to over 120 (many times). Such reliability was not always the case, but has been true for at least the last eight years, from when I installed the silicone ignition wires.

As to plug gap and the effect of high voltage, with the CDI modules I use, I gap the plugs to about .045". I arrived at this figure by widening the gap until ignition became unreliable at high rpm, then narrowed the gap by .010" I've noticed some variation here between engines of different compression ratio or chamber design but in general a plug gap of between .040 and .050 appears to work quite well with this particular assemblage..

I have not posted your entire message to the list because I believe a private message is exactly that, but I will make this reply a general posting because of my failure to speak clearly on what I consider a very important factor in Volkswagen maintenance. I'm also making this a general post in recognition of your successful effort to clearify the matter.

I believe your insight and experience are assets that make this list of value and would like to hear any other comments you may have on the 'sermon' files. I hope you will share them with the list at large.

CD Ignition and $$$

While there is an initial cost for everything, some things are well worth the expense, as in the case of adding a Capacitance Discharge ignition module to an early Volkswagen engine.

Stock ignition does a fine job at low speed but as engine RPM rises, spark voltage falls. This is in response to fundamental electrical laws. In the stock system, as the points age and the rubbing block wears, resistance rises while system ‘on-time’ falls, further reducing the available spark energy. At 3,000 RPM the available spark energy may be only a quarter of the idle speed value. The result is incomplete combustion and an overall drop in engine efficiency.

CD ignition is justified because it provides 100% of the possible spark energy at ALL engine speeds.

The most notable improvement is increased fuel economy. Some users claim up to 25% increase in miles-per-gallon. In my ’67 bug I get 35-37 mpg on long trips (>400 miles) at highway speed. Before installing the CD, 28-30. On that basis alone the CD is well justified. But then there are the added advantages of reduced maintenance and prolonged spark plug life.

Having used electronic ignition systems on a variety of vehicles — including N6886, a homebuilt airplane — for more than twenty years, finding such systems on modern cars and motorcycle is really no surprise; CDI is superior to what has gone before.

CDI Modules--Loose Ends

My articles about capacitive discharge ignition modules, archived by Mr. Richard Kurtz on his web site (the address of which I've lost again due to another system crash) generates a fairly consistant stream of messages. The questions most commonly asked have to do with the following:

I do not work for Universal Corporation nor do I have any arrangement with them. I recommend their product because it has worked reliably for me in more than a hundred installations.

My recommendation is not based on any formal, quantified product-testing program. I've used a number of other electronic ignition systems but MSD is the only brand-name I can recall. The CDI module from Universal proved more reliable than the three MSD modules I tried. I have not used a Petronics (sp?) system.

I do not know the absolute maximum rpm at which the Universal CDI module will operate with a 4-cylinder, 4-cycle engine but I've personally run them for relatively short periods of time, typically less than thirty minutes, above 7,000 rpm with no problem. (For sustained high-speed operation it would be wise to direct a blast of ram air at the CDI module's cooling fins.)

I use commonly available silicon-insulated ignition harness (carbon-core) in conjunction with a stock (black, blue or what-have-you) Bosch ignition coil and Bosch platinum-electrode spark plugs. Using these wires, I've not seen any evidence of insulation failure on vehicles fitted with CDI modules. My baja-bug, in which the ignition harness is exposed to the weather, has used the same wires — El Cheepo stuff from J.C.Whitney — for the last ten years. Indeed, with silicon/graphite ignition harness the only cause for replacement has been failure of the air seals or distributor-tower boots.

The longest service I've gotten from a set of NON-PLATINUM spark plugs was about 26,000 miles. I had a platinum plug fail after 56,000 miles and changed-out the whole set but I know of a V6 that has accumulated over 80,000 on a set of platinum plugs and is still going strong.

I use commonly available ignition points, whatever is hanging on the rack at the local FLAPS. I observe the usual precautions when installing the points and lubricate the rubbing block with high-temperature silicon grease about twice a year. The rubbing block lasts... however long it lasts, usually about 25,000 miles but I've had some last over 40,000. The points must be adjusted as the rubbing block wears, usually once or twice a year, depending on the miles driven. Aside from some minor flattening, when triggering a CDI module the contact points show no signs of wear. When it comes time to change the points I usually just plug in the spare distributor, rebuilding it and replacing the points at my convenience. I do not see the use of a points-triggered ignition module as a detriment. The VW distributor normally requires service at about the same interval as the rubbing block wears. It is no problem to include point replacement with adjusting the distributor's thrust shims. Indeed, the use of points-triggering provides an excellent back-up since it allows me to return to the standard Kettering ignition should the CDI unit fail.

I know of a case where a vehicle got a 25% boost in its mileage after a CDI module was installed... (20 mpg vs 16) but I suspect there were other factors involved. Typically, I see a 5% to 10% improvement in highway mileage (ie, constant high speed) after installation of a CDI module, based on a test-run of approximately 102 miles (that is, from my shop to Indian Truck Trail & return). These appear to be valid figures, borne out by longer runs on equally good roads but under less controlled conditions (San Diego to Kansas City & return). I was disappointed by my mileage on the Inuvik Run — about 22.5 mpg for about 8,500 miles — but the vehicle was carrying a fairly heavy load and the route included about 2,000 miles of bad roads.

———

CDI modules are a practical way to retro-fit modern-day technology to a 1930's-era engine. The engine remains in tune much longer than those fitted with the stock Kettering-based ignition, which works best at low engine speeds. The spark voltage delivered by the CDI module is fairly constant across the operating range of the Volkswagen engine, providing a cleaner burn and better economy at higher rpms.

The strongest endorsement for this type of ignition modification comes not from me but from the automotive industry, which abandoned the Kettering ignition as soon as electronic systems of equal reliability became available.

Several messages asked how it was possible for a CDI module costing under a hundred dollars to perform as well as one costing over $600. I don't have an answer for that because I find fault with the question itself. Perhaps the real question should be 'How good a system do I need?' In the case of early air-cooled VW engines, it's clear to me that the Universal CDI module is good enough.

Electronic Ignition for early VW

The Kettering ignition system of points, condenser and coil was never more than a compromise. (The Model T, with one coil per cylinder was more dependable, but also more complex and costly.) The component most likely to fail in the Kettering system was the points, since they had to carry up to ten amps of current, a difficult task for any switch turned on and off fifty times per second. Until they found something better, Detroit designed their way around the problem with dual points and even dual ignition systems. The cure wasn't found until the advent of the transistor in 1948, and didn't gain commercial popularity for another twenty years.

The cure for the Kettering system is to use the points not as a current-carrying switch but merely as a signaling device to tell the ignition system when to fire the spark. The actually switching is done with a solid state device called an SCR (silicon controlled-rectifier), a specialized form of transistor.

And instead of feeding the coil a diet of 12 volt current, it is fed 400 volts, allowing it to build up the maximum charge in the shortest time. The 400 volt energy is developed using a tiny switching transformer inside the ignition module, the energy stored in a large capacitor which is discharged into the coil at the appropriate time. This capacitance-discharge gave such systems their name, often abbreviated to CD.

'Point-switched' CD ignition systems require periodic maintenance as the rubbing block wore down, typically about every 10,000 miles. The points required replacement at about 50,000 miles, due to rubbing block wear. The points themselves are still in perfect condition at that time. Designed to switch a 120 watt load fifty times per second, they hardly notice the micro-ampere load needed to signal the CD module.

The biggest advantage in CD ignition is improved efficiency. Spark voltage remains constant at all speeds, and constantly high. With a dependable 40,000 volt spark at all engine speeds the spark plugs may be gapped much wider, providing better flame-front ignition. The wider plug gap fouls less readily, giving even worn engines a boost in efficiency. With electronic ignition regular sparking plugs last about 25,000 miles, the new platinum jobbies up to 120,000. Over all, CD ignition insures better combustion, resulting in better fuel efficiency and lower emissions. The engine even runs cooler, thanks to less after-burning in the exhaust manifolds.

A point-switched CD ignition module is the wisest ignition modification you can make to an early VW since it supplants rather than replaces any of the stock ignition components. Indeed, should the electronic module fail you may return to the stock Kettering ignition by simply reversing a plug on the ignition module. Such redundancy is lacking on all modern electronic ignition systems, a potentially fatal flaw since they give no warning of incipient failure.

The most practical CD ignition module for Volkswagens was available from J. C. Whitney until March of 1995 (although it was never advertised specifically for VW's). Cost was about $50 and installation took thirty minutes for a clumsy mechanic with few tools and no electrical background. J. C. Whitney's current 'VW-specific' CD offerings cost about $100 and requires replacement of the distributor. This newer system, and all others presently offered by J.C.Whitney, uses optical triggering. Properly installed, such systems need no adjustment for the life of the distributor, about 70,000 miles in most cases. But as with all optical or magnetically triggered systems, you cannot revert to Kettering ignition without re-installing a set of points or replacing the entire distributor.

As to the dependability of such aftermarket CD modules, I have installed well over 100 (possibly twice that) with but a single failure, and that one was bad out of the box (and promptly replaced by the manufacturer).

I've used CD ignition modules since 1961, building the first few. (I am a ham radio operator.) I have more than 20 years experience with one unit: I installed a CD module on my 1973 Datsun the week it was purchased (new). The Datsun has accumulated 230,000 (on two only two engines). All of my VW's (four) are fitted with CD ignition although none have accumulated as many miles as the Datsun.

Good news on CDI modules

In an earlier sermon I bemoaned the fact J. C. Whitney no longer carried the points-triggered CDI module I believed to be most suitable for installation in early Volkswagens. (Part number 73XX4959N, or its waterproof cousin 73XX7080X)

Mr. Keith Gawlik, a fellow subscriber to this list and a resident of Boulder, Colorado, tracked down the manufacturer of the CDI module and provided me with an address and phone number.

Universal Corportation 730 Independent Avenue Grand Junction, CO 81505
Tel (970)242-5267

(Yes, that's the correct Area Code. It is one of the new ones.)

A call to Universal put me in touch with Mrs Eileen Iles, who told me they were waiting on new tooling for the extruded aluminum case (which also serves as the heat sink for the module). The delay had disrupted only that one model and she expected it to be back into production (and back in J. C. Whitney's catalog) in the near future, promising to let me know so I could pass the word.

As I mentioned in an earlier posting, I've had perfect reliability from this unit in numerous installations, the only failure being one dead out of the box which was promptly replaced, no questions asked. (And that was so long ago I'd lost the address.)

Mrs Iles was surprised to know she had customers on the Internet (she said to say 'Hello').

Hello!

Adjusting The Thermostat

With all this talk about thermostats, how does one adjust the thing properly.

Adjusting your thermostat is pretty simple. But first you have to get at it. To do that, you'll have to remove the rear section of the lower tin-ware on the passenger-side of the engine.

Once you have access to the thermostat and its bracket, remove the bolt securing the thermostat bellows to the bracket. The engine should be cool and the thermostat bellows fully closed when you do this.

With the bellows free in the bracket, LOOSEN the nut holding the bracket to the stud that projects from the side of the crankcase. You want to be able to slide the bracket up & down but the nut must be firm enough to hold the bracket in position when you let go. Now check your flaps to make sure they are FULLY OPEN. The procedure here varies according to the year you have. The basic idea is that when the rod attached to the bellows is pushed UP the flaps will be pushed OPEN, so one way to check is to simply push the rod up as far as it will go. It should stay there, thanks to the spring attached to the connecting rod linking the two pairs of flaps.

Fully up — fully open — is the HOT position.

Notice how the bracket completely surrounds the bellows? What you want to do is cause the upper part of the bracket to just touch the upper part of the bellows. In practice, the bracket serves to prevent the bellows from expanding too far, which can cause the bellows to crack.

When you have the bracket properly positioned, tighten down the nut.

Now comes a bit of fumbling. Reach up, grasp the bellows and pull it DOWN, rotating it as needed to cause the flat-sided boss on the bottom of the bellows to mate with the hole in the bottom of the bracket. The flat-sided boss prevents the bellows from rotating, which would cause it to unscrew itself from the actuating rod.

If the bellows can't be pulled down far enough to mate with the bracket, you can back-off a few turns from the rod. But insure you have at least six full threads of engagement (more is better).

Insert a short 8x1.25mm bolt with a suitable FLAT washer, plus a warpy washer, into the threaded hole on the bottom of the bellows and tighten it down while holding the bellows firmly aligned in the flat-sided hole. The flat washer must be large enough to span the boss on the base of the bellows and contact the bracket, otherwise the thing will simply spring back up.

That's all there is to it. The first time you do it, take as long as it takes. Once you've done it a few times, it takes only a couple of minutes to set the adjustment.

When pulling the engine for maintenance that involves removal of the blower housing, it's usually most convenient to remove the thermostat from its bracket and to unscrew it from its rod as part of dropping the engine, when the vehicle is hoisted up and there is room to get at the underside. For the same reason, it makes good sense to hold-off re-installing the thermostat and lower tin-ware until you replace the engine in the vehicle.

The short bolt and large-diameter flat washer used to secure the thermostat to its bracket are somewhat unique. It's a good idea to keep them with the bellows.

Cooling System

Although the Fresh Air blower housing does not use engine cooling air for cabin heat, as is shown by the geometry of the blower housing and the position of the internal air vanes, leaving the Fresh Air heater outlets open will cause a pressure drop that will reduce the engine's capacity to cool itself. The Fresh Air outlets must be blocked or connected to functional heat exchangers (that is, heater boxes that aren't rusted-out).

Hoping to improve the cooling of up-right engines, I ran some experiments with the Fresh Air outlets blocked off, different oil cooler configurations and so forth. Blocking the heater ducts provided no additional engine cooling, whereas leaving them open caused a sharp rise in CHT and oil temps.

Removing the screen from the upright oil cooler, a fairly common practice at one time, produced a rise in oil temp. Apparently the screen acts as a turbulence generator, allowing the air to pick up a bit more heat as it passes through the fin-less cooler.

Removing the up-right oil cooler from the blower housing and mounting an external cooler over the cooling air inlet produced dramatically lower cylinder head temps for #3 & #4 cylinders as well as lower oil temps. A small air dam must be installed in the blower housing at the bottom, near the location of the missing cooler to insure adequate air-flow to the #3 & #4 cylinder head.

Mr. Gene Berg's claim that removing the upright cooler caused a rise in temperature may have been due to his failure to include the air dam. I was not able to reproduce his results with the air dam in place. Even without it, oil temp was lower than before although CHT on #3 rose slightly.

Assuming the timing and carb to be correctly set and the lower cylinder air deflectors are in place, if an early engine has a chronic cooling problem it's wise to inspect the oil pump for wear. Replacing the up-right style cooler with the later model dog-house cooler is the best solution of all. (The dog-house style cooler appears to be about 4x as efficient as the up-right cooler.) The other most common cause of overheating is failure of the engine compartment seal. When in motion the air under the vehicle is at a higher pressure than the air over the rear window and deck lid, allowing the engine to re-circulate the heated air from under the vehicle. If the vehicle is habitually parked near trees the cooling problem my be due to leaves blocking the fins on the cylinder heads.

Doghouse Retrofit

Time and time again, people visit my garage wanting a "Dog House" oil cooler on their pre 1970 Bug. I am wondering if a late model oil cooler would work on an early case with the small oil holes on top of case where the cooler bolts on? If so, which oil cooler seals do I use?

Yes, a late-model dog-house style oil cooler can be retro-fitted to the early-model engines.

Somewhere in the archives, or perhaps in one of my articles, I've given all the details for adding a dog-house cooler to an early engine.

Mechanically, there isn't much too it, although you need to drop the engine to do the swap. The oil cooler adapter bolts to the case, the late-model oil cooler bolts to the adapter and away you go. But like most things, success is in the details. You will need a dog-house-type blower housing, the 10mm wider fan, new forward breast tin (for the exhaust ducting) and the exhast ducting itself. Local junk yards were charging $65 for all the necessary tin-ware plus $35 for a USED oil cooler (the price is higher now). If you do not know the provenance of an oil cooler it is unwise to use it. If it is off a blown engine the oil cooler will have trapped a lot of metal particles that will cause early failure of a good engine. Best bet is to use a new or rebuilt unit.

For a leak-free installation you need TWO sets of grommets (one for the adapter, one for the cooler) so you'll need a post-71 gasket set, or you may be able to salvage grommets from the remnants of old gasket sets used to install upright coolers. Don't even think of using old grommets. You need the 'crush' of the new grommets to provide tension on the fasteners. And don't use any sealant on the grommets — it will get squeezed out and end up in either the cooler or your bearings.

The adapter — available from Bug-pack or a junky — dictates the type of grommets (seals) you'll need. In the overhaul gasket set there are two types of grommets, one for early engines with the small hole, one for later models. The adapter dictates the OD the grommet, the crankcase the ID. Dig through the gasket set until you find the set that match your needs — you'll be looking for the THIN-WIDE grommets (those for a Type III engine are THICK/WIDE... whatever you do, don't get them mixed up). Be careful not to over-torque when you install the adapter to an early case. You will have to replace the stud with a bolt of suitable length. With the proper grommet installed, the adaptor will come down flush on the crankcase. This is where you need to be careful. IF you don't have the right grommets you're liable to strip out the threaded bore for the bolt (ie, where the stud was) or even break off one of the ears. If the adapter is not flush the oil cooler will be too high by that amount, causing a mis-fit of the blower housing, which can lead to air-leaks, excessive vibration and so forth. The different grommets are illustarated in Tom Wilson's book 'How to Rebuild Your Air-cooled Volkswagen Engine'.

Having a COMPLETE set of dog-house tin-ware is vital to the success of the conversion. The piece of tin-ware most difficult to find is the little bracket which bolts to the back of the oil cooler and provides the nut-plate for securing the new blower-housing. Don't leave this piece out. It forms a vital air-dam as well as serving to secure the 'flappy' part of the dog-house. Without it, you'll have a massive leak of cooling air and vibrations from the unsecured blower housing will eventually cause the oil cooler to loosen and leak.

I always install new foam rubber gaskets on the oil cooler. They get torn rather easily by removal of the blower housing and they have a critical role — if the high pressure cooling air can find some way around the oil cooler, it will. The foam, in conjunction with the blower housing and 'dog-house', forms an air seal on the sides and top of the oil cooler. The little 'mystery' bracket (that most people leave out), with a small piece of foam attached, forms the air seal for the bottom of the oil cooler. Without it the oil cooler is only about 50% effective — the air blows thru the gap. If you can't find this little piece of tin-ware you will have to fabricate something to serve as the air-seal for the lower edge of the oil cooler. There are a number of ways to accomplish this but don't put your faith in glued-on weather-stripping or the like — it will come loose in time and may block the oil cooler.

After-market tin-ware is especially bad when it comes to forming a proper seal around the oil cooler. I've a hunch the Taiwanese or Siamese or whatever have never seen a properly assembled dog-house style blower housing with all of the bits & pieces properly installed. For whatever reason, after-market dog-house style tin-ware often leaves gaps of an inch or more around the base of the oil cooler, defeating the whole purpose of the thing.

Sealing the exhaust ducting is equally important, not only where it attaches to the dog-house and the back of the blower housing, but where it passes thru the breast tin. I use RTV and literally glue the ducting in place.

Since you'll be replacing the breast tin, this is a good opportunity to install a bulkhead fitting for the fuel line. You'll find this covered in at least two of my articles on the 'sermon' page.

The dog-house oil cooler, which is in fact an EXTERNAL oil cooler, represents a vast improvement over the old-style up-right oil cooler. The wider fan, new blower housing and external exhaust serves to make the oil cooler circuit entirely separate from normal engine cooling.

The Hoover Bit

The Missing Piece

I'm guilty of taking VW-specific magazines to task for the many errors and omissions in their articles. I'm not against VW-specific magazines — there is no 'hidden agenda'. Indeed, I've urged people to use the magazines for their ads and illustrations but not to put much faith in their technical text since it was often incomplete, inaccurate or skewed to favor a device or service offered by one of the magazine's subscribers.

Over the years that I've been uploading articles to the internet my position with regard to the magazines and the poor job they do has earned me a lot of flack. Most of it comes from kids who simply don't know any better, some from older VW owners who should. I thank them for their opinion and that's usually the last I hear from them. But occasionally one of these misguided missiles will wave their lawyer at me. It's all horseshit of course, but it gets tiresome. The truth is, the technical content of the VW-specific magazines is very low. Everyone associated with the magazines has a vested interest, either in their job with the magazine or some outside activity that is fostered by their relationship with the magazine. I don't. My opinion may not be correct but it's always my honest opinion, not dictated by fear, greed or financial interest. And while I may not always be correct, my opinion is based on first-hand experience — I'm the guy with the greasy fingernails — I spend more time at the workbench than the typewriter.

During the course of a recent thread having to do with the retro-fit of a late-model dog-house oil-cooler to an early engine, I mentioned a critically important piece of tin-ware, a small bracket that bolts to the dog-house cooler, serving as an air-dam for the cooler and as a bolting bracket for the fan housing. The absence of this air-dam creates a substantial air leak, allowing air to by-pass the oil cooler. The bracket also serves to secure the blower housing to the oil cooler. Without the bracket and the critical fastener, the tin-ware around the oil cooler is blown out of position by the force of the cooling air, allowing almost as much air to go around the oil cooler as flows through it. The bottom line is that failure to install the bracket results in a profound reduction in the effectiveness of the oil cooler.

A Florida subscriber to the Type2 list read my comments about the benefits of the dog-house cooler and followed the recent thread, as well as asking a number of questions regarding air vanes and thermostats in private messages. He is new to Volkswagens — as were we all at one time — and not especially confident of his skills as a mechanic — as were we all at one time. He decided to tackle the job when an illustrated article on the modification appeared in the April, 1997 issue of 'Dune Buggies and Hot VWs' magazine (page 54). But the article made no mention of the critical bracket and, never having seen one, he could not deduce its location from the illustrations, a copy of which he sent to me by surface mail.

He couldn't see it because it isn't there. The bracket is neither mentioned in the text nor shown in the illustrations —whoever did the work and wrote the article, left it out.

Without that critical little bracket you'll just be pissing away your money on the mod. Get the bracket. Do it right. Pour through the shop manuals until you see how it is installed — I think it only fits one way.

The article was written by Bruce Simurda, the Editor and Associate Publisher of 'Dune Buggies and Hot VWs'. The article presents SoCal Imports as one source of the components needed to do the mod. It would be interesting to hear their comments regarding the missing bracket.

Hoover Bit II

on the 4 or 5 doghouse engines i've pulled apart in my short time, i can not once remember a bracket...

at least, i cant ever remember having to remove any sort of bolt from there...

,

The bracket, which fastens to the two upper bolts securing the oil cooler to the adaptor, is missing on about half the engines I see. Ditto for the stamped steel air-dams in the cylinder heads. And on most of the engines I see, the usual complaint is overheating.

You don't have to remove the fastener to remove the blower housing, just loosen it. The fastener is usually a Filster head machine screw, as for the other tin-ware. (I like to use bolts instead of screws.) It should have the large diameter washer plus a warpy washer. It fits in the notch just beside where the air-vane return spring is fastened. Normally, the screw and washer are loosely installed in the bracket, mating with the blower-housing when the assembly is lowered over the oil cooler. Without the bracket & fastener, at high rpms the tin flap over the blower housing bulges out and most of the air escapes around the oil cooler instead of blowing through it. There's a little foam gasket on the oil cooler that's supposed to seal this leakage path but it's easily defeated when the flap is not secured. (Hint: Use a full-width foam seal. And the proper fastener.)

Form follows function. The bracket is evidence of the critical attention to detail paid by Volkswagen inorder to insure maximum air-flow thru the cooler's core. Failure to include the bracket in their article or to stress the need for the wider fan, is just another of those 'little details' the magazines don't bother with. Unfortunately, attention to detail is the major difference between a good engine and a piece of crap.

Install a Thermostat

Do it.

The thing will run without it, the better the climate, the better it will run. And if you're running a full-flow oil filter the main bearings will last about as long. But that's it; that's the limit of the 'benefits' you'll receive from re-designing the Volkswagen engine, because that's what you've done; you've told generations of superbly qualified engineers to stick it in their ear, that you know a better way to do it. Unfortunately, without the thermostat your jugs will wear like a bitch, as will your valve guides; you'll burn more gas, suck a lot of oil and have a hell of a time passing your smog check. Of course, all the experts in the VW-specific rags say no thermostat is a wizard idea, along with blue coils and yellow wires itty-bitty fan pulleys and all the other bitchin' tricks that made them rich and famous as builders of fine automobiles. What? Oh. Well, then make them famous as builders of winning racers. What? Gee... you mean all they do is TALK about it? Ummmmm.....

Put the thermostat back in. To a real mechanic, anyone who builds an engine without a proper cooling system — and that includes a thermostat and air-vanes — is like a guy going around with his fly unzipped.

Here's how to do it.

You need a blower housing with a working set of air-vanes.

The connecting-rod across the front of the blower housing connecting the air-vanes together. Plus the spring that holds the air-vanes OPEN.

The right-side set of air-vanes must have a thermostat link-rod.

Under the engine you need the thermostat bracket and the thermostat.

To install, make sure the thermostat link-rod slides down through the head and projects between the push-rod tubes under the engine. Secure the blower housing and generator (I'll assume you took the opportunity to replace the modified intake manifold).

Under the engine, reach up and thread the thermostat onto the link-rod. Run it all the way up. Now put the thermostat bracket onto the thermostat. Make sure the base of the thermostat fits the opening in the bracket, which is flat-sided to prevent the thermostat from unscrewing itself as it expands and contracts. Now pull DOWN on the whole assembly and fit the bracket over the stud on the side of the sump. Install a flat washer, a warpy washer and a nut. Pull DOWN on the assembly until the air-vanes are fully closed.

Don’t over-do it. Tighten down the nut securing the bracket.

I’ll assume you tested the thermostat before you did all of this, and that your engine has all its tin-ware. The lower tin provides a plenum that insures the thermostat is bathed in heated air from the cylinders and heads.

The bottom line is that your engine warms up faster, idles better, runs sweeter and lasts longer.

On the other hand, you may wish to leave it off and make your personal style statement to the VW world :-)

Kool Tin

Since my list query about sources for decent Kool tin (that is, not the Taiwanese tin foil grade, casual fit tin...) I've learned that Berg sells sturdy stuff and that the 1600cc non-North American vanagon engines also had such tin stock. I've read in one of your list posts that the Kool tin when used on a 1600 with properly modified upright tin can produce better cooling. Can you outline the tinware modifications necessary to make this work?

You mentioned leaving off the stock deflector plates and welding the Kool tin to stock tinware after modifications to get a tight fit. I could probably "wing" something based on this, but I'm hoping to benefit from your experience here and get some more detail so I don't inadvertantly cutoff critical airflow with a less than astute mod ;).

Volkswagen leaves off the deflector plates when they install 'kool tin' lower shrouding. The deflector plates are not compatible with the tighter 'kool-tin' lower shrouding.

With the engine upside-down on the assembly-fixture and the push-rod tubes off, heads loose, trial fit the kool-tin, observing how it was meant to be fastened and exactly where it was meant to fit between the cylinder fins.

Stock VW kool-tin fits reasonably well but is rather loose, especially in the middle. Experience has shown the original method of installation was inadequate — the kool-tin always came loose, ended up down on top of the push-rod tubes.

The first and most obvious fix is to drill a couple of small holes through the central wedge — the part that goes between the cylinders — and thread some thin-gauge safety wire through the holes. With the engine right-side up you'll see that it's possible to cut & shape two short pieces of welding rod or heavy-gauge stainless steel safety wire to fit down into the cylinder fins and bridge the gap between the cylinders. This is what I use to secure the thin-gauge safety wire I've installed in the kool-tin, drawing the stuff up until it is tight to fins. I shape the tin-ware with rubber or plastic mallets where necessary, with my hands in other areas, grinding or cutting away anything that prevents a smooth, symmetrical fit

To insure the sides can not come free I use two procedures. At the rear of the engine I modify the air-dams that fasten to the cylinder tin (and trap the breast tin between them) to form a smooth fit with the kool-tin, typically by snipping the metal into a series of fingers, heating them and molding each finger to the shape of the kool tin, all this while the tin-ware is securely fastened in position. Each little finger is tack-welded using a aircraft torch with a small tip. When the thing is well secured I take it off, weld it up, sand-blast it and otherwise prepare it for painting.

At the front of the engine, in order for the kool-tin to fit, you must modify the basic bottom-tin-ware pieces, a full-length piece on the driver's side of the engine, a shorter piece on the side of the engine mounting the thermostat bracket. The modification is simply doing whatever is needed to make the tin-ware fit with the kool-tin in place. Typically, this means reducing the convoluted curves and indentations of the origianl piece, which formed a very critical part of the engine's shrouding, into a simply curved panel that will accomodate the kool-tin. The convolutions, bulges and so forth are no longer required since their function is being performed by the Kool-tin.

To insure a good mechanical fit, I then fabricate a flange of sheet-metal of a suitable thickness to fit between the upper and lower pieces of tin-ware (ie, the cylinder head tin-ware and the lower tin-ware) of sufficient depth and shape (I put a little lip on it) to allow it be welded to the kool-tin. The lower-tin-ware is removed while this fitting and welding is going on, of course. It's usually necessary to fasten the kool-tin into the proper position with wire or by some other means in order to accomplish the weld —once you remove the lower tin-ware, the kool-tin is no longer held in position and will move around on you. I generally tack the flange at a couple of points then reassemble the lower tin-ware to be sure I've gotten it right. You're after a really snug fit here, something that will force air to flow THROUGH the fins rather than around them.

Once I have a nice fit fore & act I clean the welds and paint the parts. This work should be done well ahead of any actual engine assembly. The work doesn't have to be pretty — no one is ever going to see it — but do the best you can, taking a bit of time to forge and grind your welds. You'll have to use gas-welding, the tin-ware is a bit thin for MIG. And the thin stuff is prone to cracking so it pays to make a good job of it. Some of my first efforts were merely tacked together. They held up remarkably well but were not nearly so tight as fully-welded units. On average, I spend about forty hours making up the tin-ware for a big-bore stroker. On the wider engines you must even modify the thermostat bracket... and make a new thermostat rod.

Except for final fitting, all of this work should be done on a mock-up since the welding, grinding and so forth might cause damage to a real engine. (A mock-up is any suitable crankcase — even one with a hole in it — fitted with suitable jugs & spacers to give the proper width.

Welding the flange & air-dam to the kool-tin improves its stiffness but you'll find the center is still 'soft'. Although I continue to use the safety-wire fasteners, I also weld a couple of pieces of heavy wire across the bottom, exterior of the kool-tin. Normally, doing this would prevent the stock kool-tin from being removed but after the kool-tin has been modified there is no need to retain the stock securing notches other than as locators. With the notches ground into smooth ‘U’s the kool-tin drops into place on the head-studs without the bending required of the stock kool-tin. The welded wire stiffeners are about 1/8" in diameter and the width of the flat portion of the kool-tin. They add a remarkable amount of stiffness to the kool-tin, allowing it to be fastened more securely, eliminating any vibration that may develop.

I think it would be very difficult to NOT get better cooling using tighter lower shrouding, unless you installed it in such a manner that it could come loose.

Some of the most valuable time you can spend would be to study the lower shrouding on the Corvair, VW Type IV, and most aircraft engines enclosed in pressure-cowlings. When you compare these more efficient cowling methods to the early VW engine it will make the short-comings of the deflector plates painfully evident.

Proper shrouding improves the efficiency of your cooling system. Not only will it cause your engine to run cooler, tighter shrouding allows the thermostat to keep the engine at a more even temperature, which greatly improves the engines service life.

Normal Oil Temps

What is a normal oil temperature reading for a 74 bus 1800 engine? or any bus for that matter...i'm getting an oil temp gauge and once i install it i would be curious as to what normal is compared to "too hot".

This is one of the most common questions I hear. The correct answer is rather fuzzy.

The fact is, there's no one ideal temperature. By their nature, air-cooled engines have a wider envelope of 'normal' operating temperature than does their water-cooled cousins. What you're given to work with in the case of air-cooled engines is a range of safe operation. On simple instruments the range of normal operation is usually marked in green, caution in yellow and waythehelltohot in red.

I've never seen a published figure for the normal oil temperature range for any air-cooled Volkswagen but their Industrial Engine Division showed the green arc as being from 170 to about 220, with a yellow arc above that, apparently up to about 250, and red over the last segment of the dial-face.

You could get the industrial engines with a set of gauges for oil temp, oil pressure and amps. Pressure was picked-off at the gallery where the oil-pressure signal-lamp switch goes in vehicles. Oil temp was picked-off at the inlet to the oil pump, a suitable adaptor replacing the threaded plug found there. Part of the reason for the fuzziness of figures offered by other VW owners is probably due to a lack of standardization in their instrumentation — the Stewart-Warner gauge on my baja bug reads cooler than the El Cheepo gauge on my bus, and so on.

Another reason for the fuzziness has to do with that stuff we use as our cooling fluid — air.

The operating instructions for the industrial engines listed a range of air temperatures at which you could run with a maximum load on the engine. I think the upper limit was about 85 degrees Fahrenheit. Above that you were cautioned to reduce the load if the oil temperture rose out of the green — pretty much common sense, if you're running a grain-drill or an irrigation pump.

It's not too surprising to find the Owner's Manual for Volkswagen vehicles saying about the same thing, albeit with reference to the oil-pressure warning lamp — if it's a hot day and you're driving fast or carrying a heavy load and the lamp begins to flicker, the manual tells you to slow down... to reduce the load on the engine.

The funny part here is that while a farmer is bright enough to figure this out, most driver's somehow miss the point. I get a lot of messages from people asking why their bus overheats when they drive seventy miles an hour on a 90-degree day, as if there's some dark mystery involved. Sadly, telling them they're driving too fast often gets a rather snippy response. :-)

The truth is, air-cooled engines are most suitable for COLD climates. Water-cooled engines do best in the desert. This is one of those grizzly facts that continually bumps heads with Conventional Wisdom... at least, until they bother to sit down and figure it out on paper. Pointing out that Berlin is as far north as Winnepeg sometimes helps but the myth of Kubelwagens in the Sahara usually overpowers any intelligent answer. There were some Bucket-Cars used in north Africa but according to German mechanics who were there, they had a habit of swallowing #3 exhaust valve, a failure-mode woefully familiar to anyone pounding across west Texas in an early beetle. (A lot of Texas is farther south than Cairo. Most of the north African campaign was fought near the shore of the Mediterranean, in Tripolitania and in the Libyan Desert, hundreds of miles north of the Sahara.)

This isn't to say an air-cooled engine is unsuitable for a hot climate, it's simply not as suitable as a water-cooled engine under those conditions. You can keep right on using your air-cooled engine in Brawley or Qunianga Kebir (which IS in the Sahara Desert), but you've got to keep your foot out of it — you simply don't have enough latent cooling capacity to handle maximum output at high ambient air temps.

So what's the 'normal' oil temperature? I don't know. I know what's 'normal' for my engine and vehicle and instruments and load and climate. But I don't know what's 'normal' for yours.

If you'll examine the archives you'll see that the question of temperatures is a pretty popular theme. You'll also see a lot of different numbers, the 'normal' temps registered by different people in different locations doing different types of driving with their vehicles. About the best you can do is make a note of the range of temperatures they've cited and see if your combination gives a number within that range. It ain't too scientific but you could do a lot worse.

Oil Cooler/Tin Mods

I was never able to duplicate Gene's claimed results regarding engine temperatures and external oil coolers. Indeed, Gene never clearly defined what he was measuring. I believe I've already mentioned this situation in an article on external oil coolers.

My original interest was in learning how the Volkswagen engine was cooled so I could insure adequate cooling when the engine was installed in an airplane — converted VW engines in airplanes being notorious for swallowing the rear-most exhaust valves.

I dismantled the blower-housing from a 40-hp engine (this was in the late sixties) and replaced it with a sheet of plexiglas. Running on the test stand, I could introduce smoke-streams and figure out what VW was trying to do. (Later, I rigged the big squirrel-cage blower I used on my flow-bench to suck air down thru an engine with the blower housing removed, using Temp-L-sticks, thermistors and the like to gain some understanding of the temperature change in the heads based on air-flow and engine speed.)

I discovered the major emphasis in the original design was in providing the CORNERS of the engine with air, with a very intricate series of air vanes and dams devoted to this purpose. Because of the obstruction of the oil cooler, the left head didn't flow very well and because of the offset of the cylinders, #3 got the least air of all.

Removing the upright oil cooler brought an immediate improvement in airflow although you had to do something about the 'hole'. I first tried various forms of air dam before realizing I was going at the problem backwards. Adequate flow can only come when there is adequate pressure and Volkswagens' method of sustaining adequate pressure using a pair of deflector plates and the tin-ware skirts across the ends of #2 & #4 cylinder didn't work very well. To maintain sufficient air pressure — needed to insure adequate flow to the 'corners' you must improve the cowling of the underside of the cylinders, a step Volkswagen got around to a few years later.

For aircraft use, a tight upper plenum combined with tight lower cylinder cowling did the trick. This was not a popular fix because many of the lightplane designs do not include pressure cowlings.

There is also considerable improvement you can make in the heads, getting rid of any casting flash and insuring maximum air-flow down thru the fins around the exhaust stacks.

I modified a number of Type IV's for use in aircraft but all of the above work was done with the early model engine.

Getting back to external oil coolers, the dog-house cooler — and that of the Type IV — is an external-type, in that air used to cool the oil is exhausted to the atmosphere and not used for engine cooling.

In one of my articles I described the auxiliary oil cooler I designed for my ’65 bus. I didn’t give a lot of detail about the design process but it involved making a manomoeter from plastic tubing, plywood and colored water to measure the air pressure inside the engine compartment. Addition of air scoops caused a significant increase in engine compartment air-pressure. While many still argue the merits of air-scoops on early buses one need only examine the cooling-air inlets of later model buses to see they too incorporate a scoop-type design.

Once I understood the problem I was able to come up with the design of an auxiliary oil cooler that worked, and very well too, as demonstrated on a run to Kansas City when I had to tow a Westy over South Pass (outside of Needles, California) in temperatures of over 100 degrees.

A couple of closing points.

I don’t want to get into a pissing contest with a dead man but I was never able to substantiate many of Gene Berg’s claims. Indeed, in many cases I couldn’t even get him to explain what he was measuring, where he was measuring it and how it was measured. I said as much years before his untimely death. Nothing has happened to change that.

The information I developed on auxiliary oil cooling applies mostly to my ’65 bus. The general principles MAY apply to later-model buses but the wiser course would be to run some tests before cutting metal.

I don’t see any benefit in your idea of removing the oil cooler in your Type IV. However, should you need an auxilary oil cooler there are convenient means of installing such without removing the stock oil cooler.

All of the Type IV’s I’ve seen that were experiencing problems with overheating, the fault was due to poor maintenance.... usually missing air-seals or tin-ware.

Push-rod Tubes and Cooling

It's hard to get excited about push-rod tubes, those eight accordion-pleated pipes lurking under the cylinders. They form an oil-tight (we hope!) conduit between the valve gallery and the crankcase, allowing multiple return paths for the oil pumped out to the rockers through the push-rods.

At overhaul time it's best to use new push-rod tubes since the bellows portion on either makes them especially difficult to clean. Not the outside; they clean up a treat after an overnight soak in carb cleaner. It's those deep folds on the inside that can't be cleaned. And who knows what kind of crap may be lurking in them? Best to start with new ones; they cost about a buck each, cheap insurance.

But whatever you do, don't even think of using two-part push-rod tubes. They will make your engine run hot.

Eh? The push-rod tubes create heat?

No, they don't create it, but the stock tubes are wizards at getting rid of it! Given a thin coat of flat black paint to preserve them and lower their thermal resistance, your eight push-rod tubes serve as eight auxiliary oil coolers. Thanks to the surface of the bellows sections and the fact the push-rod tubes are constantly bathed in a film of hot oil from the heads, they do a dandy job of coupling heat to the air that flows over them. And that function works in both directions, too.

Heat always flows 'downhill.' If you put a hot thing next to a cold thing, the cold thing absorbs the heat while the hot thing loses it until they achieve equilibrium. Even if the difference is only a degree or two, the heat flows toward the cooler part.

Since the push-rod tubes are bathed in the flow of air that has just passed over the cylinders, the air is hot. But not as hot as the oil coming from the valve gallery. The cylinder head is the second-hottest part of your engine (the exhaust valves and stacks are first) and the oil in the valve galleries is typically a hundred degrees or more above the oil temperature in the sump. (Fahrenheit scale used here.) But that short trip down the push-rod tubes is sufficient to suck a lot of the heat away, thanks to the slightly cooler air coming off the cylinders and the generous surface area of the push-rod tubes.

And that function works in both directions, too. (I wonder why I keep saying that...)

When you start your engine the push-rod tubes serve to ABSORB heat.

The air coming from around the cylinders is hotter than the tubes — and hotter than the oil in them. The design and location of the push-rod tubes helps the engine warm up quickly and reach a dimensionally stable temperature which greatly reduces the wear factor on pistons and rings.

If you replace your stock push-rod tubes with those trick two-part anodized aluminum jobbies so beloved of show-car freaks, you've just thrown away one of the more subtle gems of the VW engine design. And provided ample evidence your engine is for Show rather than Go. And chromed push-rod tubes are even worse than the aluminum jobbies.

Adjustable push-rod tubes have their place; everyone should carry one in their kit of spares, just as we carry a spare fan belt, throttle wire and so forth. If a rock gets around your skid plate and dings a tube, you're out of the race. But with a two-piece push-rod tube in your kit you need only pop the cover, pull the rocker shaft, slide out the push-rod (praying it isn't bent too badly) yank off the damaged tube, replace it with the adjustable tube and you're back in action. Very handy thing to have — when you need one.

But seeing chrome push-rod tubes, or those colorful aluminum jobbies, on an engine does serve a useful purpose: It tells you to stay the hell away from whoever built the engine for they know not whereof they speak.

Splash Shields

The function of the splash shields is EXACTLY the opposite of cooling, although there's a footnote to that as well.

Here's the situation: You are running at speed. You encounter rain, or a puddle, or you ford a creek (common stuff in Baja; no bridges!). Want to imagine what happens to your cast iron cylinders when they get an eyeful of LIQUID water?

Situation 2. You're running at speed, the air under the vehicle is at higher than ambient pressure. Beneath the cylinders the cooling air encounters higher exit pressure at cylinders 1 & 3, reducing cooling air flow. The result is that the portion of the cylinder at the 1 o'clock to about the 3 o'clock position (for #1 cyl; 9 to 11 for #3, in each case relative to an observery looking into the cylinder from the valves) is running hotter than the portion of the cylinder from about 4 to 6 (ie, 8 to 6), since that lower portion is being supercooled by the blast of air provided by the vehicle's forward motion.

Situation 3 is as described in my sermon on push-rod tubes; they are part of your cooling system. But they are also part of your temperature CONTROL system, in that they help the oil heat faster thus achieving a stable operating temperature more quickly.

When the engine temperature is stable the engine performs more efficiently and with less wear. The splash shields form a plenum chamber for the cooling air exhaust, allowing the cylinders to enjoy a uniform airflow regardless of vehicle speed. Plus their name sort of gives it away; liquid water can cause sudden contraction of the cast iron jugs, resulting in oil leaks around the lower spigot and compression leaks at the heads. Bad things happen to a hot air-cooled engine when it gets doused with water. The splash shields form a baffle, and so long as the blower is blowing, very little water SPRAY ever contacts the cylinders... and no LIQUID water at all... unless you're really trying to win.

We learned all this the hard way, stripping out baja's to the bone. Less weight, more acceleration. We eventually saw that Volkswagen engineers had already been there, done that. In the end, we re-designed our skid pans to perform the baffling/shielding function and thus ended a host of problems that had plagued us since our attempts to 'improve' on the original design.

If you really want to improve your engine, look at the Porsche, or the late 2000cc Type IV's; now work BACKWARDS, retrofitting your Type I/III with things such as better lower shrouding (ie, Kool Tin), shaft seals (ie, Sand Seals), hydraulic lifters, full-flow oil filtration, electronic ignition, an external oil cooler (Dog-house Cooler) and so on. It's really pretty easy to be a VW guru when VW has already paid the engineering bill :-)

Align Boring

What is the correct procedure for checking alignment of shaft bores in a crankcase?

There's more than one way to do this and the method I use isn't very precise.

After checking that each of the re-machined bores is a true circle, I dismantle the crankcase and measure the depth of each half-bore using a plunger-mike that reads to tenths (ie, .0001"). Because of the amount of 'crush' inherent in the design, you can have the bores asymmetric by up to three thou or so and still have a usable crankcase, assuming they are all the same. You'll see this kind of asymmetry even in new cases. But what you CAN'T live with is to have the depth of ONE of the bores radically different from the others.

The problems I'm looking for usually show up on used crankcases that have been improperly align-bored but it's worth your time to check even a new case.

On re-manufactured cases, you want to focus your attention of the #2 main-bearing web and bore. If the web has been severely pounded its re-machined bore will usually be asymmetric, so much so the case often isn't usable.

In an ideal world all of the bores would be perfectly identical and symmetrical. That is seldom true. Tolerance is about seven tenths (ie, .0007") for bore diameter so they should all fall within a thou of each other. I measure each bore at three or four points and record the measurements. The crankcase is torqued to spec with all of the fasteners in the plain of the crankshaft installed. Extremes of temperature should be avoided and if the case has just been machined it would be wise to put off any measurements until it has cooled off.

The half-depth is compared to the average of those measurements. After you've measured and recorded all eight half-depths a couple of times, any asymmetry should be obvious. If the asymmetry is consistant, it may be ignored so long as it's under three-thou or so. Anything more, in either case-half, will lead to problems with the mesh of the distributor driver-gear. And of course, any single bore which is not in the same plain as the others is grounds for rejecting the case.

You should already have checked the run-out of your crank. Tolerance for run-out is about the same (ie, .0007") but you have to take into account the diameter and allowed out-of-roundness of the journals on the vee-blocks at the time you check for run-out on the journal between the vee-blocks. See the Bentley manual for the specl, which I can't recall — but it's about a thousandth of an inch (.0010")

These problems are seldom a worry if you start with a good crank and case. As I said in an earlier message, Gene Berg's cranks are the best I've seen, and any align-bore done by Larry Pauter's shop (Pauter Machine Company) was always dead-on. But many one-time rebuilders have to work with what they have, using whatever machining services are locally available.

It's important to note here that I am not doing anything unique or unusual, nor am I looking for some exotic, one-in-a-million fit. All I'm doing is trying to insure that the components going into the engines I build meet Volkswagen's published specifications. Assembling the parts is an entirely different subject. But as sure as God made little green apples, if you start with parts that are out of spec, there's no way in hell you'll ever come up with a reliable engine.

Case Paint

I've used a variety of flat black paint over the years and found most stood up fairly well, except for flat black primer. The least expensive way is to buy a pint of high quality oil-based gloss black enamel and dilute it about 25% with unleaded gasoline (!) (You may call it naptha if you wish.) The gas causes the paint to dry dull instead of glossy.

Oldest engine painted with the above was assembed in '71 or 72, now back in the shop awaiting an overhaul. Paint looks pretty good!

Case Savers

Case savers are threaded steel inserts installed in the VW crankcase to prevent the head studs from shearing their threads and pulling out. American rebuilders of VW engines have been using them since the late 1950's. Volkswagen began installing them in their cases in 1973.

I have seen four different types of case savers intended for after-market installation. The ones I use are threaded 14 x 1.75 (exterior), thru-threaded on the interior for either 8mm or 10mm studs. Variations include those which are closed at the bottom and those having different exterior threads but 14mm x 1.75 is the most common. (The earliest ones I used had an SAE exterior thread.)

Case savers are installed as a matter of course by most overhaul shops. If building a large displacement engine using an early crankcase you will want to select a case saver that will not interfere with opening the spigot bores for larger cylinders, nor get in the way of relieving the case for stroker cranks.

Installation is a straight forward drilling & tapping job. Special tooling is used to support the left case half (ie, the one with the main bearing studs). Tapping is done with a Tap-matic sensitive feed or by hand. The case-savers are normally installed with high strength, hi-temp loc-tite and allowed to cure before any crank relief work or machining the spigot bores. To thread the case savers into the case I modified a couple of old spark plugs, fitting them with 8mm and 10mm stud-ends to serve as installation tools. (If no one is watching, I run them in with an air tool.)

When properly done, installation of case savers is a one-time job that eliminates the possibility of pulled studs. Since case savers are nothing more than threaded sleeves, anyone with a lathe can make them. Although seldom advertised, case savers are available from VW after-market suppliers such as Johnny's Speed & Chrome, Barrett Enterprises, or Hoy-Fox. Cost is about forty cents each; you'll need sixteen.

Case savers are superior to Heli-coils due to their larger contact area and are used in aircraft engines where maximum strength is needed. (They're often called 'stud inserts.')

Engine Paint

My article on painting VW engines has in the several years since it was posted produced more mail than any of the other two hundred or so other articles.

That tells me I didn't do a very good job.

Within the range of temperatures we're concerned with, which is basically the maximum range of our oil temperatures — say, 400 degrees Fahrenheit as the max — a THIN coat of flat-black paint will enhance the heat-flow... from surfaces which are in contact with the oil. That means, the valve covers, push-rod tubes, cylinders, generator tower, crankcase (*) and sump-plate.

The physics of this heat-flow enhancement can get a little hairy but they generally fall-in with the reasoning Jazz laid out in his message. Key factors are that the black surface must be thin — having to do with the wavelength of the heat-energy being transmitted — and must be intimately bonded to the heated surface, the metal to which the paint is applied, and that the paint not contain clay, metallic particles or other substances that act as insulators. In plain language, do NOT use the so-called 'high-temperature' paints, firstly because we aren't dealing with high temperatures, and finally because such paints do in fact act as insulators.

The (*) has to do with aluminum vs magnesium alloy. Paint doesn't like to stick to aluminum unless the surface has been chemically etched. Since this isn't practical with the Type IV crankcase, I don't recommend that it be painted, which is why I specifically mentioned 'magnesium-alloy' when talking about painting crankcases. Magnesium is much more chemically reactive than aluminum — it is, in effect, 'self-etching' (unless passivated) — and gains far more benefit from the corrosion-protective qualities of a layer of paint than does aluminum. So paint your early-style crankcase but don't worry about it if you have a Type IV. (I feel bound to mention that there are such things as self-etching paint intended specifically for aluminum. Most of these are formulated for the aviation industry, are difficult to find except from aviation-oriented suppliers and are expensive. I think such things are beyond the scope of articles directed toward the general population of Volkswagen owners.)

With regard to the aluminum heads, which I also do NOT recommend be painted, the problem has more to do with the temperatures encountered near the exhaust stacks, which is so high it will destroy all common forms of flat-black paint. There are ways to blacken aluminum and thereby enhance it's thermal radiation properties — you can see examples of this on many motorcycles — but the process is beyond the means of the typical Volkswagen owner.

Then we get to the ‘All Black Engine’ confusion.

I trod upon many a toe when I said that folks who chomed their engines hadn’t a clue. That particular thread got its start with regard to the benefits —meaning trophies to be won at car-shows — of POLISHING the crankcase.

A polished crankcase, along with chrome valve covers, push-rod tubes, generator tower and sump-plate cause a VW engine to run so hot you wouldn’t believe it — the thing literally melts down. Of course, if you live in Lapland, this may be exactly what you want, which is why Volkswagen offered chrome valve covers and push-rod tubes and sump-plates and split bearings —all as part of their ‘high-latitude’ package, intended to keep their air-cooled twirler warm and working in a sub-zero climate.

See the problem here? If Volkswagen themselves offered such things — and there were part-numbers that would yield-up marvelously well-chromed parts —then obviously the things had to be GOOD for the engine, right? Speaking from my perspective in sunny southern Cal, I said ‘No,’ loud and clear. Yet there were those pesky VW part-numbers... Conventional Wisdom wins again.

The truth is, with regard to any part of your engine NOT in contact with hot oil, you may paint it — or chrome it — any color you wish. In the case of your shrouding, tin-ware and blower housing, the finish — paint, chrome or what-have-you — is there only to protect the metal. The metal parts themselves are NOT a factor in the transfer of heat via radiation. The metal is there to contain the envelope of cooling air. I realize the metal will get hot through both conduction and radiation absorbtion but the quantity of heat is miniscule when compared to that being radiated by those parts of the engine in contact with the oil. Indeed, this perception of heat is subjective. When the engine is running and the car is moving, the shrouding and tin-ware is usually only slightly warmer than the ambient air temperature. It is only when the vehicle is brought to a halt and the engine shut off that any significant quantity of heat can be absorbed by the tin-ware. The subjective part is the fact that you can not put your hand on the tin-ware when roaring down the highway at sixty mph... but you can when the vehicle has stopped... by which time the tin-ware feels hot to the touch. And Conventional Wisdom wins again.

Want to polish your crankcase? Chrome your valve covers? Go right ahead. But don’t plan on driving the vehicle.

Finally, those pesky heat-exchangers.... The shrouding of your heat-exchangers — the metal canister surrounding the cast aluminum heat-exchanger inside — contacts the exhaust system at only one or two points. While the shrouding does get hot through absorbtion of the heat being radiated by the cast-aluminum heat exchanger, the relatively loose fit of the canister to the exhaust pipe insures there will always be some amount of air-flow through the heat-exchanger, meaning it seldom gets hot enough to cause the break-down of regular (as opposed to high-temperature) paint. That means you can paint your heat-exchangers any color you wish. The paint will burn-off in a small area immediately adjacent to the exhaust pipe but the remainder of the metal will be protected — and you very defintely need to protect your heat exchangers with a coat of paint, otherwise they will rust-out in only a couple of years. The heat exchangers on my '67 bug came with the car — original equipment. They keep trying to rust, and I keep painting them. I'm sure the rust will eventually win but I think me and the heat exchangers are putting up a hell of a good fight :-)

The heat-exchangers on the Type IV are a different case, one in which I haven't enough experience to recommend how they should be finished.

In my original post on painting your engine I stressed the primary purpose was to protect the metal, to insure your engine would last as long as possible. The enhanced heat-flow derived from using the proper paint is a freebie but one that should not be scorned through the use of paints or finishes that might reduce the ability of the engine to cool itself.

Gold Engine Paint?

I'm not familiar with gold GEX engines but one of the Chem-Film formulations (a form of chemical anodizing) is for magnesium allows and leaves the material looking like faintly tarnished brass. It offers some corrosion resistance and makes an excellent base for paint. However, any iron or steel will 'kill' the process, so I doubt they are using Chem-Film although there are probably other surface treatments that leave a similar appearance. (Chem-Film is a brand name.) But if the gold color is actually paint, I'd look for an engine from another builder. Gold (color) is fairly high up the spectrum when it comes to heat transfer; even bare metal should do better.

Flat black is best (unless you're a tree).

Loose Barrels

I am in the middle of building a 1776cc with 90.5mm barrels. I heard from a friend that the barrels are only supposed to move .5mm max around inside the case. Mine however move around atleast 1mm.

Will this cause any problems? What could I do besides have the case machined to accept bigger barrels and make an 1835?

You may have a problem.

The spigot-hole for cast-iron cylinders in a magnesium alloy crankcase must be kept fairly tight due to the difference in their coefficient of expansion.

The normal allowance is about one-thousandnth of an inch of play for each inch of bore. Since the nominal diameter of the spigot-skirt of a 90.5mm cylinder is 3.785, the nominal spigot-bore diameter would be about 3.790.

But those are ‘nominal’ figures. There is considerable variation between the various manufacturers and even within them, with one batch of jugs being thou up or down from the last batch. Whoever opened up your crank case should have miked your jugs and set their tools accordingly.

92mm jugs are made from the same castings as 90.5mm cylinders — their skirt and head diameters are the same, only the bore diameter is different.

Having spigot-holes that are too tight results in hard starting, scuffed pistons and in the worst case, a thrown rod. When the spigot-holes are too loose the cylinders shuffle on the case making it impossible to maintain proper tension on the cylinder-head studs. As they loosen up you lose compression, start losing a lot of oil from the spigot-bores and generally end up with a doggy, drippy, unreliable oil-pumper.

Some lo-buck rebuilders of big-bore engines start with a used crankcase, open up the spigot bores to an enormous 3.825 or thereabouts, slather thick layers of blue RTV on the jugs, slap the engine together and cross their fingers. In most cases the thing survives the warranty period but not much longer.

Since your message did not cite specific dimensions I suggest you start there — blueprint what you’ve got and figure out if its usable. You can push the figures a bit — maybe three thou too fat — but any clearance more than .008 or thereabouts is going to produce the problems mentioned above — the bigger the gap, the bigger the problems and the sooner you’ll see them.

A properly built Volkswagen engine is capable of delivering twenty years of reliable service. It’s worth doing the job right.
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Oil Gallery Plug Repair

Based on your description your engine appears to have blown-out the plug sealing one of the main oil galleries to your cam-followers. Oversize plugs are available but chances are you won't be able to find them locally. The only truly reliable alternative is to thread the bore to accept a set-screw of suitable diameter and install it with loctite. Unfortunately, tapping the thread will contaminate an extremely critical portion of your engine with the metal particles produced by the tapping operation.

The usual field repair in such a case is to provide a pressurized source of lubricant to the oil gallery and to do the tapping while the lubricant is flooding from the open bore, carrying with it (hopefully!) all of the swarf produced by the tapping operation. Once tapped, the lubricant must be drained and all oil removed from the threads. The bore and set-screw are then primed and installed with loctite or similar sealant.

The lubricant need not be under high pressure, only sufficient to insure a positive flow through the bore inorder to carry away the swarf. Spent lubricant can not be reused, however, since you must consider it to be contaminated with metal particles. You must weigh the mess, preparation and cost of the gallon or two of oil against the alternative — tearing down the engine — or the less positive repair procedure described below.

The usual method of setting-up for this job (which also applies to the earlier engines) is to introduced the pressured supply of oil at the oil pressure sensor. Being downstream from the oil-pressure control valve, you can get a good flow with only a few pounds of pressure. (If you introduce the flow upstream from the oil-pressure control valve you would have to overcome the tension of the valve's spring, typically 28 to 45 psi, depending on the engine. The lower the pressure you must work with, the better off you are.)

There are a number of methods of providing a pressurized source of lubricant but for low pressures the handiest means is to modify a tank-type garden sprayer by installing a suitable fixture in the sprayer's hose. (This is how you 'pre-lube' a newly assembled engine before running it for the first time.)

Understand, this method introduces oil THROUGHOUT the engine — you will very quickly fill up the crankcase. If you're careful to stop tapping and let the threads flush, you may drain the crankcase as many times as necessary during this process. Oil from the sump may be used in the pressure bottle but any oil coming from the threaded bore must be thrown away.

However, since you have the old plug there is a somewhat riskier but less messy procedure that may result in an effective and reliable repair. That is to knurl the plug so as to increase it's outside diameter, clean the bore, removing all trace of oil, treat the bore and plug with loctite, and drive the thing back in. Once in place, it should be straked, then allowed to stand for 24 hours for the sealant to harden.

This type of knurling can be easily accomplished using the procedure described in one of my articles on fire prevention. The procedure calls for rolling the plug on a board using a mill-cut file. A light amount of pressure on the file will emboss (or knurl) the plug. The metal raised by the knurling process effectively increases the diameter of the plug — hopefully enough to make it a tight fit in the bore. But since this type of hand-knurling produces linear channels, the thing will still leak unless a suitable sealant is used and allowed to properly cure.

Straking simply means displacing metal with a punch. To strake a plug in the bore you make a series of center-punch marks around the periphery of the bore. The displacement of the metal of the crankcase toward the plug will serve to lock it in place... but only against a moderate amount of internal pressure. Since the gallery will see up to 70 psi, and since the plug has appreciable surface area, the straking alone is not sufficient to insure the thing will stay tight and leak-free. You need to use all three of the procedures — knurling, hardening sealant, and straking — to give you the bests odds of success.

Polished Crankcase

Don't do it, if you intend to drive the vehicle. If it's something for display, feel free to polish it to a nice shine. A coat of clear laquer will preserve the polish for about a year.

But if you intend to drive the vehicle, give the cleaned, deburred crankcase one final wash with hot soapy water followed by a boiling water rinse and allow it to air–dry. A touch of compressed air through the oil passages would be wise (and I assume all plugs are out).

Your clean, dry case should be protected with a LIGHT coat of flat black paint on its exterior surfaces. Do not use a hi–temp paint as the high clay or eutectic metallic content forms a nice insulator. What you want is a surface that will radiate heat. Polished surfaces reflect heat. If you polish your crankcase it will run considerably hotter than normal.

This isn't an automotive hints & kinks sort of thing, it's simple physics. Veedub drivers in cold climates have long known the benefit of chrome plated valve covers and pushrod tubes. The heat–reflective surfaces cause the engine to run from ten to thirty degrees hotter.

The original Volkswagen engines (1935–37) was designed for a service life of 100,000 km; it didn't even have replaceable bearing shells. But through the use of full–flow oil filtration systems the service life of a properly assembled VW engine can exceed 300,000 km, which means the engine may be exposed to the elements for 20 years or more, and that justifies a protective coat of paint.

Flat black paint is virtually transparent to heat radiation. Giving your crankcase, pushrod tubes and valve covers a coat of flat black paint atop bare metal actually promotes engine cooling. One of the quickest ways to spot a professionally built engine is from its somber flat– and matte–black surfaces.

Pulling Dowels

(I've) tried everything but the last dowel refuses to come out.

The dowel may have picked up a bit of debris when it was installed, causing it to wedge. Heating it in an oven may help. Your torch provides only localized heat — it gets the surface too hot by the time the heat penetrates to the root of the dowel.

You can pull any dowel simply by grasping it with a collet-type puller and vibrating the crankshaft with an air-hammer. The usual method is to use to a blunt-nosed chisel in the air-hammer, inserted into the pulley retainer bolt's thread bore so the blunt-nosed chisel rests against he bottom of the hole. The crankshaft is supported in a padded vise, the collet-puller is tightened onto the dowel pin and pulled firmly by hand as you rap the thing with the air-hammer.

No collet? Then use vise-grips. Dowels are hardened. You can't mar a properly hardened down with vise-grips. Some guys don't even bother with a collet (ie, a gripper that grasps the full circumference of a shaft. VW dowels come in three diameters. You'll need a different collet for each size.). Instead, they take a pair of cheap vise-grips with soft jaws and drill them for the size of dowel they want to grip, less a few thou.

No air-hammer? Then use a regular hammer. Just be sure not to damage the crankshaft by hammering on it. No heavy blows. Pretend you're an air-hammer.

If sleeve retainer was used to secure the dowel-pins you'll need to heat the crankshaft to at least 450 degrees. Do this in an oven, where you can control the temperature. Let it heat-soak at least an hour to be sure the heat has penetrated to the dowels. After getting out the dowels, put the crank back in the oven, bring it back up to 450 degrees, let it heat-soak about an hour, then shut the oven off and leave the crank in the oven 24 hours or until the thing is stone cold.

Why does it work?

I don't know. Different mass-ratios or something. But it does work — all mechanics and machine shops pull dowels this way. Or maybe not all, seeing the trouble your local shop had with it. I'd better make this a public post.

Used Cases

For my rebuild I was questioning whether or not to get a new Brazilian/ Mexican $300 case as opposed to an align bore on a used one. What do you think?

If you can afford it, always opt for a new crankcase.

But don't read this as a blanket condemnation of all used crankcases. Volkswagen built the majority of their factory overhauls on used crankcases, and they continue to offer a wide range of replacement main-bearing shells to accomodate align-bored cases and re-ground cranks. The availability of such a wide range of bearing shells makes it obvioius that the design philosophy behind the Volkswagen engine ASSUMED the crankcase could be overhauled and reused. Verification of that conclusion is reflected by the fact Volkswagen did exactly that.

On the other hand, experts such as the late Gene Berg declared flatly that a used crankcase should never be re-used. This seemed a bit harsh since there were verifiable instances of Volkswagens on RFD routes puttering their way past the 500,000 mile mark powered, at least in their latter days, by factory- overhauled engines.

Which makes for an interesting dilemma. On the one hand we have Volkswagenwerk AG with its twenty-million engine's-worth of experience saying it's okay to re-use the crankcase, while on the other hand we have race- winning experts saying exactly the opposite. Which one is right? And to add an arrow to the quiver of the 'experts', even Volkswagen had to admit that not all of their factory re-manufactured engines stood up as well as they would have liked. Some suffered failures that were remarkably similar to the failures experienced by people such as Gene Berg, failures which justified his conclusion that a crankcase should never be reused. Yet there were those hundreds of thousands of remanufactured engines which puttered on with absolutely no problems at all. It was very confusing.

As so often happens in life, the answer is not black & white. BOTH conclusions were valid... under certain circumstances. Unfortunately, those circumstances involved some technical aspects of metallugy so arcane as to virtually insure their understanding would remain forever beyond the grasp of the typical Volkswagen owner. Including me :-)

Early Volkswagen engines use a crankcase cast from magnesium alloy. The other principle constituant of the alloy is aluminum and that's generally as far as anyone bothers to go when defining the metal that makes up the crankcase. But there are other metals as well, including copper and trace amounts of several others, such as tin and niobium.

Until recently, metallurgists had no idea that metals could display thermally-induced ‘memory’ properties. But once discovered, those properties were used in the space program and elsewhere. To take advantage of the memory properties, which are found mostly in tin/niobium alloys, you create the shape you want then heat the fabricated structure to a certain critical ‘memory-write’ temperature. Once it cools, you may crumple the thing into a ball if you wish, knowing it will return to its fabricated shape once the metal is re-heated. One of the most interesting aspects of this property is that the ‘memory-read’ temperature — the temperature at which the metal will begin returning to its ‘memorized’ shape — is considerably LOWER than the temperature needed to ‘write’ that shape into the metal’s memory. This allowed umbrella-sized dish antennas to be crumpled up to the size of a golf ball and shot into space, where they would gracefully unfold when electrically heated and retain their shape when cool.

It appears that after aging for several years, the magnesium alloy used in the early VW engines could display some of these ‘memory’ properties. No one paid much attention because to get the metal to ‘remember’ a shape, it would have to be heated to well above the engine’s NORMAL operating temperature. Unfortunately, due either to an accumulation of wear or the result of extremely high rpms, as might be encounted in an engine used for drag-racing, some parts of the crankcase COULD be raised high enough to cause that part of the casting to ‘remember’. If that part of the casting was under stress or distorted, it would ‘remember’ that over-stressed distortion.

Apparently, the shape most often ‘remembered’ was multi-lobed oval of a severly pounded-out center main-bearing web.

If my interpretation of this situation is correct, and I want you to understand up-front that it is at best an educated guess, overheating in conjunction with a pounded-out #2 main-bearing web sets the stage for what is to follow.

So you have a crankcase that, except for a pounded-out #2, appears okay. You give it an align-bore and even the most critical blueprinting says you’ve got a good case. But heat the thing to about 300 degrees Fahrenheit — considerably LOWER than the temperature needed to make the metal ‘remember’ — and all of a sudden THE CENTER MAIN BEARING BORE IS NO LONGER ROUND!

The problem is not isolated to the #2 main bearing. The oil supply for everything on the right-hand side of the engine passes thru a drilled passage at the #2 cam bearing... which is an intergal part of the #2 main-bearing web. Any distortion of the center main-bearing web, either in the bearing bore or in the web itself, will result in a castrophic loss of oil pressure. The #2 main bearing provides oiling to two of the connecting rods. The web itself forms the oil passage everything else on the right-hand side — cam followers, rockers and valves. Without sufficient oil pressure, you really don't much of an engine.

Volkswagen changed the alloy of its cast magnesium crankcases. The new alloy has a higher percentage of aluminum, which does not display any 'memory' characteristics. And of course, the Type IV is aluminum rather than magnesium.

Now let's get back to the original question. Should you use an align-bored crankcase?

I often do. But only if I know the provenance of the engine. If the thing has been overheated, or suffered any form of catastrophic failure, I'll avoid it. I've built a lot of enignes and a lot of them were based on all new components. As they approached the end of their useful life I had no qualms about align-boring the case, grinding the crankshaft and rebuilding them to spec. Exactly as Volkswagen did with hundreds of thousands of replacement engines. Not racing engines. Bug engines, or bus engines or Ghia engines. Engines fitted with proper cooling systems and, in most cases, full-flow oil filtration.

Wanna go-fast-make-noise? You're probably better off starting with all new components.

As to ordering a 'rebuilt' crankcase, I can't recommend it. The odds are, a rebuilt case will do just fine. But occasionally it won't. If I don't know the history of the engine I tend to worry. Which brings us back to where we started: If you can afford it, always opt for a new case.

1600 vs 1641

Yes, there is a slight improvement in torque with the 88mm jugs.

Your engine is actually a 1584. Going from 85.5 to 88.0 jugs gives a 4.5% increase in displacement. ('1600' to 1641 is only 3%.)

But don't bother.

The 88mm 'slipper-skirt' jugs have a poor long-term performance history, apparently because of their thinner cylinder walls — they pick up that extra 2.5mm diameter by making the walls 1.25mm thinner. And while fifty thou on the radius may not sound like much, the walls are already pretty thin to begin with for the simple reason that the 85.5's started life as 83's (!) The "1600" engine is just a bored-out 1500.

Head leaks and pulled studs were pretty rare on 1500's, even with the 8.5:1 CR ratio used on the early Type III's but became fairly common on 1600's even thouigh the CR was dropped to 7.7:1. Head leaks are virtually guaranteed when you go to the even thinner-walled 88's unless you drop your compression down to about 6.8 ~ 7.0... which takes away any advantage you will have gained from the larger displacement.

If you feel, as most of us do, that you need more power the best bet is to look for it in other areas, such as balance or breathing. While it's hard to argue with cubes, the 88mm jugs are not a wise choice.

Altitude Adjustment

Due to the lower air density at higher altitudes your engine may run slightly rich and therefore cooler. The general rule of thumb is that you may advance your timing one degree for each thousand feet of altitude. And with that stated let me offer some personal advice. If you do not have a degree wheel, and are not running electronic ignition the chances are that your timing will wander a bit even under ideal circumstances, thanks to the plug gap, wear in the distributor shaft, rubbing block and so forth. If you intend to operate above 5,000 feet elevation for a prolonged period of time (ie, a move to Denver, etc) then by all means, re-time your engine. Otherwise, leave it alone, unless it gives tells you in an obvious way that it would prefer a different setting, in which case crank in a degree or two — whatever the engine likes — to return its operation to harmony with your driving habits, load carried, type of gas and, for all I know, the color of your hair and eyes. The point is, the settings in the manuals refer to new engines operated under a set of fixed conditions. Reality is seldom so kind, yet the engine is always willing to let you know when it is happiest.

The symptoms of altitude sickness usually resemble retarded timing; lack of power, poor economy, possibly a bit of black smoke or start-up or when attempting to accelerate. However, if you are running a hot CDI or other all-electronic ignition module, the symptoms may be partially masked by the cleaner burn and longer spark duration provided by most CDI's (which are easily retro-fitted if you're not presently using one. Coupled with platinum plugs, the combo virtually eliminates tune-ups for air-cooled veedubs.)

You may put aside any fears of high-altitude (ie, low-pressure) vapor locking (as opposed to high temp vapor locks). Since about 1980 all automobile fuel sold in the United States has a vapor pressure that allows it to be used safely to about 12,000 at 100 degrees Fahrenheit (an unlikely combination). For the past twelve years the Experimental Aircraft Association has been using mogas in aircraft, reporting the results to the FAA and the EAA members. Several certified aircraft engines are now permitted to use mogas, or 'tractor' gas as pilots tend to call it. Works fine, even in old Volkswagens; no problems with low-pressure vapor-locking.

Boxer Engine

The term ‘boxer’ is used to describe a horizontally–opposed engine having a single crankshaft and camshaft in which the lobes of the camshaft are common to the opposing valves.

The origin of the term is unclear.

Other forms of horizontally opposed engines have a crankshaft for each bank of cylinders and are built with a common head instead of a common crankcrase.

The ‘boxer’ design enjoys a high ratio of common, shared, and interchangeable parts, making it one of the least expensive engines to manufacture and maintain. The simpicity of the design insures good reliability. When designed to use air cooling and when fabricated of light alloy castings, the combination of reliability, simplicity and light weight make it ideal for use in aircraft.

Chamber Volume

Holding chamber volume to .1cc is like running a four minute mile — not everyone can do it and even those who can often chose to take the bus.

Unless you're going for the gold, the added time and expense of nailing down the chamber volume to a perfect, repeatable figure within .1cc across all four jugs is really gilding the lilly. It has taken me as long as a week to match a set of heads to .1cc, whereas getting them within 1.0cc (plus or minus 0.5cc) is pretty easy.

Normally, you adjust chamber volume by sinking one of the valves. If you've got a lot of volume to make up, you sink the intake, but never very much. You want the intake valve to keep its head up. On the other hand, the exhaust valve can be down in a well and still work, thanks to the pressure during the exhaust cycle. But adjusting valve depth is not a trivial task. You need a set of stones and the tools and the skills. And you must be accustomed to working to very close tolerances. Go a bit too far and you'll end up having to do the other three over to match your mistake.

You'll encounter the same difficulties when you try to keep your deck height to some small value. Deck height determination really starts before the engine is assembled. You need to determine the precise center-to-center length of each rod — they vary according to how the big end is honed — and on each piston, the distance between the wrist-pin bore and the head of the piston. You also must measure each of your cylinders using a surface plate and surface gauge. You do your first pre-assembly by matching 'short' rods to 'long' pistons in an effort to make all of equal length but you don't really know anything until the crankcase is torqued and the cylinders seated with a dummy head, a plate with spacers that allows you to torque the cylinder studs to spec. Deck height is measured through a hole in the plate.

The trick here is to arrive at a consistant height for all of the cylinders while you maintain the same deck height. It is virtually impossible to do this without having a lathe, since the final dimension is usually achieved by shaving a few thou off the heads of the 'fat' pistons, but you can shuffle components to arrive at the best average.

Deck height is the most critical of your volumetric-balance dimensions because a small dimensional change results in a large change in volume.

If you're building a plain vanilla engine, measure everything but do not attempt to balance chamber volume until you've done at least the first pre-assembly to determine deck-height. Often times you'll be able to balance a big chamber with a small deck-height and arrive at a good average volume across all four jugs.

A key point to keep in mind is that your engine will run with some amazing imbalances in both mass and volume, but it does so at an equally amazing cost. An out of balance engine is destined to live a short, expensive life whereas one that is balanced with respect to both mass and volume uses less fuel to produce the same power and has a useful life considerably longer than it's mass-produced cousins. And these are improvements that are built-in for the life of the engine, repaying their cost many times over.

Cleaning Tinware

Cleaning steel parts is a snap compared to aluminum or magnesium alloys. Just boil it. With lye. Not only will it remove all of the grease, it also takes off the paint and much of the rust.

A 55 gal oil drum cut in half and fitted with a lid makes a good parts boiler, a kind of poor-man's hot tank. Or cold tank, although things happen more quicky when the stuff is hot. Provided with a pump, blower and a bit of plumbing, you can do a fine job of heating it using old lubricating oil. (If you're interesting in foundry work, the same burner assembly provides enough heat to melt a good-sized crucible of aluminum in about twenty minutes.)

The importance of the tin-ware is often overlooked. If you're doing an over-haul you may find my privious post 'Easy Tin' of value.

Compression Ratio

Getting it Right
Adjusting Deck Height and Compression Ratio

The use of rebuilt heads poses a problem for the unwary. Wanna NOT blow up your engine? Read on!

Doing the Numbers

We need to start with some definitions. The manuals differ on how they lable things so for now, use the following:

Compression ratio is determined by dividing the total volume (V sub t) by the swept volume (V sub s).

Total volume is the sum of the chamber volume (V sub c), the deck volume (V sub d) and the swept volume (V sub s)

Chamber volume is not calculated, it is measured directly. For your basic overhaul you don't need a very precise number but you MUST know the approximate chamber volume. An easy way to do this is to obtain a fat 50cc syringe from a veterenary or pharmacy, level the head with the valves and spark plug installed, then fill the chamber with water. Do it several times and average the results. Do it for all four chambers. When you calculate your compression ratio, use the SMALLEST of the four chambers for chamber volume (V sub c).

If the chambers are larger than 50cc use a marble to take up some of the space. Determine the marble's volume by dropping it into the half-filled syringe. It's volume equals its displacement. (Eureka!) Use the same marble(s) in all four chambers and don't forget to add its volume to the reading off the syringe.

Swept volume and deck volume are calculated using the formula:

0.785 x bore diameter squared x stroke

Stroke is 69mm for a stock engine. If you're rebuilding a 36hp, use 64mm. If your engine has a stroker crank, use that dimension. But don't guess.

To calculate deck height, use the same formula but substitute deck height for stroke. Bore diameter is whatever pistons you are using. A stock 1600cc engine uses 85.5mm jugs.

Use millimeters for all of your calculations. 1mm is approximately equal to .0394 inches. Measure your deck height then convert it to millimeters by dividing the inch dimension by .0394

Since you'll be using millimeters for your calculations, the answer will be in cubic millimeters. To convert to cubic centimenters, shove the decimal three places to the left.

Trouble in the Engine Room

To illustrate, let me walk through the calculations using real data and real heads, a pair of rebuilts I have here in the shop.

The engine is a stock 1600cc dual-port. The jugs are 85.5mm in diameter. Since we use that same diameter when we calculate deck volume, lets run the numbers and get it out of the way. 85.5 x 85.5 (that is, the diameter squared) equals 7,310.25. Now we mutiply that by 0.785 (that is, the pi factor) to get 5,738.546. We will use that value to compute both swept volume and deck volume.

5,738.546 times the 69mm stroke gives us 395,959.6913 as our swept volume.

The deck height measured .065" Dividing that by .0394 gives us 1.649mm.

5,738.546 times the 1.649mm deck height gives us 9,462.86.

The combustion chamber measured 43.5 cubic centimeters so lets convert the other factors to cubic centimeters before we add them together.

395,959.6913 becomes........	396.0cc (rounded) Swept
9,462.86 becomes.......	9.5cc (rounded) Deck
and our chamber volume was....	43.5cc (averaged) Chamber

Which gives us a total volume of...449.0 Total Volume

(Note: Engine displacement is based on swept volume rather than total volume. Four times 396cc equals 1584, the displacement of a '1600' engine.)

Dividing the total volume by the sum of the chamber and deck volume gives us 449.0 divided by 53.0 or 8.346... which is our compression ratio. And that is too high.

A Bit of Background

This particular engine is in the shop because it blew a piston — hole about as big as a quarter, right through the top of the thing. And it was just overhauled, too.

How could such a thing happen? Easy. The kid bought a pair of rebuilt heads and slapped them on without bothering to check anything. But one of the heads had been flycut. Flycutting reduces the chamber volume, which raises the compression ratio. A combination of hot weather, a heavy foot, low-ocatane gas and a high compression ratio lead to detonation. Naturally, the kid kept on driving. And of course he had to really keep his foot in it to get over them hills with only three cylinders.

The second jug blew a few minutes after the first, which convinced him to turn around and head for home. Amazingly, he managed to make it home on the two surviving cylinders. Of course, it cost him an engine. He now drives his mom's Toyota and rails against veedubs as 'nothing but junk.' His mom, no dummy, won't even let him check the air in the tires :-)

So you run the numbers and they say the compression ratio will be too high. What do we do now?

We put spacers under the cylinders, that's what. Of course, we need to know how thick a spacer we should use but that turns out to be pretty simple, we merely turn the equation around.

More Numbers

With a total volume of 449cc, what volume chamber-plus-deck will give us 7.3:1?

To find out, just divide 449 by 7.3. You should get about sixty-one and half... 61.5cc's.

And since you can't change the chamber volume, lets get it out of the equation by substracting it from the 61.5. 61.5 minus 43.5 equals 19.0cc, or about twice our original deck volume.

Since we measured the deck height as .065" the quick and dirty solution would be to double it by slapping a sixty-thou shim under the jugs and drive on. And it would work just fine, too. But quick & easy answers are often a bit too quick & easy. Remember, deck volume appears in both sides of the equation. If we increase our fixed volume — the volume of the deck plus the volume of the chamber — we have also increased our total volume. So before we dash off in all directions, lets run the numbers again. First, we'll add 9.5cc to our total volume, making it 458.5 cc's. Now we add 9.5cc's to our fixed volume, making it 62.5cc. Now divide 458.5 by 62.5 and see what you get.

7.336?

Ah ha, said the mechanic. Ah ha indeed! Close enough.

(But what if the numbers had been off? In that case simply do the calculations over again, increasing deck height by ten thou (.25mm) each time until your compression ratio drops below 7.5 to 1.)

Okay, in this case the numbers worked out close enough. And a sixty-thou spacer is a standard item, if you call around. But be careful. Everyone carries tens, twenties and forties. They'll tell you to stack them up to make a sixty but don't do it, you want as few surfaces as possible. The good shops carry shims all the way up to ninty thou (.090") in increments of ten thou (.010") and only charge about eight bucks a set. Cheep.

(Before posting this article I called around to verify availability and price of cylinder shims. A couple of outfits only carried the thinner three sizes, gave me the 'stack 'em up' bullshit. The better shops carried the full range. Johnny's Speed & Chrome sez stackemup, Mark Stephens' shop was the other sort — "We got stock, ten thru ninety. Or we can polish you up a set." I like their attitude.)

The range of available spacers brings up another point. The use of cylinder shims or spacers is the normal procedure used to adjust the compression ratio of a rebuilt engine and all of the better after-market suppliers keep the standard sizes on the shelf, ready for immediate delivery. But if you want a size that isn't in stock, the price goes up dramatically since someone will have to chuck a set of spacers in a surface grinder and bring them down to the size you need. This can cost up to forty dollars.

So let's say your numbers tell you to use a spacer exactly .035" thick. Unless you're out to win a race, don't do it. Order a set of forties and drive on. But don't stack up your shims. It increases the risk of leaks.

The rule here is to opt for the next larger size of standard shims that will give you the compression ratio you need. And it's handy to know that the paper gasket in the standard overhaul kit is about .008" thick. I don't use gaskets on my engines since I prefer a metal-to-metal joint between the cylinders and crankcase, but in a special case with stock jugs, I might use them.

Sermonette

Stock Volkswagen engines have used compression ratios as low as 5.8:1 and as high as 8.5:1. Given today's gasoline, the wiser course is to err on the low side, with a compression ratio of no more than 7.5:1, and a whole lot less if you buy your gas at a Pemex station.

Rebuilt parts are liable to vary wildly from the dimension of stock, original Volkswagen equipment. When someone sez a part is 'stock' it don't mean a thing until you clap a caliper on it and see for yourself that it falls within stock specs.

In an earlier series of posts I wrote about filter/pump adaptors that were machined about .006" undersize, rendering them useless. On returning the part to the store I demonstrated that it could not work as intended. Months later I visited the same store and saw the same filter-pump in the showcase, waiting for the next sucker to come along. When it comes to parts, rebuilt or new, it's insane to trust the veracity of the guy behind the parts counter. He's a clerk, not a mechanic, and in this case he's a dishonest clerk. YOU are the mechanic. The kid behind the counter isn't building the engine. And he isn't paying for it, either.

When you assemble an engine from an assortment of rebuilt parts you're dealing with a host of unknowns. A few simple tests and measurements not only eliminates confusion it usually results in a better engine.

Engine Break-In

If the engine has never run, you're probably safe in unbolting it willy-nilly, but I tend to work form the outside in, top to the bottom. Make everything finger-loose. Check for 'tight' nuts. Don't disturb the washers; there should be sealant under them. With everything backed off, use MEK or Klean n' Prime on the thread between the nut and the washer (you'll need the little nozzle, or a laboratory spray bottle, or Q-tips, or... I use one of those lab bottles). If you really can't get in there, take off the nut so you can get at the stud.

If you got tight nuts, replace them or chase them. When you like the way things fit, put a dot of medium strength Loctite on the primed thread right up by the washer, run the nuts up finger tight plus a twist 'o the wrist, start sneaking up on the torque. I resent my clicker three or four times, starting at about 12, ending up with 25, 26, or 27 ft/lbs, depending on temperature, type of crankcase, direction of the wind... :-) If it's an early case with thick studs, use 23 ft/lb. Later cases with stud-inserts and the small (10mm) studs have a higher torquing spec, but never exceed 28 ft/lb. After retorquing the new engine, let it sit over night then check the torque again before you close it up. Just check for the last value; you're looking for 'lazy' studs that have elogated as a result of torquing.

To me, First Fire doesn't really count as part of the break-in, it's merely the final step in the ASSEMBLY. I get it started, pick it up to about a thousand rpm, let it run until it has a certain 'hot' smell, never letting the speed settle, up and down a little, senses very busy. Mebbe three minutes, max. Oil is 10W-Something; thin. Then I drain it out into a clean container, go off and think about things for a while. Slowly decant the flushing oil, drain the last little bit into a glass dish, slosh it with MEK like a placer miner looking for gold.

I've just cleaned the inside of the newly assembled engine. It really isn't a part of the break-in cycle. Back when I was building a lot of engines, I might even use the same flushing oil on two engines, or put the same oil back in the engine, if no residue was found (but I usually throw it away; about four bucks. Cheep).

After it's flushed, I re-check the valves and timing; anything that might have kicked loose; anything I might have overlooked. (Yeah, me too.) Then I re-fill it, fire it up, warm it up — never takes long with a new engine — bring it up to about 2,500, hunt around that speed range while I'm crawling all over the thing. It's on the test stand, I'm not wearing ear muffs. I've got all the sensors cranked up to nine; smell, sight, hearing, hearing, hearing, touch. I overload in about fifteen minutes, have to shut it down and think about it. I might run it a little more to get more data on a particular thing but most often drain it, let it cool down. You always throw away this oil; it's your first break-in cycle. Check it for chunkies of course. You're real interested in any drips at this stage. There shouldn't be a single one so if you see one it usually means the thing goes back into the shop, gets torn down. This is about the worst thing that can happen. And it does, but no oftener than once in every hundred engines or so. And yes, it's usually my fault. Just plain damn stupidity or carelessness, like letting my cuff drag across the parting line just as I'm closing the case; dumb stuff. All that work ruined. But I'm getting better at it :-)

I usually keep an engine on the test stand until the rings are well seated and the temperature comes down; about six hours, on average. Then too, I tend to build 'tight' engines; you have to be careful breaking them in, giving them plenty of time to cool down between runs, keeping the oil changed even with the filter installed.

After a couple of hours you and the engine are pretty well acquainted; they're all a little different. You've got the carb(s) tweaked down to the fine numbers, the thing will start on the first revolution of the crank, the case is dry, the blow-back is next to nothing and it's starting to develop its own unique sound that will allow me to identify it years from now, assuming the muffler and intake are the same.

An apparently mindless part of breaking in an engine is seating the rings. We call it Bumps & Grinds. You slowly open the throttle to about 2500 then drop it, just let it shut. Anyone hearing you would think you're just playing with the poor thing, up and down, loud then quiet. You'll be wearing your ear muffs by then; you're breaking it in, not checking it out. You never do any of these things for very long; mebbe 20 minutes at the outside, more like fifteen, then shut it down and go do something else; let it cool off. If you're doing more than one engine you'll have to dismount it hot, put it back on its scooter, put the next customer in the chair. (I've done as many as fine engines for one customer, all as a series. Five is mebbe one too many for one man at a time.)

You keep records. If you're using a test stand you'll usually have a Hobbs meter; a kind of clock. If not, just your watch and and a note book. Doing one engine, you can't get too confused.

The engine will start flattening out its curves after five or six hours of running. Fuel consumption will have dropped down to some steady figure, as will the temperatures. Oil pressure will have come up. You'll want to verify that with a wet & dry compression check and a leak-down test, if you've got the harness. You will have to take a last look at the valves — unless you're running hydraulics.

Breaking in an engine with hydraulic lifters is a little different than with solids, first because the valves probably won't tell you anything at all. They'll always be running a perfect zero-lash. But hydraulics in a freshly machined magnesium crankcase can generate a bit more 'mud' than with solids, or even hydrualics in an aluminum crankcase. So you take it easier at first, accumulating about 45 minutes of run-time before you start seating in the rings.

Understand, the engine has NEVER been allowed to sit about at an idle. Breaking in an engine means WEARING IN an engine; it is a kind of controlled friction. But the mud does bad things to the minute clearances of hydraulic lifters, which are having an especially hard time because the engine is running hotter than it ever will again. So you do more short runs and longer cooling-off periods when you break-in a Type I fitted with hydraulics. That is, during the first two to three hours. After that, there doesn't seem to be any difference, except the hydraulic engine will run quieter. And a little more efficiently, but you won't see that until you've got mebbe six hours on it, by which time it probably will have been installed in a vehicle and roared off down the road.

Air-cooled engines have pretty loose tolerances compared to their water-cooled cousins. And with the inherent rev-limiters built in the the VW carburetion, cam and valves, you could run a factory-built VW right out of the box and not have any problems. That was then. No telling what kind of an engine you'll wind up with nowadays. It's best to pretend its a custom-assembled one-off design and break it in accordingly, taking lots of time to correct any problems, let the thing cool between runs (and I mean at least an hour), change the oil at least twice in the first six hours, and doing anything else you can think of to ease the birthing pains.

The complete wear-in cycle continue for about a hundred hours, after which the engine's curves will stay substantially the same for the next thousand hours of engine operation. Understand, the engine is still wearing, still experiencing friction. But now it is WEARING OUT, not in. The wear during its service life will be very uniform and consistantly small, but after a thousand hours or so you will see the first signs of terminal wear from the valves, the weak links in the VW system. The lower end should be good for at least 1,500 hours and will probably run 2,000 without a whit of trouble (say, 100,000 miles) assuming you're running a full-flow filter. Beyond that, it will depend on if you've got a shaft seal, how well you've done your maintenance, your particular driving habits, and the vehicle in which the engine is installed, with early buses providing about half the service life of a sedan engine, later buses falling somewhere between the two.

Given the fact this is your first engine, I'm really looking forward to you having a successful installation. Please keep the list up to date on your efforts. Although you may not believe it, your success will cause of at least three other subscribers to take the plunge. It isn't just one engine you're bringing to life here but four.

"Bug Eats Lexus!" (News at eleven)

Friday. Had to run some errands in town. Took the baja instead of the bike. Guy talking on a cell phone decided he wanted to occupy my lane. With me in it. Lexus. Went to cut me off. I stayed alongside, smiled. No turn signal, he just decided to move over, apparently willing to play bumper tag. Except my baja has crash bars on the SIDES as well as front, back, top, bottom and a few places in between. We were doing about 60 on a 4-lane city street, intersection coming up, the Yuppie Prince — not in a turning lane — is being forced to Plan Ahead for the first time in years. So he floors it. After all, $50,000 vs ... I gave the accelerator a gentle touch of toe and at that precise, wonderful moment, I ate the fan belt! Engine immediately went to about nine thousand rpm, slams me back into the seat like something out of 'Road Warrior' breathing nitrous oxide. Lights come on, horn goes off, speedo winds up to something seriously silly as I shoot through the intersection on the tail-end of the green, hang a left, coast into Carrow's parking lot leaving the Yuppie Prince in his $50,000 cage to sort it out with Deputy Dawg, who he almost creamed diving into the intersection on the tail-end of the yellow. The Deputy was still writing in his little book by the time I got the spare belt installed. Sometimes God frowns. But sometimes He smiles, too.

Engine Rebuild -- Cleaning

You don‘t want to get anything inside of the engine. It isn‘t the nature of the solvent or diesel or gasoline or whatever you‘ll be using as a cleanser, it is because of what the solvent will carry with it when it gets inside — a lot of dirt.

If you‘ll build a platform of blocks about four inches high then go to the grocery store and buy a couple of turkey roasting pans — those cheap throw–away aluminum jobbies — you can sit the pans on the blocks, put a few more blocks inside the pans and sit the engine, flywheel–down, atop the blocks. By plugging all openings with paper toweling — and really doing a good job of it — you can start washing the engine from the pulley end and working down. The crud ends up in the pan(s) from whence you can drain it away, thanks to its being a little higher than the floor, bench top or what–have–you.

If you use paint thinner as a solvent you‘ll find that its high vapor pressure keeps it from evaporating as quickly as gasoline. This not only reduces the fire hazard but will allow you to re–use the solvent, either directly, by loading a brush and carring it to some high point on the upright engine, or draining it off, allowing the solids to settle–out overnight and carefully decanting the solvent back into your ‘working‘ containing — a coffee can or whatever.

A very useful trick for cleaning used solvent is to pour it into a containing having a few inches of water in the bottom. The contaminants and suspended solids — dirt and the like — will fall through the solvent and into the water, whereas the solvent will float on the water. The disadvantage here is that you must decant the solvent via syphon — never a very good idea — by pump or, my favorite, by displacement… I lower a huge hunk of iron into my settling container, causing the solvent to overflow into a clean container. Other guys just run more water into the can, displacing the solvent that way. But then they have to deal with the water.

It will take about three gallons of solvent to clean the engine. Just keep at it, working from the top down. If you‘ve plugged all of the holes with wads of toweling, newsprint, etc, they will soak up some solvent but will not allow contaminants to get into the engine.

On your tin–ware, go after the grease with solvent or lye — I use Easy–Off oven cleaner. Spray it on, scrub it around with a bristle brush then wash it off with hot soapy water. You‘ll have to use several applications. Don‘t worry about the paint — it will probably come off anyway.

When you get the tin–ware clean you'll see a lot of it is bent and there will be some fatigue fractures at deeply drawn corners. The best bet is to tap things straight and repair any cracks or tears by welding. Your tin–ware is your cooling system and deserves more care than it gets.

I remove the paint, again, using lye or paint remove, after which I tackle any rust with sand paper. When I get down to clean metal and have made any necessary repairs, I wipe the tin–ware with paint thinner, dry it and give it a moderate coat of Rustoleum Rusty Metal Primer then allow it to cure for a couple of days. Working away from the shop, I rub down the first coat of primer with #0000 steel wool until I achieve a uniform shine. While working down this first coat of paint I can see if the part is perfectly clean, if additional repairs are needed and so forth. A little #120 sand paper will pick up anything you missed during cleaning, after which the part deserves another coat of primer before going back thorugh the cycle.

I wipe the rubbed–down part with paint thinner again, dry it and give it a second coat of Rustoleum. The second coat usually takes a little longer to cure. Putting the parts inside the bus with the windows up will speed things along at the cost of making the bus smell of paint.

When the second coat is cured I repeat the rubbing–down, wipe down & drying. The third coat is gray sanding primer. When it cures it gets the rub–down treatment, after which the part should shine as if it were polished, which it is. The color coat is Rustoleum Gloss Black or Machinery Gray, depending on the part. Before spraying the color coat I go through the wipe–down & drying again. The color coat is a double coat, laid on full and allowed to flat. The paint and the part need to be warm to get the best finish. I apply the second coat of color when the first has reached the tacky stage, usually after an hour or so. The parts are handled by bailing wire hooks, always using two or more hooks to have access to all surfaces of the part during spraying. The parts are then allowed to cure for several days before being handled. You'll have to chase the threads on the nut plates after painting.

This sounds like a lot of work for tin–ware and I suppose it is, but painting and rubbing–out are the sort of things you can use to fill in idle moments. The resulting finish is attractive, durable, easy to repair if scratched and very easy to keep clean, thanks to the glossy finish. If you want to fake out your friends, make up some letter–stamps from urethane foam sponge, spray a little white paint on them and stamp the numbers onto the tin–ware a la Volkswagen — the thing comes out looking like a factory–overhauled engine, right down to the blotchy stencil/stampings ('613', 'M10', 'J5', etc. I don't know what they mean but they were present on all factory–overhauled engines :–)

Treat your air–cleaner and accessory parts in the same fashion.

A very critical piece of tin–ware and one often overlooked is the tiny support bracket on the oil cooler, the one that bolts around the outboard end of the oil cooler and from there, to the cast magnesium blower housing. This innocent looking piece of tin–ware is what keeps your oil cooler from leaking. I serves to damp vibrations in the cantelevered oil cooler. If this part is missing from your engine, it is illustrated in Tom Wilson's book (see pages 66, 67, 148, 149 & 150). This part was missing on the engine I've rebuilding. Logic told me something should be there but no one knew what the part looked liked since it was not on any of the engines I was able to examine and several people insisted it did not exist since they had never seen one. Nor was I able to find a replacement. In the end, I was forced to weld one up.

Free Horsepower

A subscriber of this list recently took me to task for my repeated use of the expression ‘properly assembled engine,’ insisting that some ‘shade tree mechanic from California’ could not possibly improve on Volkswagen’s own methods and their millions of engine–worths of experience.

He failed to consider the fact that I build just one engine at a time. And where VW specifies an acceptable range of tolerance in their parts, a necessity for high–volume production, I don’t have that particular burden. When setting crankshaft end–play, for example, I dress the thrust–face of the #1 bearing until I achieve a clearance of .0025 EXACTLY. This takes… as long as it takes, from a few minutes to a day or more if I have to track down another set of bearings. And I didn’t learn this out of books, I learned it from VW mechanics; guys who took considerable pride in being able to improve on a ‘factory job’.

What remarkable improvement in horsepower or longevity results from assembling an engine to better than factory spec? In the case of crankshaft end–play, I doubt if there’s any at all but the truth is, I don’t really care. I know that if all the shims are dead flat, the flywheel and crank are true and the thrust surface of the bearing brought to truth with dye and judicious flatting, I get a nicer fit that holds spec longer. (The wear limit here is .006; you can check it without dismantling your engine by taking the measurement from the pulley–end of the crank. It’s a quick check on the general state of health of the lower end.) No quotas. No time clocks. When it’s right, the engine tells me so. And I derive great satisfaction from that. This applies to fitting the rods, adjusting ring–gap — to everything involved in ‘proper’ assembly of an engine. And you can do it too.

Chances are, if you’ve never built an engine before, you won’t do any worse a job of it than Volkswagen AND MAY DO EVEN BETTER, which is why I think everyone should build their own engines. But most of you don’t. A lot of you are satisfied with a short– block from a reputable manufacturer. And that can be a costly mistake.

Back when the Volkswagen engine was designed, the importance of balancing, both dynamic and volumetric, was not well understood; by modern standards the VW balancing specs are quite crude. The best proof of this is to compare the output of a properly assembled engine against one assembled to stock specs. The difference is never less than a 5% increase in horsepower and often as much as 10% when careful attention is given to proper balance. This shows up as improved efficiency, with the balanced engine requiring less fuel for the same output, and producing less heat. The balanced engine also lasts longer.

To properly (there's that word again!) balance an engine the clutch pressure plate, flywheel, crankshaft (with the cam gear installed), and fan pulley are balanced AS A UNIT. This cannot be done with a short–block without dismantling the engine. In effect, each time you elect to use a short–block you are accepting the fact the engine will not be as efficient as it could be.

Another burden I escape by building one engine at a time is that I can do as many pre–assemblies as I feel are necessary; VW puts each engine together once, as does all of the high–volume after– market engine builders I know of.

With new parts, held to a reasonable tolerance and assembled — one time — with reasonable care, the finished product will be no worse than the stack–up of those tolerances. You could get a real dog. But tolerance stack–ups tend to cancel themselves out; the odds are in your favor. Even so, I prefer not to play the odds when it comes to engine assembly. Poker, yes; but with engines I'll cheat until I get it right.

Getting the volumetric balance right is something VW would rather not talk about since they don't time all four cylinders to fire at the same point of rotation; even an engine with perfect volumetric balance will be out of balance when the #3 cylinder is timed to fire 4 degrees later than its three brothers. (Delaying the timing of #3 cylinder was Volkswagens solution to the chronic overheating caused by the internal oil cooler.)

Volumetric balance means all of the cylinders have the same internal volume, meaning each will have exactly the same compression ratio and will deliver the same specific impulse when the spark plug fires, assuming they fire at the same degree of rotation. In theory, this isn't very important if the engine is designed to operate at slow speeds and has a massy flywheel. In practice, the difference is as I've stated above. It is quite common to achieve an overall 10% gain in horsepower by properly assembling the Volkswagen engine. No tricks and no add–ons.

Volumetric balance starts with the heads. Their chamber volumes must match. In practice, you increase the volume of the three smaller chambers to match that of the largest. You do this by re–seating the valves and removing metal from the chamber by burnishing, grinding and polishing. (As a matter of course, all chambers are polished mirror–bright using a felt hob and polishing compound.) With the combustion chamber volume known, the crankcase is then assembled and the deck height measured. Cylinder spacers are used to arrive at a standard height, chosen according to the desired compression ratio. The final adjustment to a 'fat' cylinder may be made by shaving the head of the piston by up to .005", all other adjustments made by grinding the cylinder spacers, if needed. (Cylinder spacers are available in a wide range of thicknesses for all cylinder diameters.)

When measuring deck height it's important that the engine be properly torqued, including heavy plates used to simulate the heads. The plate is usually cast iron or precision ground cast aluminum plate, 1/2" to 3/4" thick, pierced for use of a depth gauge; usually a dial indicator. Steel spacers, their ends machined square, are used to take up the different length of the head studs. (Sections of water pipe are perfectly adequate.)

After deck height is determined, the pistons and rods may be balanced. Rods and pistons are statically balanced; the rods are balanced so as to have a common center of mass (ie, big–end vs little–end balancing).

Sounds pretty sexy, eh? Lots of exotic tools? Frankly, no. You can cc your heads with a turkey baster. And the polished cast plate I used to make my deck–height fixtures cost $4.20 at a scrap yard. The dial indicator is the same one I use for determining end–play, runout, cam lift and so on. The head–work is done with a standard kit of Cratex tools, common stuff to anyone who has ported or polished a head. (about $24 from Enco)

But balancing can be expensive. I use a guy who does only racing and aircraft engines; his minimum spec is an order of magnitude better than VW spec and he charges accordingly. A regular automotive engine balancer usually charges between $50 and $75, depending on where you live. Their typical spec will be much better than the VW factory spec. For example, within a set of four stock connecting rods the weight variation can be 8 grams (580–588). That's 'low–spec' for VW rods. (VW does not have a spec for center of balance (ie, center of mass; big–end vs small– end).) A set of balanced rods will vary no more than .01 gram, and their center of mass will fall within .005" of the same point. ('Balanced' rods from an after–market source usually means they'll meet the minimum VW spec, which is to say they are NOT balanced, in modern–day terms. Buy the best rods you can afford [SIR offers good value] then have them balanced.) If you're unlucky enough to have an engine that was casually rebuilt using rods from different weight groups, the difference between the heavy and light rod could be as much as 16 grams. (Engines that have two heavy rods on the same side have a characteristic lope at idle that conventional wisdom says is the sign of a 'hot' engine, mistaking the lope for the valve overlap of a high performance cam.)

Central to balancing is the use of a counterweighted crankshaft. This too was unknown territory in the early 1930's when the VW engine was designed; conventional wisdom of that period said an opposed–type engine did not require further balancing. Thanks to modern computers we now know that the stock VW crankshaft flexes in a peculiar way around the center main bearing. The flexure is called phlugoid motion (ask an engineer) and causes the bearing to wear in an oval pattern as it pounds out the center main bearing web. A properly balanced counterweighted crankshaft, fitted with balanced rods, spins with less phlugoid motion. The energy that was being transferred to the bearing (and pounding it out) is delivered to the flywheel; engine efficiency goes up, heating goes down and the bearings last longer.

In my opinion the best VW crankshafts are those made by Gene Berg. They are straight — you seldom find any measurable runout, and are finished to extremely close standards; the journals match. If you assemble a lot of engines you'll run into new cranks that have one journal half a thou tighter or looser than its fellows; I've never seen that sort of sloppiness with Gene's cranks. And their finish is beautiful.

Gene will probably tell you his cranks are balanced, which means they probably are. But they are not balanced as an assembly, with clutch, flywheel, gearing and pulley attached. You gotta do it over.

If it rotates, it must be balanced. If it's designed to rotate as an assembly then the assembly must be balanced AS A UNIT. (Hint: Dismantle your alternator. Take the rotor WITH THE FAN ATTACHED, to the balancer. The result is more air. Less driving power. Better cooling. And your alternator bearings last longer.)

Sermonette

There's no such thing as a free lunch. (I'll let someone else explain that to our foreign subscribers.) But here I am telling you where to find five or more 'free' horsepower and get a lot of other benefits at the same time. And since the engine isn't using any more fuel, how can it be developing more horsepower? The answer lies in what those 'free' horsepower were doing in the unbalanced engine. They were making heat — about 3,500 watts of it. In the case of volumetric balancing (and proper firing time for all four cylinders), the engine was working against itself, using some of its energy to counter the effects of late timing and an uneven specific impulse. In the case of static and dynamic balancing the losses appeared as increased friction, internal heating due to flexure, and dealing with the stored– energy loads induced by the uneven specific impulses.

There's no such thing as a free lunch but this is one lunch you've been paying for all along. Balancing your engine allows you to get some benefit from what you've been paying for.

Free Horsepower II

I was sorting some pulleys today, looking for one dinged-up enough to sacrifice for an assembly crank — you weld a handle on an old pulley, use it to turn the crank during engine assembly. A couple of the pulleys had serial numbers stamped on the hubs, meaning they are part of a balanced assembly for that particular engine. (There's still a few engines-in-progress around the shop.)

The sight of the serial numbers reminded me that I'd failed to mention that critical detail in my sermons about engine balancing ('Free Horsepower'). When you get your parts back from the balancer it's wise to mark them with the serial number of the engine they are destined for. Use cut-steel stamps to stamp the numbers onto the hub of the fan pulley, the rim of the flywheel and the flange of the pressure plate. A vibrating carbide scribe is best for marking the crankshaft.

A set of steel stamps is about five bucks from Harbor Freight. They come in all sizes, from 1/16" characters for gun work to 3/8" European-style numbers for stamping the serial number on engines rebuilt on a replacement crankcase. In some states such crankcase re-numbering is a legal requirement, and is always done on aircraft engines. You'll also want to stamp the #1 main bearing flange and the crankcase parting line with the over-size if the crankcase has been align-bored. The good shops do this as a matter of course but some of us can't afford the good shops. The bearing flange is marked at the 3 o'clock position looking into the bearing from the flywheel. The parting-line marks are put on the upper surface just opposite the generator tower but enough toward the flywheel so they can be easily seen. Half a millimeter over-size is .020, a full mil .040.

If you overhaul an engine it's polite to add a dash-number to the serial number: -1 for the first overhaul, -X2 for the second, and so forth. In some places it's not only polite, it's a legal necessity. (I've seen aircraft engines with six dash numbers after the serial.) Another method I've seen is to punch an asterick after the serial number: -* meaning the first overhaul, -** for the second and so forth. In some circles this is considered less positive than dash-number markings since it's harder to disguise -xxx4 (four overhauls) than -**** (Aircraft engines use aluminum crankcases that are easily welded; it's fairly easy for a weldor to 'vanish' a couple of astericks.) Various engine modifications are marked in the same way, with special codes or characters for each.

If you manufacture an engine using all new parts you are legally entitled (and required, in some cases) to use a unique serial number. The last four digits of the serial number will be found somewhere on every major part of the engine. If you ever encounter a 2180 with a prop instead of a clutch and a serial number that starts ‘HVX’, it’s one of mine. (Hoover, Volkswagen, Experimental. The ‘Experimental’ reflects the catagory in which home-built aircraft are licensed.) Although most of the aircraft engines I’ve built are still flying, one turned up in a Manx in Oklahoma. (Yes, I overhauled it. It’s my policy to maintain what I’ve built.)

The Gasket Basket

Under a bench in my shop I got a box of gaskets. Some are real gaskets, others are a piece of paper on which a gasket lay while being sprayed, leaving the outline of the gasket. Others are drawings of gaskets. One is a carefully made STEEL copy of a gasket for a magneto mount I once manufactured.

Tucked here and there around the shop are rolls of gasket paper and cork; some neoprene sheet. Odds & ends of poster–board, even a few shirt–cards. (Back when, the laundry folded your starched shirts onto this nifty white card.) Also some breakfast cereal boxes. A hunk from the side of a carton that carried laundry soap. Some leather. Lotsa stuff, all good for gaskets.

It wasn't too many years ago that a mechanic was expected to make his own gaskets. You'd take the part, make a pattern, check the fit then go make a gasket. Simple things, like an oil pump cover, you just draw around the part; cut it out. In the case of thirty–year old Volkswagens, those days may come again. Fortunately, veedubs only use a few gaskets; easy ones to make; like cutting out paper dollies.

The gasket basket provides the patterns, the other stuff is material useful for making gaskets. To make a gasket you simply trace its outline then cut it out; scissors or razor works fine. You can use a razor to make the holes but a hole–punch works best. Just press the punch firmly against the material and give it a smooth twist. Thicker stuff, tap the hole–punch with a plastic–headed mallet. (You can get hole punches in an incredible assortment of sizes; see the Harbor Freight catalog, or the one from Enco Equipment Supply; machinists make gaskets too.) Work on a piece of wood. (Yeah, I know the dining room table is wood, but…)

The typical gasket, as for your carb or sump, look like stiff paper, because that's what it is. But it's not ordinary paper. Gasket material is made with resins designed to resist oil and gasoline. Without the resins, a paper gasket is nothing more than a slow leak. (A lot of VW sump gaskets are like that.)

When you make a gasket from paper or cardboard you must treat it with sealant. A treated cardboard gasket works fine for the sump but a hard–paper gasket for the carb tends to ooze no matter what sealant you use. To prevent this, buy a roll of resin– impregnated gasket material of the proper thickness. Good auto– parts places carry a wide variety of gasket material whereas the chain–store type of parts store many not even know what you're talking about.

Commercially–made gaskets are usually better than anything you make yourself. They're accurately cut and use the right material (except in the case of those sump gaskets I mentioned earlier). And commercially–made gaskets are usually inexpensive — certainly less trouble than making your own. When you buy a gasket, smile at the man and ask for two. (Go on; he'll think you've got a whole shop full of engines back at the house.) When you get home, write down what the gasket is for and the date, right there on the gasket itself. Then put it in your gasket basket. Or gasket book. Or hang it up someplace out of the way (maybe over there with that collection of fan belts). Because the next time you need that particular gasket the kid behind the parts counter is liable to frown and say "Did you say an AIR COOLED Volkswagen?"

Gasket Sealants

They sell some great gasket sealants nowadays; as tough as RTV but in a spray–can. Marvelous stuff. Makes your bug forget how to drip.

Historically, gaskets were sealed with just about anything that came to hand, like tallow. Or beeswax. A lot of steam engines called for SOAPED gaskets. (I don't know what kind of soap they used but the gasket surface was often corroded by the time I got to see it.) The usual stuff was heavy grease. Or soaking the gasket in oil. Some called for painting the gasket with… ta da! Gasket Shellac! (I'll bet you've wondered why they called it that.) Gasket shellac was just that; a thick, gooey shellac. And like all shellacs, the vehicle (ie, the stuff that made it fluid) was alcohol. Gasket shellac was the stuff that resisted gasoline; you used it on gaskets and washers that came into contact with gas.

Peeling a page from the shellac idea, I've made successful gaskets using urethane varnish as a sealant. (No, I won't tell you where I used them. But they worked.) Different paints might do the job for you. Or even water. (We usta soak cork gaskets in water before torquing them down. It seemed to keep them from tearing. You'd come along later, re–torque them.)

What's a Gasket?

A gasket's job is to make a leak–free joint between two surfaces. Unless the parts are polished like a mirror, their surfaces have tool marks that form channels large enough to pass molecules of oil, gas, water, air, steam… whatever the gasket is trying to keep in. The gasket is compressed into those microscopic grooves and seals them.

In theory, the best gasket is none at all; parts so slick they stick together like

Jo blocks. Nowadays, what with numerically controlled tools and other innovations, we are blessed with machined surfaces so finely finished that paper gaskets may not be necessary, a coating of sealant is enough to provide a leak– free joint. But as a general rule, if the joint was fitted with a gasket, use a new gasket on reassembly.

Sermonette

I don't know who showed me how to make gaskets, probably my grandfather; maybe my dad. Us kids would be standing around, watching somebody work on something and they would hand us a part and say 'Go make me a gasket for this. Use the red stuff,' and we'd take the part and go make a gasket. A child's chore; something given to the youngest apprentice. Like cleaning parts. (Yuk!)

Coming home from Baja, Jaysie and I were 'way the hellangone south of the line, out on that long empty stretch between Ciudad Insurgentes and Huatamote, and there's this big Ford camper, blowing steam. Older couple. Oregon plates. BIG camper.

In Baja you stop to help and there was already some folks there but their English was worse than my Spanish and the feller in the camper didn't know if they were trying to steal his engine or fix it. Thing was, he'd blown a gasket on his water pump. (He had some other problems, but the pump is what slowed him down.) So we made him a gasket. Used a Wheaties box. Sprayed it up good with Rustoleum paint. The feller's eyes were the size of golf balls, watching me and Mr. Avilos fix his truck, as if gaskets only came from the Great Parts–House in the Sky.

When did folks stop learning useful things?

Gaskets II

A week or so ago we were discussing my recent success at making gaskets. You mentioned that it was easy to make gaskets if you the proper material for the job. I guess you mean there are different types of material for different parts of the engine. Care to elaborate?

Gasket material comes in different thicknesses, a distinction obvious by inspection. You'll recall that your oil pump uses an extremely thin gasket whereas your exhaust flanges use ones of metal, wrapped around asbestos (yes, you can still get asbestos gasket material… if in a kit manufactured in a foreign country).

The object of the thin material is to permit the pump to properly align in the bore of the crankcase, a thicker gasket would cause some misalignment and reduce the oil flow. On the cover, you want the minimum possible clearance between the ends of the pump's gears and the cover plate, hence the need for a thin gasket.

Most gaskets are meant to seal the joint between two parts for the life of the assembly. The best material for gaskets of that type is a kind of glue that hardens when exposed to pressure and heat. The gasket not only seals the joint, it bonds to both surfaces and must be scraped away when the assembly is dismantled for overhaul. Gasket scrapers are standard tools in any mechanic's kit.

Often times the joint in an assembly must retain oil yet allow for some degree of motion, induced either mechanically or by metals having different thermal coefficients, as in the case of the Volkswagen crankcase and cylinders. Such gaskets fall into the group of 'elastomeric' seals, as do shaft and tranny seals. Another gasket type is one intended to permit the parts to be dismantled frequenty, as is the case with your valve cover gaskets. For that task you want a material that will compress to form a seal but will not harden nor bond to the surface that must remain free. The usual procedure is to glue valve cover gaskets to the valve covers and leave the other surface free to form a seal with the cylinder head.

Your axle boots are another form of gasket, as are the boots on your tie–rod ends, although when the gasket is a molded elastomer, such as neoprene or silicone, we tend to call them 'seals' rather than gaskets, but as you can see the primary fuction — keeping something in while keeping something out –– grease and dirt in this case, gasoline and air in others, is the primary role of gaskets. And seals.

The gasket used under your carb should be made of a material that will compress but will not bond. But once compressed the stuff tends to stay that way, meaning you need a new gasket each time you dismount your carb.

Some gasket material is permiable, allowing oil to pass through it. The cheap cardboard gaskets for the sump, as found in oil change kits, are like that. Such gaskets have a place, but not in a Volkswagen engine. The only reason they are there is because they are cheap and everyone expects a VW to drip. It doesn’t have to be like that, as I pointed out in one of my sermons.

In theory, it’s possible to machine surfaces to such a fine finish that they need no gasket at all. The VW comes close to that goal with its engine case but still requires a coat of sealant along the joint to keep the oil in and the dirt out.

Your window seals are gaskets of a sort, as is the seal around the windscreen or the bas of your radio’s antenna. Gaskets (or seals) exposed to ultraviolet light must be made of material that will withstand UV degredation. And so it goes. Different tasks call for different gaskets, some thick, some thing, some soft, some hard, some flame resistant and so on.

Just as there’s no on sealant that can do every job, neither is there such a thing as a universal gasket material, although paper, in all its forms, comes close. (Leather was once the most common gasket stuff, and is still used in a surprisingly wide variety of applications; some leather seals flew to the moon. Oil impregnated wood is still used for many shaft–sealing applications. Indeed, it’s hard to find a material that hasn’t been pressed into service as a gasket or seal. I once patched the hull of a dory with pieces of cotton fabric and varnish. The cotton fabric came from a ladies skirt. (Okay, it wasn’t exactly a gasket but definitely a seal.)

Jugs

(The following was in response to a Vintage VW List subscriber who was given a freshly overhauled engine for free.)

The 'Free' Engine and Parts that Don't Work

I'll tell you one thing that don't work. Doing a ring–job on a VW. The fixture to properly hone a VW jug is the size of a milling machine. I think there are two of them in southern California, which could well mean two of them in the whole damn country. The problem is returning the cast iron jug to a perfect circle AT OPERATING TEMPERATURE, close enough to the OD of available pistons to be sealed by available piston rings. To do this, the jug has to be distorted at room temperature to take into account their variable wall thickness (ie, the stud channels in the fins). VW stopped re–manufacturing jugs in the '60's, having found it impossible to equal the service life of new jugs at an economic cost.

If a set of jugs has less than 2,000 miles on them I might hone them and put in new rings. Otherwise, I scrap them. In the long run, it's cheaper.

If your 'free' engine has honed jugs, scrap them.

Jugs in General

First thing you do with a set of new jugs is wash them with clean mineral spirits. (Okay, gasoline, but don't get caught.) When they are perfectly, absolutely oil–free, take a cheap 1/2" paint brush and turn it into a 1/4" paint brush by cutting off half the bristles at the ferrule. That's what you need to get paint down into the bottom of the fins.

Now paint those puppies! Thin coat, please. Flat black Rustoleum in the can, not the spray stuff. Thin it out a little. Do a neat job of it; don't get any paint in the bores or the spigot sleeve, and keep paint off the sealing surfaces. (I didn't say it was easy.)

Let them harden up a couple of days. Inspect for holidays, touch them up. If you don't paint them, they won't last the twenty years and more they CAN last, when you're running a full–flow oil filter.

Once they are painted get a can of Bon Ami cleanser and scrub the bores. That pretty swirl pattern contains microscopic fragments of carborundum! It is embedded into the soft iron granules that are part of the matrix of cast iron, which unlike mild steel is far from homogenous. Spend about TWENTY MINUTES scrubbing each jug. Use a sponge and lots of cleanser but not too much water. Scrub around the bore, not up and down. When you get done, give them a good hot water rinse, and I mean too hot to touch. Get the whole cylinder hot. Wipe them with a known–clean rag or towel. Spray the bore immediately with WD–40 (a San Diego product, by the way and a nice stock to own) and put them in a warm oven or drying box (ie, light bulb in a cabinet) to insure all moisture is driven out. When dry, you can oil them lightly and bag them, or store them back in their box if the cardboard is dry.

The hour or so you spend scrubbing your jugs adds about a year to their useful life but more importantly, saves you several hundred dollars in oil over the life of the engine. Those microscopic bits of carborundum come from the manufacturing process and will remain in the jugs, being polished deeper into the walls or taken up by the rings, unless you remove them. The pumice and diatomatious earth used in Bon Ami brand cleanser has a hardness of about 4 on the Mohs scale. Carborundum is 9+, right up there with bort, industrial grade diamond. It don't go away. Cast iron is harder than pumice or diatomatious earth, they DO go away. Indeed, if you do a good job, there won't be any for the engine to flush away.

So why do people leave abrasives in engines? Because it lets the rings wear in almost instantly. If you're building engines on an assembly line, it is a justified compromise. Jugs on aircraft engines are cleaned with a series of hand–scrubbings and ultrasonics. They can last about 4,000 hours before catastrophic failure (which is why they are normally overhauled at about 2,000 hours). 4,000 hours on a Lycoming is the equivalent of about 300,000 miles on a in a VW.

(So why don't we use ultrasonics and all that high–tech stuff on veedubs? Some guys do! But the main reason is practicality. Your main bearings dictate the maximum useful life of your engine and right now, they're only good for about 150,000: they lack the surface area to survive longer. And it makes no sense to put 300,000 mile jugs on a 150,000 mile engine. The hidden lesson here is that engines are harmonious things, their parts will work — and wear — in concert. Put new, tight jugs on a worn lower end and the poor thing won't last a year. Even worse, it's liable to suffer a catastrophic rod–bearing failure. But when new parts wear–in together they will give you plenty of warning as the end of their useful life approaches.)

No, you can't use that can of Comet under the sink. It contains chlorine, something you don't want anywhere near cast iron. And don't worry about the rings seating. Follow the break–in procedure I mentioned; don't be afraid to rev that puppy up. (Think of it as birthing pains.)

Basic Jugs

A set of VW jugs includes new pistons, pins & rings.

First thing you do, you sit down with one piston, take the rings off one at a time, make a sketch of its profile, mark down if its the top or middle ring, which side up, etc. You'll see lots of different types so don't put your faith in a book. Use the set you have as your book.

Make a good drawing. Keep it clean. Keep it in a notebook and the notebook in a drawer. It's like a penny savings account. You think it's just pocket change but when you need it, it turns out to be a lifesaver.

End gap should be okay but it only takes a couple minutes to check the whole set and you've got to take them apart anyway for balancing, cleaning, etc. So check the gap. Keep the rings together by sets; put them into baggies with a paper tag telling what piston they came off of. Mark the pistons clearly, either with a scribe or a punch. Mark the jugs too — sometimes you find a wild one in a set, a couple thou larger or smaller than the others, with rings gapped to match. At the factory, they dealt with thousands of jugs from conscientious suppliers. Aftermarket stuff runs from junk to sublime, you have to decided what you've got.

Big Bore

Boring subject. Big bore means opening up the case to accept larger spigots. Type IV is 100mm and up. Biggest practical bore on regular bug engine is 92 for a late case, 90 for early (and they'll still leak), in the real world don't go over 88 & 90 (old & new). It has to do with how much 'shelf' space is left after you open up the bore. The jug has to seat on a flat, parallel surface to insure no oil leak, fretting, etc between jug and case. Open the case too much, not enough sealing surface, engine goes to hell. And not just from leaks. There are purely mechanical considerations here as well. The total stress of jugs, studs & heads is concentrated at the base of the jugs. The jugs will pound into the case during the first five–six hours of running. Smart builders do it on a test stand, dismantle tin, re–torque. Do it again about 50,000 miles, maybe pull the heads then, too. Don't gasket the jug/case joint, use Permatex, the non–hardening kind (light tan?) or that new gray RTV gasket stuff. Paper gasket is a joke between cast iron & magnesium subject to heat cycles (as VW learned). Best builders O–ring the spigot bores. Tricky to do (needs special tooling) but works like a dream. (See Larry Pauter's all–billet aluminum cases. About six grand each.)

J.C.Whitney Big Bores

I've never bought any from them. I've seen too many different brands, too many unbalanceable sets. You're going to have to trust to luck and understand it's on your shoulders. That's why balancing becomes so important. You are not just assembling an engine, you are manufacturing it.

If the things claim to be Big Bore but also say they don't require machining the case, walk on by. The biggest stock bore was 85.5mm. The only way you can fit a bigger jug into the stock spigot hole is to make the skirt and cylinder wall thinner. Thin sections of cast iron don't do well when subjected to rapid heat cycling. Such 'big bore' jugs appear to distort, leading to uneven wear. They certainly don't hold up as well as their heavier walled cousins.

Standard Size Jugs

Regular jugs have stricter standards in both material and workmanship. I'd be more willing to try a mail–order set of standard jugs. I've a hunch the odds would be on the side of getting better quality than the so–called Big Bore things.

(The following was in response to a desire reassemble the 'free' engine [the cam was about three teeth off] without replacing the jug, balancing, or replacing the exhaust valves & guides.)

Run What ya' Brung!

Sure, it'll run. Might even last a year or two if you're careful. But it won't be sweet. Its life is 90% over before you begin. If your only option is to sell the thing to a kid, I guess that's the way to go. But you must understand that once you touch something with a wrench you own it. First sign of trouble, the kid's going to come knocking on your door. Or maybe his dad. Have that thing sitting out in the drive, dripping oil, swallowing a quart a hundred and blowing smoke all over town, everybody knows. At least, all the mechanics do. (Big scarlet 'M' sewn to your shirt? Same thing.)

Unless you're all packed and ready to move I think it would make real good sense to build the best engine you can, make sure the buyer understands any corners you've had to cut and the down– stream consequences. Do a good job, it's going to be around for a long time. And every time people see it some of them will remember who built the engine.

We Don’t Always Get What We Pay For… but we always get what we deserve.

Come on! A week ago you didn’t have a spare engine, now you do. Make it the best engine you can build. Every engine will teach you something; every engine will instill habits. You want to learn the good habits, have them teach you the right stuff. And none of the really good mechanics die rich.

Loctite Accelerant

Loctite Corporation provides two primers to insure proper curing of their product, one is Locquic Primer T, the other Klean n' Prime. You should be able to procure either from the dealer selling Loctite. And stick to that brand, or use a primer specific to the thread adhesive you're using; the Loctite primer is not compatible with the Hercules adhesives, etc.

The Loctite p/n for Klean n' Prime is 2556. It comes in a 6-oz spray-can. Rather pricey but one can lasts for years. The cleaning is via trichloroethane, so don't use it in an unventilated area. The priming is in the form of accelerants that cause the Loctite adhesive to harden more quickly.

If you're speaking of a Type IV engine designed to use hydraulic valve lifters, the oil galleries are of the proper size. I can't say as to the gallery size in the non-hydraulic 1.7 engines. I know guys have retrofitted hydraulics to them but don't recall any mention of opening up the galleries (or of problems).

Noisy lifters are usually a sign of worn lifter bores (ie, low oil pressure), overheating (low oil pressure) or contaminated oil. If the noise is isolated to a single valve, I would suspect a valve problem, such as a loose seat, an improperly adjusted rocker, or a dirty lifter. The first of these problems would be persistant, the second would respond to inspection/adjustment and the third might vanish with an oil change. You are the Mechanic In Charge; what's your opinion?

More Sealants

I used 'Ultra-copper' on a lot of engines and liked it, except for the latex base. As a sealant it was better than Permatex since it formed a thinner seal, but as an assembly component I didn't like the way it would sometimes peel off the case due to an accidental touch. Permatex would smear but there was always some left. I started using the Loctite stuff because it not only formed the thinnest seal I'd ever seen (thinner is better when there's no gasket), it was at least as tenacious as Permatex; you didn't have to worry that an accidental touch would force you to clean & recoat the parting line.

But as I recall, the thinner for both Permatex and Ultra-copper was something so potent it made boy-mechanics have two-headed motorcycles. I wouldn't put Loctite on a bagle but otherwise it's fairly benign; Hypolon has some trichloroethane, the other compounds are mostly silicones.

One note of caution, and the reason I've made this a general posting: If you've got to fix it and drive on, USE PERMATEX. But if you're building engines in the privacy of your own bedroom, with lots of time between assembly and test-running — at least 8 hours (more is better) — then use the newer sealants. The have a required CURE TIME. The only guys I know who don't like them are the types who never read labels; don't give them a chance to do their job.

If you think about it, outfits like the Loctite Corporations are to be numbered among the Good Guys, white hats and all. They'll never tell you red cars or faster, or waste your time expounding on the virtues of 500 watt stereo systems in a bug. The value of what they sell is obvious. And if you've got some sexy sealing problem, they'll usually offer some free advice on what might work. (This is mebbe a sermonette but I won't call it that.)

Paint Your Engine

Recent comments posted to this list make it clear some subscribers are not aware of the benefits of painting their engine. The basic reason for doing so is preservation. When fitted with a full–flow oil filtration system the VW flat fours can deliver 150,000 miles or more of service before the lower end requires overhaul. Indeed, when fitted with hydraulic cam followers, stainless steel valves and other modern innovations such as electronic ignition, it's not uncommon for a properly assembled engine to deliver 100,000 miles of service without requiring any form of repair.

A light coat of flat black paint on the magnesium–alloy crankcase not only protects it from corrosion, it enhances the heat–flow characteristics of the surface. The cast iron cylinders benefit even more, although they are more difficult to paint. The trick is to get the paint right down into the bottom of the fins. To do so calls for the use of a suitable brush, made by cutting off half the bristles from a small (1/2") paint brush; not an artists brush, the regular sort does fine. You must use a brush instead of spray because by the time you've sprayed enough paint to reach the bottom, you've flooded the upper part of the fins and made an unholy mess. So start with the brush, take your time and give your new jugs at least a day to dry before handling them.

High time engines, especially those operated in cold climates where corrosive substances are used for snow removal, are often found to have virtually no fins at all when the engine is torn down for rebuild. Ions of the corrosive material, common rock salt in most cases, attach readily to unprotected cast iron, and once attached are impossible to remove without boiling with a 'getter.' This means that once the corrosive ion finds a home on your cast iron cylinders, the corrosive action will continue year round, thanks to water vapor in the air.

Rusty or corroded metal makes a fine heat insulator, as every weldor knows. A few ounces of paint judiciously applied prior to assembling your engine is not only the mark of an experienced mechanic, it is one of those tricks so simple it is often overlooked. But in the long term it means greater service life and lower operating costs.

And before you succumb to conventional wisdom, drop by any airport and examine the engines that inspired the original Volkswagen engineers. Aircraft engines are painted as a matter of course, although such niceties were ignored with the VW in the interest of economy. The original idea was to replace rather than overhaul the engine, and to replace it fairly often — typically, at something less than 100,000 km (56,000 miles). Alas, this option is no longer practical in todays economic climate.

Pistons and Cams from JCW

In response to Steve Pribyl's question about buying jugs and cams from J.C.Whitney, I recommend against it. I've had three instances where a set of JCW-supplied pistons/cylinders contained one from a different weight group. This makes them almost impossible to balance since the VW spec per group is something like 8 grams (!) (You want them balanced to .1gm or better.) The two examples of JCW-supplied cams I've seen were regrinds with a very rough finish. Since the cam/cam-follower interface is one of the fastest wearing parts of a VW engine, you need the best compatability between cam and cam-follower. I've had good results by sticking to cams and followers from the same manufacturer and source. And the stock VW wiggle stick does just fine for most applications.

The only way a piston from one weight group could end up with another is for someone to have swapped them. I know suppliers here in southern California have allowed certain customers to prowl their warehouse, breaking open sets of jugs and checking them until they matched up a set within a gram or so; saves having to send them to a balancer. I don't know where/how JCW gets/stores its sets of jugs but three unusable sets tells me something is going on.

There is a reputable parts house in Georgia — NOPI? — that will sell you a set of Mahle's for less than JCW. I've not dealt with them but I know several guys who do. They probably advertise in DB&HVW, or perhaps one of the list subscribers can provide their address and phone.

Reading Spark Plugs

As with the compression test, the color of the porcelain insulator of a spark plug is often used as an indicator of the engine's condition. Unfortunately, the nature of the test is generally misunderstood.

For starters, the test should only be performed with NEW spark plugs. (I'll get to the obvious in a minute.)

The visual condition of the porcelain insulator on a spark-plug's nose reflects the operating condition of the engine at the time the ignition was shut off AND ROTATION CEASED. To do this test successfully you must run the engine at a steady rate at the speed you wish to examine, throw in the clutch, OPEN the throttle and shut off the ignition simulataneously.

The reason for this is that fuel or oil may contaminate the hot nose of the plug if the engine is allowed to rotate after the ignition is shut off. Anything that gets on the hot nose of the plug can confuse the color 'signature'. If the engine is allowed to come to rest with the throttle closed it will generate a strong vacuum in the manifold, drawing in an overly-rich fuel charge and possibly some oil, either of which can confuse the reading. As a point of interest, modern formulated fuels typically leave a soft, sooty residue when combustion is incomplete.

So what about all those experts who pull a plug, glance at the porcelain and declare the engine good or bad? They're looking for two things, the long-term condition of the porcelain, which in most cases will indicate normal combustion, and any sign of oil and the nature of the build-up — if any — on the electrodes. At best, they are reading the near-past history of the engine rather than its immediate condition. That information, combined with other clues, is usually sufficient to give a good indication of the engine's condition.

Reading your plugs was typically done as a final step in fine-tuning your carburettion and timing. Nowadays more accurate information regarding the combustion process may be obtained through the use of an oxygen sensor, although your plugs remain a prime source of data regarding the condition of your rings and valves.

Sand Seals

All engines provide some form of crankcase ventilation, normally drawing air in through a filter and exhausting it by means of a road draft tube or engine vacuum. On older American cars the inlet filter was in the oil filler cap and replacing the cap — and the filter it contained — was a normal maintenance item. Later, Positive Crankcase Ventilation enjoyed a moment of fame as the latest 'improvement' to come out of Detroit (although many engine manufacturers had been doing it for years). Even so, PCV remains a foundation item in pollution control.

In the Volkswagen, air is drawn in around the fan pulley, exhausted to the air breather. There is no filter. Condensate, both water and oil, is allowed to drip onto the roadway via the flapper valve on the end of the road–draft tube.

When re–building a Volkswagen engine, to insure dependable operation under all conditions the nose of the engine is machined to accept a seal that fits around the hub of the fan pulley, the hub being modified to provide a smooth sealing surface. A filtered air inlet is provided. The filter is located on the firewall or blower housing, plumbed to the engine with hose, usually to fittings in the valve covers on directly to the valve galleries; the stock return–line to the breather is retained. The better filters provide for moisture trapping. The normal outlet is unchanged. The seal is commonly called a sand seal since it is a virtual necessity when running off pavement.

Without such a seal, whatever is in the air will be drawn into your engine. Dust, rain, insects… all will eventually find their way into your crankcase. Even when running a full flow oil filter, the lack of a sand seal forces you to change your oil quite frequently to get rid of dust and chemical contaminants picked up from the air drawn through the crankcase.

When this sermon was first posted it earned me a couple of flamers from certain souls insisting 'sand seals' were bad, or not needed on their engine since they weren't out to win the Baja; sand seals were just another of those tricky bits mechanics are always fosting off on the public. The original VW didn't use sand seals and it was a fine example of German engineering; stop pushing that fancy stuff; we don't need it.

You need it.

The original VW was indeed a fine example of German engineering, circa 1932. But times change, and the sum–store of mankind's knowledge grows. Volkswagen engineers are indeed, good engineers. Forty years after the introduction of the first Volkswagen, VW introduced their Type IV engine, without a doubt the best air–cooled VW of them all. Notice the full–flow oil filter and hydraulic valve lifters. And notice too that ‘sand seal’ on the nose of the crankshaft. In fact, look at ANY modern engine; they all have shaft seals. And so should the Type I.

Fortunately, shaft seals are easily installed on the Type I engine. It has become a standard item with most engine builders.

Sand Seal & Oil

The principle behind crankcase ventilation is to have the air inlet at atmosphereic pressure and the outlet at a slight lower pressure, usually achieved by plumbing the high point of the system to the air cleaner in a location having having an air flow sufficient to induce lower pressure in the outlet hose.

Given the geometry of the VW engine there are a number of arrangements that will meet the above criteria. On high performance engines using electric fuel pumps the fuel pump opening is often used for the inlet with the normal outlet (that is, from the oil filler) retained. At one time filtered inlets that attached to one of the valve covers were popular. For some applications not using the blower housing, such as dragsters and aircraft, the crankcase was tapped at the oil cooler casting, the opening plumbed to a filtered breather. Another method was to weld a boss to the top of the crankcase near the bell housing (ie, behind the blower housing) and plumb from there. Aircraft engines using magnetos, with the propellor mounted on the pulley–end of the crank, sometimes use the distributor hole for an air inlet, although with aircraft engines the problem of sucking in dust and the like is greatly reduced and the stock system often left unchanged, especially when the propeller is fitted to the clutch–end of the crankshaft.

The object of plumbing the inlet to a new location is to allow an air filter to be used. Often times you will see a breather used which has more than one inlet, in order to insure proper crankcase ventilation when the engine is in unusual attitudes.

Improper crankcase ventilation can cause blown seals (when no ventilation is provided), accumulations of sludge (when there is no low pressure outlet) and other assorted ills, some probably imagined. The saddest case is to see an obviously expensive engine being operated in a dusty environment without a sand seal. You hope it’s life will be a happy one because you know it will be short.

The use of filtered air for crankcase ventilation is another example of sound engineering practice that is violated by the sixty–five year old design of the VW engine and which contibutes to its short life. But it is an omission we can easily remedy.

Stock Cam

Personally, I like the stock cam for stock engines. Smoother ramp and better wear, thanks to closer compatibility between the cast iron cam (demi–cast steel) and the cam followers. Their rubbing contact is one of the high–friction points in the engine. Mix–match cams & followers, you'll see accelerated wear on the softer of the two.

Assembling Pistons & Cylinders

I sprayed the cylinders with WD-40 before using the ring compresser...

WD-40 is handy stuff around the shop but it is basically kerosene. And kerosene isn't a very good assembly lubricant.

Before installing our pistons into the cylinders, wipe the cylinder bore with a good coat of straight-weight motor oil, either 30W or 40W. Be sure the entire surface of the bore is coated with oil. Don't overdo it. Too much oil will defeat the sealant you'll be applying to the base of the cylinders; sealant works best applied to a clean, oil-free surface.

Grease of various kinds is used as an assembly lubricant on the engine's bearings, which can deal with the small amount of grease, but cylinders must be oiled — the piston rings were not designed to deal with grease.

Before installing the piston rings, oil the grooves into which they go. The tops & bottoms of the grooves are sealing surfaces and must be covered by a film of lubricant when the engine is first started.

After having a couple of start-up failures, some mechanics over-react and literally soak the assembled piston in a can of oil before installing it in the jug. This prevents dry starts but is far too messy and that messiness can lead to other problems. Your jugs only need about a teaspoonful of oil to do their thing at start-up time but it has to be in the right places.

I've made this a general post because it is the second instance of someone using WD-40 as an assembly lubricant. Like I said, WD-40 is handy (and a nice stock to own!) but don't fall in love with it. A flit gun filled with kerosene will do the same job, and has for the last hundred years.

Cam Gear Alignment

I got a racing cam for my engine I'm building. They say the dot is supposed to line up with the slot but it can go both ways. I called them but they aren't much help. Can you help?

Take a look at your new 'racing' cam. Look at the lobe farthest from the flange. This is the lobe for the exhaust valves on #1 & #3 cylinder. Hold the cam-shaft horizontally with the flange toward your chest. Keeping the camshaft horizontal, rotate it until the lobe farthest from the flange is pointing straight down.

The slot in the flange should now be perfectly straight up & down. Mate the cam gear to the flange with the dot ***up***, aligned with the slot.

If the folks who manufactured your cam have followed the Volkswagen specifications for the relationship between the slot and the cam's lobes, the cam gear is now in the proper relationship with your camshaft.

But there's a bit more to it. You need to check the cam's timing.

The bolts holding the cam gear to the camshaft should have some provision for adjusting the precise relationship between the gear and the cam. If you just bolt the gear to the cam without checking the cam's timing, chances are you'll be out of spec. To check your cam timing you need an accurate degree wheel and a dial indicator but most importantly, you need to know what you're doing.

If you just bolt the thing together willynilly the engine will run. But it won't run as well as it should. In fact, it may not run as well as a stock cam. And after going through all this trouble to install a 'racing' cam, that just doesn't make a lot of sense.

Email isn't the place to learn how to time a cam. Your best source of information is probably Bill Fisher's *How to Hotrod Volkswagen Engines*. The book is available from most after-market VW suppliers as well as J. C. Whitney.

Good luck in the race.

Case Torque Pattern

I treat the cam seal studs as thru–studs and tighten them as I draw up the six main bearing web thru–studs. I usually use a smaller beam–type torque wrench for the M8 nuts; saves having to change sockets, reset the clicker, etc. Take your time. Keep a crank on the pulley–end, give it a turn or two after each pass; a slow turn, feeling for any tight spots. If your pre–assemblies have found all the little problems, the crankshaft should spin freely with finger pressure (no rods installed) and be a tad easier during final assembly because of the thickness of sealant, except you'll also feel the drag of the rods. I've never measured the amount of torque needed to spin the crank but it is very slight in a properly set–up case/crank combination.

By flipping the engine, yes, I meant working alternately on the left and right sides during the same torquing sequence. As I said, it looked rather odd and at first it was confusing, since flipping the engine presents the opposite side as a mirror image (ie, bottom studs become top, etc). But after the first hundred engines…

There wasn't any big deal made about allowing the parts to reach a specific temperature, they just wanted them all the same. They were laid out on a bench or cart, usually with a canvas cover if there were several to be assembled. The shop often saw 90 degree days (Modesto, California) and engine assembly was done at all hours but usually in the morning, if the work–load permitted. The point is, the parts were all at the same temperature, whatever it happened to be. A cold head was never torqued to a hot engine, etc.

As to what is the 'normal' torquing temp, one of the German mechanic's personal tools included little T–handled torque wrenches with only a couple of markings. I think the symbols on opposite sides of the center mark represented a snowflake and a sun, which lead me to believe the mechanic was expected to take temperature into account when torquing up, although the difference (about a needles–width on those particular tools) couldn't have been more than a couple of pounds, if that. Maybe we can get a Russian or Canadian to help us out here. (Any Siberian mechanics out there?)

I'd be willing to pay someone if I thought I could learn from them. But a thou seems kind of steep. I've always thought knowledge was something to be shared, that anyone with a useful skill has an obligation to see it safely passed into younger hands. That's the basic reason for the sermon–series. But a set of notes can't replace hands–on experience, especially if you're bucking the headwind of Conventional Wisdom. (Red cars are faster, right? And gimme a handful of those little filters you got there. Geraldo sez these things is great!)

What's good enough? Start with perfection. Now work up. This too runs counter to Convention Wisdom but it wins a lot of races, including the one to the moon. In a more practical vein, I'm willing to take any engine I've built, hang a propeller on one end, an airplane on the other and fly to Catalina.

Gland Nut Removal

I got my parts from BusDepot on Monday and went to Dad's tuesday night full of enthusiasm. After several hours of struggle I still could (not) get the 36mm nut that holds the flywheel on, (gland nut), to move. I spent hours on it again today and it still sits there imobile. The nut will not turn.

I am using a six foot piece of angle iron bolted to the flywheel to hold it still and a five foot pipe on my breaker bar to move the nut. My dad (200lbs) was about air-borne on the pipe with me and Sharon leaning on the angle iron. I estimate 500+ foot-pounds of torque were being generated this way and still ... nothing.

I tried heat, cold, liquid wrench, hammering(but gently), and voodoo.

HELP!

It WILL come free.

Search for a suitable SIX POINT socket.

Use a very sturdy anti-torquing lever securely bolted to the flywheel. (Mine is 2x2x1/4" angle with holes drilled to accomodate brake drumes as well as flywheels.) You want the anti-torquing lever to extend to the SAME SIDE as the wrench — to loosen the nut you stand on the one while raising the other.

Use a sturdy 'cheater'. Mine is .120" wall black iron pipe.

Then use your floor jack (!). Position the wrench so you can sit the floor-jack atop the anti-torquing lever, transmit the up-thrust of the jack into the wrench/cheater via a block of wood. Pump on the jack.

I can lift about 400 pounds. If I can't make the thing move by standing on the anti-torquing lever and using the strength of my legs & back to raise the wrench, I try the jack trick. And if that merely bends things it tells me some sonofabitch has installed the gland-nut with an an impact wrench. (The body-lift produces about 2,000 ft/lbs, the jack trick generates about 10,000 ft/lbs of torque.)

If it STILL will not come free you're looking at a gland-nut that was installed (improperly) with a pneumatic impact tool — and that is what you're going to have to use to break it free.

I've had a couple other fellows ask about sticky gland nuts. I'm going to make this a general post.

-Bob

PS — Given the high incidence of idiots with air-tools, it isn't uncommon to run into nuts tightened so far beyond spec that the part is ruined. (Grendel was a good example of this but it also happens with flywheels.) In my shop I have a nifty little 'wrench' for such occasions. It is a steel bar, 3" wide by half an inch thick by FIVE FEET LONG. On one end I've welded 36mm and 46mm sockets, back to back (ie, on opposite sides of the bar). This wrench is used in conjunction with a holding-fixture that bolts to the concrete slab out behind the shop, securely fastening a recalcatrant brake drum or flywheel to the concrete. The wrench is "turned" (ie, raised) with a 20-ton jack.

It's not too hard to out-wit an idiot. But while idiots make up only a tiny proportion of mechanics, they account for nearly all of the ruin and destruction. Idiots come in all shapes, ages and sizes. Avoid them whenever possible. -rsh

Piston Pins

This article is dedicated to Ken Hooper of the Vanagon list, with my thanks for raising the question of piston pin removal.

Piston Pins & Hammers

....don't go together.

The wrist pin or gudgeon pin of a piston must be a contact-fit in both piston and only slightly looser in the eye of the connecting rod. That is, there should be no measureable clearance between them at room temperature, although the pin should be free to slide with moderate pressure. When the engine is at normal operating temperature the aluminum piston will expand more than the cast iron wrist pin, providing sufficient clearance for lubrication. But such a close fit often makes piston pins difficult to remove or install. St. Muir advocates the use of a hammer when the going gets tough. The wiser course is to out-think the problem.

The pin should never be driven in with hammer blows.

There are a variety of tools that will push or pull a piston pin into place with no more effort than turning a wrench. Because of the relatively small diameter of the wrist pin you can make such a tool from a piece of water pipe, a pipe cap and a bit of threaded rod. Such a tool allows you to remove and install piston pins with surgical precision, something lacking when you whap the thing with a hammer.

Hammering side-ways on a piston, no matter how well buffered and supported, imposes damagingly high side-loads on the connecting rod. Connecting rods are typically forged from mild steel and their shape is optimized to produce maximum rigidity in the plain of the piston's travel. By comparison, they handle side-loads poorly. Since the rod is at its maximum extension when you install the piston, the energy of a hammer blow will be multiplied by the length of the rod. You'll have no trouble bending the thing or damaging the bearing. One of those. Often both.

Prior to assembling your engine you should have tested the fit of the pins in their pistons and in the rods. Often times, even with new pistons, you'll find the pin hangs up on the retaining ring groove. Dressing the groove with a light wipe of #600 silicone carbide paper is usually enough to remove the lip causing the hang-up.

At room temperature the wrist pin should press into the connecting rod with slightly less pressure than needed with the piston. Turned so the pin is vertical, the wrist pin should not slide out of the rod, or slide out v-e-r-y slowly. Many so-called ‘rebuilt’ rods are NOT fitted with new wrist pin bushings. They merely score or swage the old bushing to reduce the ID then broach it back to size. Such rods are worn out before you install them.

Removing the wrist pins on a high-time engine can be a trial because varnish builds up on the pin between the connecting rod and the piston, forming a collar that is larger than the bore through which it must pass when the pin is removed. Solvents more active than the typical mineral spirits — MEK and the like — can dissolve the varnish but most pins will usually come free when the piston is heated. And we are talking hot-heat here, not just warming the thing up. Several minutes attention with a propane torch will usually free the most reluctant wrist pin. It may be pushed out with a section of dowel or in seriously stuck cases, pulled out with the threaded puller described below.

Making a Wrist-pin Puller

The typical VW wrist pin is about 3" long and about 7/8" of an inch in diameter (70mm by 22mm).

The puller is made from a section of tubing or pipe about four inches long. Water pipe is a good choice, so long as the ID is large enough to accept the wrist pin, which will extend up inside the puller as the pin slides out of the piston. The edge of the puller that presses against the piston must be filed to match the curvature of the piston in order to insure the puller pulls in a staight line and the piston is not damaged. When filed to the proper curve, the thick wall of the typical water pipe provides enough surface to prevent marring the aluminum piston. But tubing with thinner walls will work. The load puts the puller in compression and such a short length of thin-walled tubing is extremely strong in compression. But the thinner the wall, the more the risk of marring the piston.

Another reason pipe works so well is that you may close the upper end of the puller with a regular pipe cap. With other types of tubing you’ll have to weld the end closed or make a suitable cap. I’ve made pullers from materials as diverse as electrical conduit and even a section of tailpipe from a Bug.

The cap is drilled to accept a length of 1/2" diameter threaded rod about eight inches long. (The extra length is needed when you use the puller to insert wrist pins.) The threaded rod is turned into a puller-rod by welding or peening a nut on one end then grinding the nut until it is marginally smaller than the diameter of a wrist pin. Once ground down, the nut will pass through the piston and connecting rod but will be too large to pass through the wrist pin.

In use, the circlips, buttons or retaining rings are removed, the greased puller-rod inserted though the wrist pin, the puller tube slid over the rod and a nut threaded onto the free end of the rod. Turning the nut will cause the wrist pin to be pulled out of the piston.

Turning the nut will also cause a wrist pin to be drawn INTO a piston as well. I'll let you figure out how. But be cautious. The simple puller described above can crush a piston.

Sermonette

A remarkably thin section of steel will defeat the strength of the strongest man. When dealing with machines, humans must relie upon their wits, not their strength. If you encounter a tribe of obstinant gudgeon pins, outwit the rascals! Use chemicals to dissolve the varnish and heat to alter their dimensions. If they still refuse to budge, build a tool to move them out of there.

Any fool can pound on things and most of us do, at one time or another. Unfortunately, we usually causing more harm than good in the process.

Pulling the Engine

Here in southern California the VW dealers once sponsored a ‘rodeo’ for students taking automotive courses. The rodeo concentrated on diagnosing and repairing tricky little problems inflicted on the test vehicles by the judges. But the rodeo event most of us remember was the Engine Removal Race. As I recall, the record was hovering around the three–minute mark when the rodeos were discontinued.

Three minutes. Two guys. (The one–guy record was about ten minutes. Two guys is safer.) The basic tools you’ll need are a garage–type jack with a lift of about two feet (Harbor Freight has one for about $50 and shipping is free), a pair of jack– stands and a handful of tools.

To drop an engine out of a bug here’s what you’ve got to do:

Remove the two large nuts from the lower bell housing studs. You’ll need a 17mm wrench or socket. Disconnect the heater control cables. 10mm wrench and a pair of vise–grips to keep the fitting from turning. Disconnect the heater bellows pipes. You may need a Phillips screwdriver for the bellows. Disconnect the fuel line. It’s going to leak fuel so plan for it. The usual routine is to plug the hose with something then install a clamp. Some guys use vise–grips to crush the hose — often literally. LI>If you’re working alone, while under the vehicle you’ll reach up and position a captive wrench on the bolt(s) for the upper engine mounts. (Late model engines have a captive nut for the driver’s–side bolt. If that’s what you’ve got, now’s the time to loosen it. It’s okay, the remaining bolt will keep the engine in position.) A captive wrench is either magnetic or… something else. I use a 17mm box–end wrench, cut & modified to deal with the bolt beside the starter.

That’s what you do underneath the vehicle. Back topside: Disconnect the wiring from the coil and carb. Some vehicles have a back–up light fuse–holder in a clip on the passenger–side of the blower housing. It twists open. (Don’t lose the fuse.) Tape the wiring up out of the way. Remove the one or two upper engine mount nuts. The jack must be under the engine to keep it from tipping. Disconnect the throttle pull–wire. You’ll need either a screw-driver or a wrench, 7mm, 8mm or 10mm — depends on the car & carb, plus a pair of vise–grips to hold the ferrel to keep from kinking the wire.

Variations

The above instructions are generic. Your vehicle will have some minor variations, depending on type and age. Later vehicles have lots of pollution control stuff to disconnect and mark, early bugs may have a choke cable as well as throttle, different heater connections and so forth. Buses and Ghias have different air cleaners than bugs, different wiring runs. The purpose of these instructions is to show you that removing your engine is fundamentally quite simple. I'm assuming you'll check the manual for your particular vehicle before tackling the job.

Once you understand what's involved in removing your engine you can do it with a screw–jack or even no jack at all if you've got enough scraps of 2x4 and a decent lever. But since removal and replacement of the engine is a standard maintenance item, something you'll be doing several times in the years to come, the wiser course is to insure you have the proper tools.

Lowering the Engine

The engine is free, bolts removed, it's held in place by the jack. The mainshaft of the transmission is still plugged in to the clutch so the first step in removing the engine is to pull it straight to the rear. On some models this is impossible without removing the rear breast tin — that thing the heater hoses go through (VW calls it the Rear Cover Plate). In fact, removing that particular piece of tin is always a good idea on any engine removal except the early buses; on them, you pull the whole back of the engine compartment — real easy to drop a bus engine.

When the mainshaft is free of the clutch disk splines you have to remove the engine in a curving path downward and to the rear. You can't do that unless you're Roboman. What you'll do is move it down and to the rear in a series of little steps or jiggles, twisting the handle of the jack (lowering) and pulling to the rear, using one of the tail pipes for a handle.

When the mainshaft is free of the clutch, the engine can come straight down.

Three minutes. Yeah, right. Working alone, give yourself as long as it takes, the first time. Figure thirty minutes to an hour after that.

Safety Stuff

Accidents don't 'just happen.' We let them happen.

Don't work alone if you can help it. The other person doesn't have to be a mechanic, just someone who knows how to aim a fire extinguisher and dial a phone. If working alone, keep a phone within reach. Within TRAPPED reach. If you do something stupid you'll end up as a couch for a Volkswagen. Expect the unexpected. I heard of a guy who got his HAIR trapped, a problem I've not had to worry about for a number of years.

If it's your first time dropping an engine, don't work at night. You want to give your head/hands a chance to see/remember all the stuff under there. After you've dropped a few engines you can do it with your eyes closed — literally. Or in the dark. Or whenever you really need to. The first time, you'll be presented with an informational overload. Give yourself time to learn, not just chant your way down a check–off list. (The typical car owner knows more about the surface of the moon than the underside of their car.) Take the time to absorb what you see reach around and touch stuff. See if you can adjust the clutch (or even find it).

A wise first–step is to disconnect your battery. In fact, take the sucker out, check for corrosion. (The more often you do this, the more chances you'll have to catch corrosion before it becomes a problem.) Set the battery out of the way. Put a board across it so nothing can fall across the terminals.

To pull a bug's engine the rear bumper has to be as high as my knee. (Okay, sorry. Lemme check… About 23".) More is better. The front wheels are securely blocked to prevent forward movement. (Trick: If you're on dirt, dig two holes, roll the front wheels into them.) Made–up chocks are a good idea, as are wedge–shaped blocks. The idea here is you don't want the vehicle to move once you begin jacking.

The vehicle must be supported on stands. Best bet is a pair of lightweight commercially made jack–stands from K–mart or similar. Bugs are light, lightweight stands will work. So will stacks of wood. Don't use concrete blocks. They will shatter. Solid concrete, like a building pier, is okay so long as the point of contact is wood. (But those things weigh 40 pounds…) American–made jack–stands are better than the ones from Harbor Freight, which are made in China. I had one of their 6–ton Chinese–built stands break on me. Crystalline fracture of the latching pawl. Load was about one ton. Ruined my whole day.

(A set of jack–stands is a good project for when you get your migger.)

Once you've got the vehicle raised, shake it. Go on, give it a shove. If it's going to move, you want to know NOW, while you're still walking around.

If you're working on dirt, gravel or grass, go find a piece of plywood for the jack to roll on. If you'll habitually be forced to work on such a surface, treat the piece of plywood like a tool, which it is. Give it a couple of coats of paint. Put a date on it, maybe a VW logo. Cut a hand–hold so you can carry/hang it. This sort of thing sounds silly to guys with shops and concrete decks and lotsa tools but this sort of thing is how a person takes control of a situation. Working on sand? Add a tarp to your kit, maybe a sunshade. Working in Seattle in the gutter of a steeply sloping street in the rain? Deal with the situation; impose your will on the elements. Comfort and convenience are important factors in doing good work.

Putting it Back In

The curving path the engine must follow on removal and installation is dictated by the relationship of clutch to mainshaft and the geometry of the engine relative to the body, which is jacked up, nose down.

Buses are easy; no curve. Up/in for installation, out/down for removal. Ghias are a little different from bugs due to slightly different rear–body configuration. If you've pulled the rear breast tin (a must for all Ghias [I think]), the rest is the same.

Before re–installing the engine, tape any wires up out of the way. Using wire or string, curve the throttle wire up toward the top of the engine compartment. The throttle wire is hardened steel, 'music wire.' If you kink a throttle wire, replace it. You can get a kinked wire fairly straight but that's where it's going to break at some time in the future. And if it's not straight it's liable to wear out where the kink rubs against things. (Hint: Before replacing a throttle wire, paint it. Do it as soon as you buy it. Clean it good then put a little zinc chromate on a rag and pull the wire through it. After the paint cures you can store the wire or install it. Before you install it, use the same technique to put a little silicone lube on the wire. The paint/silicone lasts longer than grease, doesn't gum up in the tube through the body tunnel.)

Putting the engine in is more difficult than removing it due to the upward–curve business and aligning the clutch splines. This sermon isn't a how–to cookbook, there are too many variations. This sermon is an overview, to give you an idea of what needs to be done. I'll assume you've cleaned your bell housing, checked the throw–out arm, replaced the throw–out bearing, the seals (tranny and #1 main bearing) and checked the end play — these are common chores, things you do every time you replace the clutch, which is the most common reason for dropping the engine.

The main trick to re–installing the engine is getting the splines of the clutch disk to align with the splines in the mainshaft. Since the vehicle isn't horizontal, the proper engagement path is slightly downward (ie, the front of the engine is a little lower than the rear [Front is FRONT]). If you've just replaced the clutch you'll want to make sure the disk is properly aligned to the pilot bearing. You'll need some form of alignment tool and it's smart to insure it doesn't sag while torquing up the pressure plate; keep the tool in the same plane as the crankshaft. You can buy alignment tools, or use an old mainshaft picked up at a junkyard or from a tranny rebuilder. Or you can make one out of wood. VW's 'official' clutch alignment tools were made from hardwood. I often use a deep 10mm x 3/8 drive socket made by S–K. The narrow end is a shake–free fit in the gland nut, while the big end is a sliding fit in a clutch–disk bore. Since the idea is to insure concentric alignment, anything that meets that goal is usable, so long as it doesn't contaminate the work.

Once the mainshaft enters the bore of the clutch disk it will take some minor rotational alignment for the splines to mesh. Usually you can do this by rocking the engine from side to side as you press it home, other times you may need to clap a wrench on the alternator nut and crank it a little. In either case, you'll feel the 'slide' as the thing lines up.

During all this your engine has been balanced on the jack, atop a piece of plywood about eight inches square. The best point of balance is close to the flywheel–end of the sump plate. The engine won't balance there by itself, you'll have to do the balancing. This astable balance point is necessary to achieve the motion needed when aligning the mainshaft splines.

On bugs and ghias you can see how the clutch is lining up by peeking around the side of the blower housing. With a bus, you'll have to slide underneath to see what's holding things up, using the lower studs as alignment points. As a general rule, once the studs have entered their bores you've got the thing aligned close enough to re–install the throttle wire. The final alignment involves the clutch splines, keeping the proper angle of insertion, and bolting the thing up. Don't try to pull it into place with the lower stud nuts, life isn't that simple. If it doesn't want to go, stop. Take it out. Think about it a while. Check everything over and tackle it again after taking a break. (This time it'll slide right in and leave you wondering, it was so easy. Veedubs got a sense of humor.)

Bolting it Up

Plugging in a veedub engine is a treat, except for the upper mounting bolts. With two people — even a stranger willing to hold a wrench in position — you can have the thing back in and bolted up in a matter of minutes. Working alone, you'll have to do some head–work. Hopefully, readers of this list will share their method of running up the top mounting bolts. I've made some tools that let me do the job without too much difficulty, and you can buy a magnetic captive–wrench that works for most applications, but the best way is to have the assistance of a second person.

One of the most difficult chores in bolting up the engine is — surprise! — putting the rear breast tin in a Ghia or bug. The problem here is that the screws holding on the rear breast tin also hold on the small air–dam that is part of the lower shrouding, that little piece of tin under the #4 cylinder. And that's the piece of tin that has the bolts welded to it. Without that piece of tin, it's impossible to securely fasten the breast tin, a lot of heated cooling air will will leak into the engine compartment, the blower will recirculate the hot air and your engine will overheat.

The problem with bolting on that little piece of tin is that you have to position the piece of tin from UNDER the vehicle but the screws or bolts have to go in from above… and your arms are about a foot too short. There's no trick to doing this job, unless you want to weld nuts on the breast tin and put the bolts in from the bottom. The non–trick solution is to call on someone for help.

Things to Do While the Engine is Out

You'll usually pull your engine to do a clutch job, focusing on that task alone even though it will only take about twenty minutes. But there are some maintenance items that can't be done when the engine is installed. Because you pulled the engine to get at the clutch, you'll tend to view those jobs as peripheral and are liable to be a bit casual toward them. After everything is all buttoned up it's discouraging to discover the back–up lights don't work, or a new drip has appeared in the driveway; extremely discouraging if some minor maintenance item, improperly performed, forces you to drop the engine again. You must treat each job with equal importance.

Each time you do a clutch job you should inspect the concealed portion of the engine compartment seals and replace them at the first sign of hardening. Before replacing the engine seals you should inspect the seal mounting flanges for rust and deal with any found. Replacing the engine compartment seal is dead–easy: Use lots of soap. The soapy rubber seal slides into the channel easily. A pair of vise–grips makes it easy to grip the soapy rubber seal.

Having the engine out provides the perfect opportunity to clean the transmission of any drippings and road grime. Oil collects dirt, and a layer of oily dirt makes a good insulator. Your tranny gets hot in normal use, both from the friction of gearbox and differential, but also because it is acting as a very effective HEAT SINK for the engine. It runs cooler if you keep it clean. (This is the kernal of truth on which the perception that new VW's ran cooler is based. They really did! Until the tranny got coated with a layer of gunk.)

When the engine is out is also the best time to do any work on the starter, replace the boots on the axle and so forth. 'So Forth' includes an obligatory check of your front tranny mount. Use a big screw driver or pry–bar to lever it up and down while you visually inspect the nose–mount. If it moves a lot, you've got a bad mount.

Planning Ahead

The basic premise behind Preventative Maintenance is to insure proper adjustment and lubrication of parts so as to provide maximum service life AND THEN to replace the part BEFORE it fails. This last aspect of PM is often overlooked, we drive until the clutch wears out or the brake shoes are making metal– to–metal contact with the drums.

A wiser course is to plan ahead, scheduling a weekend for pulling the engine, replacing the heads (precautionary valve job), clutch, rear brake shoes and engine compartment seal. If you use your bug as a daily driver this minor overhaul (often called a Top Overhaul, with reference to the valves) takes place about every three years, after about 50,000 miles of mostly–highway driving. Three years later, you swap the entire engine, plugging in the spare you've been building/rebuilding over the last five or six years, whenever time permitted. Using this method your engine–cost–per–mile works out to about two cents and your risk of a break–down is virtually eliminated. This is a central element in the Forever Car philosophy.

The Forever Engine

With a properly built engine it's possible to run 150,000 miles three full PM cycles, before needing a major overhaul. One hundred and fifty thousand miles of service translates to about 1.3 cents per mile. This assumes an initial engine cost of about $2,000 1995 dollars and reflects a complete engine (tin–ware, alternator, heat exchangers, etc) assembled from all–new, top– quality parts, modified to run hydraulic valves and fitted with a full–flow oil filtration system.

Two grand may sound pricey for an engine; you can build a good engine for less. But if you start with a new crankcase and a Berg counterweighted crank you should be able to overhaul such an engine for under $500. The crank will easily withstand a regrind and the case will probably need only a twenty–thou align–bore Properly rebuilt, you can expect about another two full PM cycles — about 100,000 miles of service — before your cam and lifters are history. Lifter bores can be sleeved, and if done in brass will last longer than magnesium, but after a quarter of a million miles you should plan on retiring the crankcase and starting over. Even so, you've gotten a bargain; you engine cost–per–mile will be under a penny. And that makes good cents to me :–)

Pulling the Engine II

If you want to surf you need to know how to swim. Not in the intellectual sense, you have to enjoy swimming; you have to be pretty good at it. There are a few guys who break this rule but they only serve to prove its importance; they're lousy surfers, never truly at home in the water.

If you want to maintain your Volkswagen you have to know how to drop drop the engine. The Volkswagen was designed around modular components. The engine mounts to the tranny with four bolts, as does the front axle assembly. The rear axles and tranny mounts to the chassis with twelve bolts. Professor Porsche envisioned a vehicle in which the major wear components could be easily replaced as complete assemblies. This permitted quick maintenance and fostered specialized overhaul and repair centers for rebuilding engines, transmissions and front axle assemblies.

That principle remains valid even though Volkswagen has abandoned such repair centers. Indeed, all of the principle's of Ferdinand Porsche have been largely abandoned by Volkswagen AG. Today they are just another motor car company. But the wisdom and genius of Professor Porsche are forever embodied in the early VW sedan and Transporter, and in their underlying simplicity, a key feature of which is easy removal of the engine and running components.

Some months ago I described how to remove your engine, hoping to show that it's really a simple operation. Yet I continue to hear people speak of dropping an engine in terms best used for running a four minute mile or digging the Panama Canal... with a teaspoon. The fact is, the early-model Volkswagen engine probably weighs less than you do, it is one of the lightest automotive engines ever designed, it was designed to be easily removed and replaced.

If you own an early Volkswagen, dropping the engine from time to time is part of the natural order of things. You must drop the engine to replace the clutch, a periodic task. You must also drop the engine to do a valve job or to replace your engine compartment seals and a number of other maintenance chores are most easily accomplished with the engine out of the vehicle.

There are really only two kinds of Volkswagen owners, those who have removed their engine and those who are going to.

Rod Bearings

I'm sorry if my flippant 'butter knife' analogy is causing confusion. If your rods feel loose it could be due to the temperature of your shop or some other minor factor. I doubt if the crank has been reground in error, and it sounds as if your have the proper bearings.

Stock crank (per Haynes) was 2.164

eh... close, but not very precise. Your con rod journals should have been 55mm. The spec is 54.98 to 55.00. 2.164" is a few tenths (ten-thousandths) under 54.98mm.

A 'twenty thou' regrind should actually be a half a millimeter regrind, since 1mm is not .040" but more like .03942". If the machinest knew his stuff, he shot for a finished dimension of 2.1466" to 2.1458" and it sounds like he did pretty well in your case.

To make things fit you now need bearing shells that are half a millimeter thicker, meaning they should be marked "+0.50mm"

Fit the shells into a rod. Assemble it to the crank, making sure the offset mark is in the proper postion for that particular crank throw, and the matching numbers on the rod line up. The shell should be lubricated with a wipe of CV joint grease or assembly lube.

With the crank horizontal, hold the rod parallel to the floor and let it drop. It should swing down slowly.

Okay, we got that far and the sucker swung down like a rocket. Now we need to know why.

First, there may not be a problem. If you are in a warm shop, if the journal is perfectly round and well polished, and if the rod and bearing shell are a good fit, you have a circle within a circle with a thin layer of grease between them and the thing swings down quick like a bunny. No problem, just perfectly fitting parts and warm lubricant.

Are they all like that?

Can you detect ANY appreciable in/out motion when you push/pull on the little end of the con rod?

If you can't detect any play — any gross evidence of excessive clearance — then the rod, crank and bearing apparently do fit. But they are loose. The question is, are they too loose.

Since you do not have precision measuring instruments, use the Plastigage. You need to know if the clearance exceeds spec, which should be about .0015". If the radial play is more than .0025", then you need to replace the connecting rod.

What you've encountered here is a common occurance and need not be cause for alarm. If your rods are worn — pounded out, in this case — they can be rebuilt.

The drop test is a valid procedure for determining if a rod is properly fitted to the crank. The spec for rod journals is a fairly tight fit, from less than a thou to about two and half thou. A rod that drops slowly has about a thou of clearance, which is a good figure for a street engine.

Rod Length & Deck Height

The guy I talked to the longest claimed that differences in length of rods tended to be so small that only one deck height needs to be measured, likewise that there is insignificant difference between head chamber sizes, and that compression ratios will be within a hundredth for all cylinders.

I strongly suggest you measure deck height yourself, and your chambers, and then do the numbers for compression ratio. While rod length may be very close, the length of the rod is only one of several factors that make up deck height. Other factors are your crankcase, cylinders and pistons.

Only factory-new cases, or those which have been 'decked' are the same dimension from the center-line of the crankshaft to the top of the spigot hole. Depending on the brand of cylinders you use, it isn't uncommon to find variations of as much as sixty thou in cylinder height from the spigot ledge to the top. Cofap (Brazilian) are especially bad in this department. Often times you'll see a set in which the cast fins don't even line up, the mold having been joggled out of alignment before the iron was cast. When cast in this manner, the cylinders are unusable since the 'kink' in the fins prevents normal air-flow.

But when the cylinders are not of a uniform height, you can turn the three longer ones to match the shortest, if you have a lathe. Mahle and NPR are very good in holding to a consistant cylinder length. Your pistons are usually very close to identical between wrist-pin centerline to piston-top... but not always. It's wise to check. Use the wrist pin as one surface, the head of the piston (upside down) as the other. You'll need a surface plate and surface gauge but the check takes only a few seconds. If the difference is more than ten thou, I usually take a light cut across the face of the fat pistons. Here again, you'll need access to a lathe. Having all of your parts uniform allows you to commence assembly with a known base-line. Even so, tolerance stack-up errors can lead to some surprises which you will have to even out to achieve the smoothest running engine.

Quality of after-market VW parts varies wildly, and a high price is no assurance of high quality. It's best to check things out before you commence assembly. Anyone can assemble a Volkswagen engine but the difference between proper assembly and the other kind is akin to the difference between night and day. Or winners and losers. When it comes to proper engine assembly, details count. Trusting your rod length to establish deck height only works well with mono-block engines, such as V8 or in-line four. For aircraft and VW engines — those mating on the crankshaft centerline, it's always best to measure the deck height of each individual cylinder. The variations will surprise you.

Sealants

St. Muir is about 25 years behind the times when it comes to sealants. Permatex will work but it's wise to thin it slightly; it forms a pretty thick barrier.

If you want a really drip-free engine you may wish to consider using Loctite #518 sealant on the crankcase flange. This is the 'red stuff' I mention in several posts. Don't use paper gaskets around the base of the pistons. Instead, use Loctite #599, the 'grey stuff.' Also use the grey stuff on the washers for the crankcase and cylinder-head studs. Just a dab will do ya but make sure the dab forms a continuous bead.

For a dry oil pump installation, coat both sides of the paper gasket with Hylomar (Loctite #819, the 'blue stuff'). There is a similar product that comes in a spray can that I can't find at the moment; ask the guy at the parts place; it's less expensive than Hylomar and works just as well; follow the instructions on the can (let it get 'tacky' before you use it, and be sure to spray both sides of the gasket).

To keep the sump from dripping takes a bit more work. First, make sure you've got real resin-impregnated gaskets and not that cardboard crap sold in the cheap 'oil-change' kits; oil weeps right THROUGH those things. Next, make sure the sump sealing surface is not pitted. Then use a generous bead of hylomar on all of the mating surfaces of the gaskets (or the spray stuff, as above). If the casting is pitted you'll have to use the gray stuff. You'll also have to use the gray stuff if all you can find are the cardboard gaskets. And you'll have to coat both sides of the gaskets, a very messy operation. The problem with the sump is that you're making up a sandwich of steel-gasket-aluminum-gasket-magnesium. With that many different expansion rates in one stack, nothing is going to maintain a perfect seal for long. The gray stuff is an RTV compound. It not only fills voids, it cures to form a rubber-like gasket that will conform as the 'sandwich' goes through its heat cycles. But be sure to get the sealant on the EDGES of those cardboard gaskets as well as the flat surfaces. Because of the small size of the fasteners and their distance apart, the oil will soak right through the cardboard. And over-tightening the nuts only makes the problem worse.

If you plan to remove the sump plate (ie, if you don't have a full-flow oil filter), install it with new copper washers and the acorn nuts. It will weep oil around the nuts. But if you have a full-flow oil filter there will be no need to drop the sump (be sure to use one that has a drain). In that case, get some properly sized steel washers and Nyloc nuts. Install the washers with gray stuff and there will be no weepage.

All of these sealants must be installed on clean, oil-free surfaces, which is why you can't use them if you have to drop the sump; it's impossible to get all the oil off the six little studs without turning the engine upside down.

I still use Permatex #2 on the cam plug, oil pressure sensor and pipe-threaded oil line fittings. It seems to perform better under pressure than the red stuff.

Tom Wilson's method of dobbing ALL fasteners with gasket shellac definitely makes for a dryer engine, but also a messier one. This is what VW appears to have used, judging by the gobs of sealant you see on stock engines... which still leaked. My engines aren't completely dry; the #1 seal weeps a bit (as all of them do), but they are dryer than most.

Although I've listed a lot of Loctite products there are probably competitive brands that work equally well; I tend to stick with what works and these things work better than Permatex #2 for their particular tasks.

I'll go ahead an make this a general post; there may be some other folks out there who'd like to get rid of those spots in the driveway :-)

Setting End Play

Flywheels are pretty tough. Pry on one with a screwdriver, you'll break the part of the crankcase serving as a fulcrum, or bend the screwdriver, long before you'll do any harm to the flywheel.

You should check the end-play each time you replace the clutch, and adjust it to spec if it is worn beyond five thousandths of an inch. You'll need to use some pretty gross methods to detect end-play in a fully assembled engine due to the drag of the rods, fan belt and the #1 seal. The large amount of drag justifies the use of a lever of some sort to shift the flywheel. Adjusting end-play in an assembled engine is an entirely different procedure than doing so during initial assembly.

When you rebuild an engine, you want to determine end-play as early as possible after the basic crankcase-work, including any align-boring, is completed. This allows you to work with a bare crank and flywheel, no seals or rods to add drag, just the #1 bearing so you'll have the thrust face, and the #4, so the crank won't bind. This allows you to get a perfect, repeatable figure in your measurements using only hand-pressure to slide the crank back and forth. Such a minimal set-up allows you to dismantle the crankcase quickly, should you wish to take a little meat off the thrust flange to adjust the clearance. This is how I'm able to set — and to hold — a tighter than stock thrust clearance. Assuming the flywheel runs in a truly perpendicular plane, you can get by with a thrust clearance of a fat .0015" to a slim .0020", just enough to insure adequate oiling when things heat up.

The small clearance means less 'working' of the crank as you shift gears and when the load on the engine changes. Such working is what puts a side-load on your rods. The more an engine can 'work' along the Z-axis of the crank, the faster the big-end of the rods will wear and the hotter it will run. According to some mechanics, excessive end-play is a major contributor to ovaled main bearings. I'm not too sure about that one but everyone pretty much agrees on the effects of excessive end-play on your rods.

Don't misunderstand this. Close is good when it comes to oil clearance. Tight is bad. Close implies a uniform fit. Tight means something is dragging. If your end-play is set too tight you'll ruin the engine when it heats up.

Best bet? Stick to the low side of the stock spec — .003" — until you've rebuilt a few engines. Better a little loose than a ruined engine.

Since end-play is a critical factor in engine longevity, I'm going to make this a general post.

Teflon Tape

Properly applied, Teflon tape makes an excellent sealant for oil & gas fittings. Gene Berg's comments regarding its use failed to make clear that the original problem occured when Gene or one of his staff wrapped too much Teflon on a stock oil pressure warning light switch. The key-word here is 'switch', as in electrical. Teflon is a marvelously effective insulator. If the full length of the fitting was taped it would insulate the oil pressure warning light switch from the crankcase and thus fail to make the circuit.

Shards of Teflon tape have been found welded to the bearing shells in some engines. This results when someone wraps the tape too near the end of the fitting causing bits of tape to be cut off when it is torqued into the threaded hole. Being a high-temperature plastic and insoluable in oil, the shards of tape will circulate through the engine until trapped. In the case above, they got as far as the main bearing shells. Teflon tape has caused tappet and cam failures by blocking the oil passages.

When using Teflon tape in automotive service, always leave the first two threads of the fitting bare and never use Teflon tape when installing electircal switches that ground through the threads — use Permatex.

Tight Crank

I pulled the block back apart last night for the UMPTEENTH time to investigate why the blasted thing BINDS UP under torque. Maybe you mavens on the subject can tell me why it acts fine until that last torque experience and then the blasted thing just croaks out. No turning at all. Pull it back apart and it's fine. Yeesh.

Before you can deal with a tight-crank problem you will have to identify where the tightness is occuring. Normally, you would do this with precision measuring instruments — the so-called 'blueprinting' — of the crankcase, bearings and crank. The task involves verification of dimensions, not only in absolute magnitude but in the uniformity (ie, roundness) of bearing journals and bores and the straightness of the crankshaft. Unfortunately, few one-time engine builders own the tools needed for this task.

I usually start with the crankcase, bolting it to the specified torque after checking the mating surfaces. Then I use snap-gauges or in inside micrometer to check the diameter of the crankshaft bores. Each bore is checked at several points to insure they are a true circle. With the crankcase dismantled, I then check to insure the bores are in a straight line (!) With used, align-bored crankcases, you would be surprised how often they are not.

The crankshaft receives the same type of inspection, first checking the journals for absolute dimension and roundness, then checking the crank for straightness. But I also check each journal for concentricity about the centerline of the crankshaft. Here again, you would be surprised how often you find the #4 journal has been re-ground slightly askew... and can usually detect that asymmetry across the other journals as well.

The bearings are of course marked as to their size, and it takes only a moment to trial-fit the full-circle shells (ie, #'s 1, 3 & 4) on their respective journals. This is done with a bit of oil on the journal and my 'measurement' here is purely subjective — I FEEL how well it fits, judging the clearance by the amount of drag. If one of the shells feels a bit too tight or too loose, I torque it into the crankcase and measure it directly, which I have to do with #2 in any case.

By this time I've filled a page in an exercise book with a dimensioned sketch of the crankcase and the crankshaft. Then I put the bearings and crankshaft and crankcase together. Torqued to spec, the crankshaft should spin with no more than finger pressure.

End-play is one of the tricky-bits, since it involves the fit of four components (crankcase, #1 main-bearing shell, crankshaft and flywheel) plus a stack of shims. Before dealing with the shims I'm liable to do half a dozen trial-fits with different flywheels and different bearings. Often times, in the case of align-bored crankcases, I'll find the lip that supports the #1 main-bearing thrust face to have been cut a little too high or too low. If too high, I can deal with it by dressing the fit of the bearing shell, but if too low (ie, they've cut the #1 main-bearing web too thin) it means the crankcase must be rejected.

This isn't a very professional way to assemble an engine. This may sound perverse but much of what I'm doing is done purely for my own enjoyment. I like to use precision instruments. I like to know what I'm dealing with. I like the logic inherent in the fit of machined parts. And I like the silky smooth rotation of the parts when they are assembled. I won't go ahead with the assembly until I have a foundation that spins freely with finger pressure alone. But once I've achieved that fit, I know I can proceed with confidence.

I waste even more time with the rods :-)

I realize that without the surface-plate and precision tools you will not be able to duplicate the procedures above, but you can emulate the 'discovery' process by pre-assembling your engine in graduated steps.

Once you have a combination of crankshaft, crankcase and main-bearing shells that allows the crankshaft to spin freely with the crankcase torqued to spec, you can proceed to checking the end-play, mesh of the cam-gear, and so forth. The fit of the cam shaft, for example, should be checked with equal care, especially with regard to end-play. With the crankshaft and camshaft checked individually, the next step would be to pre-assemble the crankcase with both. The important point here is to progress in small steps, dealing with any problems before going on.

I am not Volkswagenwerk AG. I am my own Quality Control Department. And the parts available to me come from many sources. This forces me to do, on an engine-by-engine basis, what Volkswagen did on a mass-production scale. Not only must I insure the parts meet the required specification, I must check for tolerance stack-up errors. Without such checking and a series of pre-assembly steps, I think it would be extremely naive to assume that an engine assembled from such a miscellany of parts would operate reliably.

The problems described above are usually the reflection of an error made during the regrinding of a crankshaft or the align-boring of a crankcase. The error may be the result of an improperly adjusted tool or a lack of skill on the part of the machinist. Occasionally, I have been sold sets of bearings that contained shells of different sizes, or in the case of cam-bearings, of having a thrust-face that required dressing. The lesson in all this is to leave nothing to chance.

I think it's worth mentioning that I never got a bad crank from Gene Berg, and that I used Larry Pauter's shop for align-boring used crankcases. Even so, I still checked.

Exhaust Fumes

The heat exchangers on upright engines are virtually guaranteed not to leak exhaust fumes into the heater channel, thanks to their thicker steel walls and the surrounding aluminum fins. But a common exhaust leak is where the heat exchanger fastens to the muffler. A relatively small leak in this area, especially if directed upward, can blow exhaust gases into the heating circuit if the sleeves fastening the heat exchanges to the plenum chambers are not a perfect fit. The higher velocity of the exhaust gas has no problem overcoming the blast of air from the blower housing at that short distance.

If you have an early bus and if the heater smells of exhaust fumes, the joint between the heat exchangers an muffler should be one of the first things to check.

The plenum chambers on Brazilian mufflers are a particularly poor fit and may require a bit of tin-bending to achieve a tight system.

In about half the cases where a customer complains of exhaust fumes coming from the heater, the problem is not the exhaust system or heater but failed engine compartment seals, particularily around the engine compartment hatch.

In many cases, complaints of exhaust fumes turn out to be oil rather than exhaust, with the fumes being drawn into the blower from a variety of sources. A loose or missing crankcase ventilation tube is the most common cause in this case but spilled oil and a leaking oil cooler will produce the same symptoms.

Exhaust Nuts

When you have fasteners that come loose despite being torqued to spec and installed as per instructions provided by the engine manufacturer,   and when there is no problems with the engine, such as unusual vibrations or CHT temps, the source of the problem may be downstream from the fitting.

Factories do make errors, as the various recalls prove. But fabrication errors in repair parts are an entirely other world. I've seen Brazilian heat exchangers that had the flange welded about ten degrees off. By the time you'd reamed and jacked and bent the things into alignment you had built in some really heroic stresses that after a few heat cycles produced lots of nice noisy leaks, loosened fasteners and a host of other problems.

A very common problem with bugs and early buses is after-market exhaust systems that have resonant points far removed from the stock systems. They set up vibrations and a rich field of harmonics that often produce strange problems in remote parts of the vehicle, like an ash-tray that won't stay closed. The various fixes range from the ridiculous to the sublime but the explanations as to the cause of the problem are usually far from the mark.

A loose fastener is often only a symptom. Symptomatic relief will keep you on the road but the root problem could be something rather sneaky — and possibly dangerous.

A fastener that 'just comes loose' is enough to keep me awake nites.

Exhaust Studs

Preventing Exhaust Port Stud Failure

Obtain eight brass or bronze Exhaust Port Nuts. They are about 14mm in length, long enough to cover nearly all of the threads on the exhaust port studs when used with a suitable brass or stainless steel washer. Install them with a copper–based anti– seize compound and dob a bit onto any exposed threads. It will cook into a glob and protect the thread. One of the nuts will be thinner than the others in order to fit the lower stud on the #3 exhaust port.

At one time Nissan and Toyota used brass nuts that would fit VW exhaust studs, and brass nuts were even sold as a bubble–pak item. I don't know if they are still available from these sources. Most recently I've made my own from phosphor bronze 1/2" hexigondal rod; it takes only a few minutes on the lathe to make a set of nuts.

Volkswagen provided special nuts for use on the exhaust ports but most of the engines I see have regular steel nuts installed. They can usually be coaxed off with repeated applications of Liquid Wrench or similar but often the studs are in sad shape and need to be replaced.

I've heard of fellows using stainless steel exhaust studs but haven't seen any and don't know how well they perform. If any one knows of a source for metric threaded stainless steel studs, please pass the word along.

Inexpensive Extractor

Making an Exhaust System

A big-bore stroker is wider than a stock engine by twice the thickness of the spacers used under the jugs, needed to accommodate the longer rods which themselves are needed to maintain the angle of the downward load imposed by the longer throw of the stroker crank. In the case of my 2180, the engine is .80" wider than stock.

You can't use a stock muffler with a wider engine, nor would you want to. But neither can you use most extractor systems since they're sold already welded to the dimensions of a stock engine. You can buy a kit of parts and roll your own but it ain't cheap and it ain't fast. I recently needed a cheap, quick extractor for a bored, stroked engine.

For more than a year J. C. Whitney has been offering an inexpensive extractor that will fit any engine width and has the tail pipe positioned low enough to clear the bumper on a bus. The stock number is 21-xx-3034-A, where 'xx' is the catalog code. The extractor costs between $45 and $70, depending on which JCW catalog you're using, when you order, if you qualify for a 10% discount, and if they'll ship it free. There's a lot of luck attached to any order placed with J. C. Whitney.

Construction-wise, the extractor is a piece of crap. The welding is poorly done, the flanges are not parallel and the tubing isn't very round. The first time you fire it up you'll blow fiberglas all over the neighborhood because the shoddy 12" muffler has no internal baffle. Made in Red China.

Shoddy goods but you can make the thing work. On the up-side, the thing isn't very expensive and will fit just about any veedub Ghia or bus up to '71, the -009 of mufflers. On the down-side, there's no way in hell to install a heater-pipe plenum chamber on the left side. There's enough room to jury-rig something on the right side, which is okay for early buses since the right heat exchanger feeds the cockpit, but the #4 exhaust stack on the extractor comes out of the flange at a weird angle and makes it impossible to get the heater ducting through the hole in the tin- ware. Good luck coming up with a fix. Just remember frostbite is better than asphyxiation.

Doing it Right

To make a proper job of it, when you order the extractor also order four 1-1/2" 2-hole exhaust flanges. They cost about a buck and a half each. JCW p/n is 24-xx-0881-N. Then go down to your local hardware store and pick up some stainless steel nuts & bolts. Five-sixteenths is about the right size, inch and a quarter about the right length. Get some stainless steel washers, too.

The object is to come up with an exhaust system that does not depend on clamps to maintain a seal nor provide structural support. So we throw away the stock veedub muffler clamp kit and replace it with welded flanges.

Your heater boxes are not 1-1/2" diameter and the flanges will just sort of sit there but three or five nails of the proper size will center the flange on the pipe and hold it for tack welding. The El Cheepo extractor isn't inch and a half either so use the same trick. You'll have to cut the flare off the extractor's heater-box connections in order to slide on the flanges but you can leave the swage — it will provide additional strength.

Bolt the flanges together in pairs using the stainless steel hardware. Position them so the parting line falls at the end of the extractor's tubing, the swage of which slides over the heater box tubing. Insure you've got a gasket between the flanges and don't torque them down just yet. Inch and a half ID two-hole exhaust gaskets are standard items at a real parts store whereas the typical franchised FLAPS-guy will simply look at you. Or, if you can't find gaskets, make some using high-temperature gasket material. Fel-pro makes some good stuff, sorta like ceramic paper that hardens when heated. Makes a nice exhaust gasket.

Get the entire intake and exhaust system assembled before doing any welding. In effect, you're using your engine as a welding jig. The only way things are going to come out straight is to insure you've got all the kinks out before you weld-on the flanges. You'll also need to run a bead around the extractor's tubing where it slides together.

The proper way to assembly your intake and exhaust system is to get all the nuts on loosely and then tighten things down in a logical sequence, starting with the heat exchangers, then the carb. heat pipe and finally the extractor flanges. (Indeed, the secret to quickly installing a stock muffler is to loosen the heater boxes.)

When everything is aligned — and don't be surprised if you have to persuade things with a rubber mallet — tack-weld the flanges in place, tack-weld the tubing, and after a final alignment check, run smooth, gas-tight beads between the flanges and the tubing.

The results will surprise you. When the flanges are torqued down on the gaskets, the system will be completely leak-free and extremely strong. Unfortunately, it won't be very quiet. The 12" glass-packed bullet-style muffler unpacks its glass the first time you put your foot down, leaving you with a 12" expansion chamber that does nothing to quiet the exhaust.

Making it Quiet

It doesn't take a rocket scientist to see that if you can weld flanges between the extractor and your heat exchangers, you can do the same between the extractor and that silly little muffler. You'll need a bigger flange of course. What you'll be doing is sawing the thing in two just aft of where the four tubes merge into the muffler, which is about three inches in diameter. Flanges with a 3" ID are also stock items, as are high quality, American made glass-paks that really do a nice job of quieting the exhaust without squeezing the life out of the engine.

Living With Flanges

Once you've welded flanges to your heat exchangers it means you've got to stick with flanged exhaust systems. This isn't a problem if you're forced to use an extractor since the flanges are better than muffler clamps. Flanges never leak while cheap extractors invented the word. But flanges work equally well with a stock muffler, replacing those ridiculous muffler clamps and ring gaskets with a leak-free joint that's as strong as the pipe it's welded to.

Sermonette

You can't buy a well-made extractor for a big bore engine for under two hundred dollars, and while the Chinese product discussed in this article is an amazingly bad piece of workmanship, it can be made to provide years of leak-free service if you are willing to apply a little Yankee ingenuity to the problem.

Installing Muffler

Maybe I will be baptised in fire for my initial foray into the mechanic's world. Driving up the toll-way today one of the tail-pipes fell off my muffler. Stopping and looking I can now see this big hole in the very rusty muffler. So I will install a new one.

I know you have mentioned this before but should I just go with a cheapo from Whitney's or something more expensive? German?

Since you are doing the work yourself you might wish to go with the cheaper Brazilian muffler. It is a poorer fit but once installed it will provide nearly the same span of service as it's heavier, easier to install German cousin. You will have to replace it more frequently but since you are doing the work — and assuming it is properly installed (meaning easy to remove), there's very little economy in using the more expensive German part. Indeed, you may wish to consider buying a pair of cheaper mufflers, storing one away as a hedge against inflation.

Making a Volkswagen muffler fit is remarkably easy — you simply start with ALL of the exhaust AND intake manifolding loose. It sounds like a perfect hoo-raw to loosen the heat exchangers, the rear breast-tin and the intake manifold but the small amount of slack that comes from things being loose is what allows the muffler to align and the bolts started without any difficulty at all. Once each gasket is in place and you have at least a few threads advanced on every fastener — the heat-riser being especially difficult in this department — you will arrive at a perfect installation with no more trouble than it takes to GRADUALLY tighten the fasteners in a logical sequence, starting with the carb-heat tube, then the rear exhaust stacks, the manifolding (if you have single-port heads be sure to renew their gaskets) and so on, finishing with the forward exhast stacks (ie, the heat-exchanger to cylinder head).

I prefer to use welded, flanged fittings between my heat exchangers and the muffler but the ring-clamps do an adequate job if the heat-exhanger's exhaust pipe is not eroded and you make doubly sure the muffler is well-seated on them, the ring-gasket snug against the flange and the cambered metal washer has not been forgotten. Be sure to use a fragmiable sealent here. Because of the shape of the junction, with the smaller heat-exchanger pipe fitting into the larger, flared part of the muffler, any leak will be directed FORWARD, often with enough pressure to pump exhaust gases into your heating system via the plenum around the rear exhaust stack.

One of the most critical aspects of installing a new muffler is to insure against any exhaust leak in the vicinity of the rear exhaust stacks and carb-heat tube, since this junction is located near the plenum chamber accepting air from the blower housing. Do whatever is needed to make your heater air supply as tight as possible. Because of the poor fit of many Brazilian mufflers I've abandoned the metal collars used to connect the heat-exchangers to the plenum chambers, using instead a wrapping of thin (.014") stainless steel sheet, formed into a tube and secured with a pair of hose clamps on each side. Installed loose, the pre-formed stainless steel will accept any amount of shuffling about as I position and connect the heater hoses from the blower housing. Once everything is in place, with the necessary gaskets and air-seals thru the rear breast tin (you can still get curious circular gaskets from J.C.Whitney), the stainless steel sleeves with their pair of worm-threaded hose clamps are much easier to tighten down than the original part with its single, often obscurely-placed screw.

Also with regard to preventing exhaust gases getting into the heater system, bed the ring gasket and flange with a fragmiable sealent such as the type of Permatex that hardens. Permatex was not specifically made for this application but it works extremely well. So long as the joint is mechanically secure, the clay-like sealent will prevent any exhaust gases being jetted into the area of the plenum. For removal, a few light hammer blows will shatter the sealent, causing the parts to come free.

These instructions apply only to the upright engine of course, which I've assumed you have from your mention of two tail pipes. I do hope you are not using this arrangement on a bus. The bus has such a large drag-area you really don't want to pump your exhaust directly astern — if you do, it will quickly find its way into the cabin. Best to dump the exhaust to the side, as VW intended.

As for hints on removing the old muffler, it depends entirely on how it was installed. Done properly, with anti-sieze on the threads and fragmiable sealeant on the flanged tubes, it should come away rather easily. But when improperly installed you may find it very difficult to remove without damaging the exhaust studs. Patience is your best tool in this latter case. Patience and lots of Liquid Wrench. Read the instructions for whatever nut-loosener you choose to use — in most cases there should be some mention of tapping on the part once it has been saturated with the stuff. This tiny amount of tapping is often the difference between having the thing come apart or sticking together as if welded. The most persistant 'clinger' I can recall took me four days of soaking and tapping before the nuts agreed to come free.

Avoid brute-force at all costs. Even so, be prepared to replace an exhaust stud or two — if the thing was improperly installed you'll probably find the studs have been damaged by rust.

If possible, use bronze nuts when reassembling the thing, or stainless steel nuts, well protected with anti-sieze.

Once you have the muffler installed, after about a week of use, it would be a good idea to inspect it carefully for any fasteners that may have loosened. A small amount of slack may be taken up at that time, mostly from the cooking and compression of the various gaskets.

I've found the copper-based anti-sieze to work best for high-temperature applications such as exhaust systems. If you use stainless steel hardware, ask the vendor if he offers a special anti-sieze for high-temperature applications — the best SS hardware is hardened stuff that takes a special anti-sieze compound. Common SS hardware is plain 303 alloy — copper-based anti-sieze will work fine.

A couple of notes:

Very few Brazilian-built beetles were fitted with heaters. They had no heat exchangers, using the J-tubes and lower tin-ware found on the VW industrial engine, and the blower housing had no heater outlets. This lack of experience with plenum chambers and heat exchangers might explain the truly horrible quality of the heater-related components on the typical Brazilian-built muffler. I have seen some with the carb-heat flange undrilled and many with the drilling unthreaded, threaded at an angle and so on — really awful work. (The thread is 6 x 1.00mm by the way.) But they can be made to work.

It's risky to buy a Brazilian-built muffler via mail-order — you're liable to get what someone else has already rejected. It's best to inspect the thing before plunking down your money.

I've heard stories of horrendous difficulties encountered while attempting to replace the stock VW muffler. In almost every case the person doing the work had failed to loosen the heat exchangers, intake manifold and rear breast tin (which should be removed entirely in most cases). Unless these parts provide some freedom of motion during the assembly process, it may be impossible to install the muffler.

Take your time. Use plenty of Liquid-Wrench during disassembly and adequate amounts of sealent and anti-sieze during re-assembly. Use bronze, brass or stainless-steel nuts if available. The copper-plated 'exhaust-nuts' sold by many after-market suppliers are a scam — they are steel nyloc-type nuts without the nylon insert — the thin wash of copper plating will vanish within days leaving you with a steel nut to rust-weld itself to the exhaust stud. If someone offers you 'copper' exhaust nuts, check them with a magnet.

Your muffler is the one part of your car that can kill you without your even knowing about it. I feel that such a deadly topic deserves more attention than it receives and have made this a public posting on that basis.

Stale Air Heating

VW made a big thing of their 'Fresh Air' heating system when they changed over from the 36hp. The bigger blower housing incorporated a pair of air channels ducted directly to the heat exchangers; before, cabin heat was provided by air that had been used to cool the engine, and often picked up exhaust fumes or stank of oil, hence the emphasis on 'Fresh' air.

Since about 1961 Volkswagen cabin heat has been provided by the waste heat from two the engine's four cylinders; air–flow is governed by engine speed and an adjustable flapper valve in each heat exchanger. The heating system functions as an 'open–loop' or 'one–pass' system; you'll have to open a window or wind–wing to provide an exhaust otherwise the flow of heated air will depend on cabin leakage, which is quite small on the tightly built VW's. But as the outside air temperature falls, so too will the amount of cabin heat. Because of the one–pass design, by the time the outside air temperature approaches zero degrees Fahrenheit, the cabin temp will be hovering around the freezing point; heavy woolens are the uniform of the day. The problem is even worse in the Transporter, with its larger surface areas and greater interior volume. In below–freezing weather the Transporter's heating system is inadequate. A gasoline–burning auxiliary heater is the quick and easy solution. And the expensive one.

Re–upholstering, with heavy use of urethane insulation, can improve the cold–weather comfort factor of both bug and Transporter but there is another solution that's often overlooked. That solution is to convert the heating system into a closed–loop or multiple–pass design, as is used in most modern automobiles.

Recirculating Heating Systems

Multiple–pass heating means passing the same air through the heater a multiple number of times. Since the air picks up more heat on each pass, even an un–insulated Transporter can be brought to a toasty temperature on a cold winter day.

Converting an early VW to use multiple–pass heating is quite simple: Install a fan and ducts to recirculate the cabin air through the heat exchangers. The heated air is returned to the cabin through the existing heater ducts. There are kits of parts available from J.C.Whitney (and others) that will let you convert your present system to a recirculating system. But there's no such thing as a free lunch; there are some good points and some bad points associated with Stale Air heating.

The good news is the thing works. If you're tired of numb fingers and rubbing the windscreen with an old sock, throw in one of the kits and learn how to sweat again.

The bad news is that the quality of the kits is generally poor, and they want you to chop a humongous hole in your firewall for the return–duct. Given the name and purpose of that particular bulkhead, this isn't the smartest thing to do to your vehicle. Besides provide a passage for smoke & flames should you have a bad day, the firewall opening also makes a handy path for engine noise.

The poor quality of the kits shows up as shoddy hardware, cheap ducting and a noisy blower motor. Given the cost of the thing (about $100 for a bus, $85 for a bug), you could probably do better prowling the junk yards in hopes of modifying the blower & ducting from another make.

Bus owners make out like bandits with recirculating heater kits because they can hide them under the rear seat, down beside the rear heater box (reference here is to an older bus). But the kit makers want the bug owners to mount the thing behind the rear seat, hence the need for the hole in the firewall.

I've not tried this but I think it would be possible to mount the recirculating blower under the rear seat of the bug as well as the bus. The ducting is more of a problem but a permanent solution would be the use of formed fiberglas ducting. If anyone's interested in how such ducts are formed and made (they are fairly common in aircraft) I'll be happy to provide details.

But First…

Freezing temperatures usually go with corrosive road salts (as a native Californian I'm not quite clear on which came first…) and many heater–no–work complaints have to do with rusted out heat exchangers or ducting, especially on the bus. Before considering a Stale Air heating system you need to insure the stock system is in good condition and working properly.

Should you wish to cobble up your own recirculation system be sure to use a variable–speed fan. Indeed, if you're a confirmed tinkerer you can rig a thermostat to the system, giving your thirty year old VW all the winter–time comfort and convenience of a modern automobile.

Sermonette

It's about 80 degrees as I write this (April, 1995), a lovely spring day in southern California. And the perfect time to work on your heater, oil your tire chains and do other chores associated with winter driving. If you wait until the first freeze you've missed both the point of this sermonette and a summer's–worth of opportunity.

What's a Backfire?

I was taught that a back-fire occurs in the exhaust when an accumulated charge of combustable gases is ignited, either by the exhaust gas from another cylinder or by some other means, causing it to 'fire back' into the cylinder.

A stack-fire on the other hand is when the gases in the intake manifold are ignited, causing the thing to fire-back through the carb. Stack-fire is usually more destructive and dangerous than a backfire although either is a good symptom that something is wrong with the ignition timing or valve train.

Of course, you can cause your engine to backfire simply by switching the ignition off and then on while at speed. Kids love to do this and mechanics love them to do it too, since the resulting damage to the engine and exhaust system insures a steady income and early retirement.

Air Filters

The only truly reusable filter is an oil-bath type, and even that requires the coir baffle to be washed with kerosene from time to time, the oil bath changed and so forth. Filters of treated paper are almost as good at trapping small particles as an oil bath. Once trapped, they are discarded.

'Reusable' filters that do not include some disposable element for trapping fine particles are suspect, since the particles you want to worry about are too small to be removed by conventional cleaning methods.

Oil bath air filters are based on a fundamental principle of physics, wherein the greater mass of any particulate matter, as compared to the mass of a molecule of air, prevents the particle from negotiating the sharp bend introduced in the air stream, causing the particle to collide with the pool of oil and become trapped.

Paper, cloth or other filters are based on the labyrinth principle. In tests, oil-bath (or water, for large stationary engines) have proven to be more efficient, albeit larger and messier and requiring more maintenance.

Off-roaders use paper filters only because oil-bath types do not stand up to the jolts. Military 'off-road' equipment such as tanks (!) use a combination of centrifugal and labyrinth principles. The centrifugal filters are either active (ie, consuming power) or passive, using ducts and vanes to create a vortex in the air-flow. Labyrinth filters usually have a reusable outer filter and a disposable inner filter, the former for coarse material, the later for fine.

Your Volkswagen's oil bath air cleaner may look clunky and out of date, but if properly maintained it does a better job protecting your engine than a paper air filter.

Automatic Choke

What is your opinion of the automatic choke. I hear all kinds of contradictory information. I have a 1970 bus equiped with a stock 1600 single port with a 30 pict 3 carb. "St. Muir" says to disconnect it altogether. If I keep it functional, how do I adjust it properly?

The electrically powered automatic choke on Solex carbs is a good idea. Properly adjusted, they provide quick starts during cold weather and enhance warm-up without any negative effect during cruise.

The choke consists of a heater coil that heats a bi-metallic spring. When the spring is cold it holds the choke-plate across the inlet of the carb. The spring tension is low enough to allow the choke-plate to be opened by the increased air-flow when the throttle is opened.

When the bi-metallic spring is heated by the electric heating element it moves the choke-plate to the vertical position and holds it there against a stop located on the outer body of the carb.

With the bi-metallic spring properly installed so as to engage the lever on the end of the choke-plate shaft, adjustment is nothing more than rotating the bi-metallic spring holder so as to bring the choke-plate to a nearly horizontal position. It will only move one way and the 'nearly' is defined by fine-tuning; if it does not start and idle reliably, rotate it a little more — or a little less(!) until the engine starts reliably and will idle without any throttle.

If you live where it snows you'll probably want to adjust the choke each spring and fall, providing more choking action for winter starts, less for summer. There are a couple of marks on the body of the choke to facilitate this. The range of adjustment is very small so don't get carried away.   The choke is in good condition if the shaft is free to rotate, the heating element unbroken (does it get hot?) and the travel-limiting pin undamaged (the pin rides in an arc on the throttle-positioner quadrant-plate (the thing with the teeth against which the upper part of the throttle lever rests; look for the adjusting screw; it fits against the quadrant-plate) on the driver's side of the carb).

If the heater element is damaged, replace it. The element, a coil of nichrome wire, is riveted into the housing. Replacement consists of replacing the housing. And yes, the element comes with different heat ranges, some that warm up faster than others for use in warmer climates. If the shaft does not rotate smoothly soak that portion of the carb in carb cleaner for 24 hours after first removing the plastic insulator behind the choke heater element. Since the choke sees virtually no motion, as compared to the throttle, it is unlikely that the choke shaft or bores will wear out. Failure to move freely is usually due to an accumulation of crud. Proper cleaning and a shot of low-residue silicon lubricant is usually all that's needed to restore smooth operation. But sometimes corrosion is a factor. If the body of the carburetor or the choke shaft is corroded, it must be completely dismantled and polished smooth. This calls for removal of the butterfly valve, the fasteners of which must be carefully straked on re-assembly. Failure to strake thee fasteners (ie, to peed them over) can cause them to be sucked into the engine. Feeding screws down the carb is never a good thing to do.

The choke is electrical and starts working as soon as you turn on the key, meaning it's function is NOT directly related to the operation of the engine. Normally, it takes three to seven minutes for the electrical heater element to shut off the choke but expect it to take longer — as it should — during really cold weather, shorter during hot weather. The elegance of this system is that the function of the choke is 'conditioned' by the ambient air temperature. Cold day, longer choking action, warm day, less.

Note that if you leave the key on WITHOUT starting your engine, the choke will still actuate — and may be fully opened (unchoked) when you finally get around to starting the engine. If you fail to understand this point, and have a habit of turning on the key some time before starting the engine, you can easily come to the conclusion that automatic chokes 'don't work', as a lot of people have done. In the same vein, a seemingly non-related electrical problem can prevent the choke from actuating properly, leading to poor fuel economy and other ills.

The electric choke is an intelligent, well-engineered replacement for the troublesome and failure-prone mechanical choke fitted to the early 28PIC carb. It offers a big step forward in engine management. Failure to understand — or appreciate — how the electrically operated choke operates has caused people to follow the advice of St. Muir, who obviously did not understand the thing, and tear it out. Don't do it. Instead, learn how it works and how to maintain it. You'll be rewarded with a vehicle that starts more reliably and warms up faster, plus an engine that will last longer.

Brass Carb Tube

Can someone familiar with this problem post a picture of the offending component on the web? I thought we were talking about hoses coming loose. Mine are all clamped down. Now I think we're talking about the brass fitting itself coming out.

Joe,

I've mentioned the following in a couple of my sermons but given the spate of interest generated by the thread it's probably worth repeating.

The brass tubes pressed into the VW fuel pump and Solex carburetors have a habit of working loose. They appear to work loose more frequently when you install a fuel filter in the line betwen the pump and the carb, a very dangerous idea and one not recommended by any automobile manufacturer. The VW's fuel pump already has a filter, and the gas tank is fitted with a strainer. The troube is, no one bothers to clean them, or to maintain their fuel tank.

The root problem is a rusty fuel tank or rusty fuel pipe. The cure is to eliminate the rust and re-seal the fuel tank. I've a lengthy sermon describing the process.

The problem with loose brass tubes is how to re-secure them. The answer is to make them larger in diameter by knurling. You can do this using a file as your knurling tool, pressing it hard against the brass tube while you roll it back and forth on a block of wood. You will emboss or knurl an impression of the file's teeth into the brass. This will increase the diameter of the brass tube by some small amount. Small, but enough to provide a good interference fit when you drive the brass tubing back into whence it came. Before doing so, clean the bore and apply a dot of high strength loctite to the tube. (The green stuff, sometimes called 'Sleeve Retainer'). Prime the hole so the loctite will cure quickly. Strake the boss around the tube once it is driven in for added security.

The sermon on making a bulkhead fitting for the fuel line where it passes through the forward breast tin is also germain to this thread.

As to disconnecting the fuel line when preparing to drop an engine, the best procedure is to clamp the hose before it is disconnected. There are special clamps just for tubing and Volkswagen used one of the more traditional spring-clip types. Most VW mechanics have one or two of them in their kits. Vise-grips, adjusted to provide about 1/16" clearance will also work as a fuel hose clamp. I don't like the modern screw-type fuel hose clamps because they take two hands to tighten. The old VW clamp turns out to be the best type for Volkswagens since you can do the job one-handed.

As a general rule, if you can indent the fuel hose with your thumbnail it is elastic enough to withstand being clamped. If the hose is so old it has lost its elasticity, attempting to clamp it is liable to break the hose. In such cases the wiser course is to drain the fuel tank by syphoning, drain the residue directly, and replace the fuel hose. In smoggy climates the hose will harden in as little as two years.

Attempting to plug a hardened hose with a pencil or fid will usually crack the hose, allowing it to leak. A bolt about 1-1/2" long and of a diameter to fit inside the fuel hose will provide a better seal although it must be clamped in place.

Ideally, your fuel system should provide for a shut-off valve at the tank or at the filter just down-stream from the tank. Such valves and filters are readily available and not to difficult to install on either the VW sedan or Transporter.

A filter should never be installed on the output-side of a pump. The little inline filters so commonly seen on VW's are as asperin to cancer and probably cause more problems than they cure. The added mass of the filter when filled with fuel is probably a contributing factor in causing the brass tubing to come loose.

Clamps, Cutoffs & Stuff

J.C.Whitney offers a pair of 'hose pinchers' for clamping fuel and vacuum lines, six bucks (p/n 38 — 2717-T). Most mechanics use a small pair of vise grips with the jaws set to about 5mm. Of course, if you're clamping the typical 30 year old VW bus fuel line, it will break like a stick. (My post on VW engine fires may be of interest if you drive an older VW.)

I've got a few sharpened dowels in my kit, use them as plugs. I also have some 'T' and 'L' sections of plugged brass tubing for the same purpose, plus some neoprene hose & plugs for tubing; you can't clamp steel tubing.

If you earn your living working on vehicles you simply can't afford to have any gasoline around while you work. The new formulated gas is toxic as hell and any gasoline can give you a nice chemical burn; fire doesn't even enter into it. Gas under the vehicle? Move the vehicle. Dry up the gas. Deal with the drip. In forty years I've had the misfortune to see two Crispy Critters under the remains of vehicles.

A shut-off valve is a standard feature on a properly designed fuel system, required by law in some areas. Installing one on a vehicle that doesn't have one is less of a chore than you may think. The best shut-off valves are the ones used in light aircraft. They often incorporate a filter element and usually cost like the dickens. Regular brass fittings will work if they are designed for gasoline. Most use O-rings; be sure replacements are available. (They usually are; O-rings are pretty much standardized). Motorcycle fuel shut-offs work fine, if the valve is from a large bike. These can often be had for a song at motorcycle wrecking yards and aren't all that expensive new. All of the motorcycle shut-offs I've seen use O-rings and the parts are widely available.

If you have a fuel tank that uses brazed-in-place tubing for the outlet/vent instead of threaded fittings, you can always adapt the tubing to accept an SAE flared fitting, install a steel flex hose, and mount the fuel shut-off in some convenient location. If the tank is more than ten years old it may be wise to remove it, get rid of the internal rust, and slosh it with sealant. Installing a fuel shut off can be part of the overhaul, which may as well include modifying the tank to accept threaded fittings. (See an older VW fuel tank; make it look like that.) But never play with a fuel tank unless you understand the hazards; gasoline vapor has about the same explosive energy as dynamite; that loud noise may be the last thing you ever hear.

If your bus is old enough to vote (mine's almost old enough to be President) consider replacing your steel fuel lines with stainless steel as part of your next overhaul. In the engine compartment stainless steel/Teflon flex hoses with AN fittings are worth considering; they seem to last forever. And never put a clamp-on or push-on fuel filter in the engine compartment. VW puts the filter in or under the fuel tank, another in or before the fuel pump. Never put one between the pump and the carb. (I know, everyone does it. That doesn't make it right. See my post on rusty fuel tanks [which is why they need such filters]. Learn to deal with the problem, not the symptom.)

Cleaning Air Filter

Books and archives say "clean with kerosene", or "that if dirty clean". Do I just soak the whole unit with kero?? Should I light it?? Is there a wrong way to do this? Presently I have an aftermarket foam air cleaner that I want to remove. The stock air cleaner has been sitting for years

Here is the method I was taught to use by one of the mechanics at Deet Eichel VW in Modesto, back in the mid-1950's, but before we begin let's make sure you understand there are two parts to an oil-bath air-cleaner — the oil bath and the labyrnth filter. The oil-bath requires cleaning quite frequently — every day, if you're traveling off-pavement. The labyrnth part usually does not need to be cleaned as often (but if running through flour-dust conditons, it can clog up in a matter of miles). In normal service, running on pavement, I clean the labyrnth element about once a year, the oil-bath about four times a year. (On the trip to Inuvik I cleaned both due to the many stretches of unpaved or dusty roads.)

Now let's go clean the thing.

The labyrnth part of the filter consists of a coir element. To clean it, you soak it in solvent then slosh it out. The part must be upside-down for this to work. It is left to stand for about an hour. After soaking, it was flushed with solvent several times, that is, emptied, then filled, again and again — about half a dozen times. It was then filled with clean solvent or kerosene, the clean stuff was poured out and the part was set aside to drain overnight.

Some of the later-model oil-bath air-cleaners include voids and chambers meant to silence the whistle of the air-stream at high speeds. Be sure you do not trap solvent in these spaces. Also, be sure the thing drains as dry as you can get it. If it is too wet when you re-install it, it will trap large particles and quickly clog — the labyrnth is meant to trap small particles, the oil-bath is for the big stuff. Don't worry about it being too dry — the little particles soak up the kerosene, becoming bigger particles as they collect dust and ultimately end up in the oil bath.

The filter element is coir, a vegetable fiber. The old-timer's trick of burning out an air-filter element applied only to certain equally old cars and didn't work very well even then — it got rid of the grease but left lots of residue to be sucked into the engine.

The lower portion of the air filter is cleaned in the usual manner — scraping it out with a putty knife if necessary. Once perfectly clean, fill with oil up to the mark, mate with the upper part and re-install.

-Bob Hoover

PS — Solvent, be it mineral spirits or kerosene, is re-usable. Just let the solids settle out. There are various tricks for getting rid of the solids, such as putting a little water in the bottom of the barrel (the thinner floats on the water but the solids fall thru) but just letting it stand and decanting it carefully will give you fairly clean solvent — certainly clean enough for this task. But the final slosh should be done with clean kerosene. (Think of it as three-weight oil :-)

Engine Fires

The typical VW engine fire results not from a lack of clamps but from:

A - Abrasion of the fuel pipe where it passes through the forward breast tin, and

B - Failure of the pressed-in brass pipe in either the carb or the fuel pump.

A clamp provides no benefit when fitted to a hose hardened by age. The externally reinforced hose used by Volkswagen works perfectly well, as history has shown, so long as it is in good condition. The major problem here is owners who fail to replace the hoses when they harden.

Internally reinforced hose should always be secured with clamps.

My first 'sermons' were posted in response to the fire hazard in older Volkswagens. In those articles I explain how to prevent the fuel pipe from being worn through by fabricating a simple bulkhead fitting, and how to re-install the brass tube in the carb or fuel pump, which always warns of impending failure by leaking, often for months before it finally lets go.

The saddest part of fuel-related fires in air-cooled Volkswagens is that they are preventable.

Fuel Filters II

My comment about not installing a fuel filter between the pump and the carb was politely questioned by two of our cousins across the pond, one of whom (Andy Erskine) pointed out that if the pump were working correctly there should be no problem. He is perfectly correct. With a push–rod of the correct length and the proper springs installed, the mechanical VW fuel pump can generate only a few ounces of output pressure.

[For those of you unfamiliar with the innards of the VW fuel pump, a rocker pulls a flexible diaphragm downward, drawing fuel into the pump chamber. But the rocker, which is driven by a push rod riding a caming surface on the distributor gear, is fastened to the diaphragm by a draw–rod and toggle; it can only pull the rod down, it can not push it up. The upward movement — the pumping stroke — is provided by a light spring, compressed when the diaphragm is pulled down. The strength of the spring is selected to match the buoyancy of the carburetor float. When the carburetor bowl is full of fuel the float pushes a needle valve against a seat, shutting off the flow of fuel from the pump. The fuel pipe and pump chamber are now full of fuel, which holds the diaphragm down. The rocker continues to rock but without pulling down the diaphragm which is already down, held that way by the chamber full of fuel at a pressure determined by the buoyancy of the carburetor float. When the float valve opens fuel flows into the bowl and the spring extends, pumping more fuel. Since the push rod is driven by the distributor gear this cycle occurs at one half engine speed.]

That's how it's supposed to work, and the fuel pump is indeed a remarkably reliable component that usually succumbs gracefully to accumulated wear only after many years of service. But the fuel pump contains a second chamber, the deliver chamber, isolated from the pumping chamber and from the carb by check valves, one of which is called the cut–off valve. In normal operation the pressure of the pumped fuel holds the cut–off valve open against the pressure of a spring that normally closes the cut–off valve when you shut off the engine. I've witnessed a peculiar surging action that produces sufficient pressure to overcome the float valve, resulting in overly rich running and erratic engine operation. This occurred in a narrow range between 1,000 and 1,500 rpm and despite exhaustive tests could not be diagnosed further. But in each occurrence the problem vanished when the fuel pump was rebuilt or replaced. And in each occurrence the cut–off valve spring was heavily corroded where it contacted the top of the pump. I suspect the problem was some form of harmonic between the pump spring and the cut–off valve spring, during which the cut–off valve acted as a positive displacement pump on closing. There was no in–line filter involved in either of the above cases, but the pressure generated was considerable, enough to make the fuel line pulse.

I've seen no service bulletins on the above but I have heard of similar occurances from other mechanics. And Volkswagen did see fit to adopt a differently designed pump.

Another case of high pressure fuel delivery related to the incipient failure of the operating lever pin (ie, the rocker pivot) that caused the rocker to bind – – and eventual break — the diaphragm pull rod. But before breaking, the bound pull rod acted as a PUSH ROD, pumping with enough force to pop an in–line fuel filter out of a neoprene hose as neatly as a seed from a grape. With fuel in the carb bowl, the engine continued to run until it was shut off in frantic haste.

So I'll stick to my guns on this one.

(The incidents above involved the old–style pump, the one I've dealt with most frequently during my 39 years of tinkering with Volkswagens and the one I find easiest to rebuild. And no, the pumps in question were not on my personal vehicles.)

Sermonette

The most elegant thing about a part which is NOT installed is that it cannot fail. Nor does it require maintenance, repair or replacement. As I pointed out in my original posting, the proper solution to a rusty fuel tank or fuel pipe is to deal with the problem directly by eliminating the rust, taking steps to see it does not recur. And while the value of a replaceable fuel filter can't be argued, sound engineering practice calls for them to be installed on the suction side of the fuel pump.

I'll now don my asbestos underwear. And send greetings to Mr. Heath Smith. I pray he will continue on the path he has chosen, for he is destined to live in interesting times.

Fuel Pump Poop

Have you ever had the little brass tube come out of your fuel pump? Howzabout outta the carb? Messy, eh?

Heres a reasonalbly good fix:

Using a mill-cut file (one row of teeth, crossing the file at an angle), place the cleaned brass tube on a piece of wood and ROLL it back and forth using the file and lots of pressure. Do it slow. And only put the file on the portion of the tube you want to ENLARGE.

What you're doing is KNURLING the brass tube. Knurling will increase the diameter of the tube by a small amount due to the displacement of the brass by the hardened steel teeth of the file. (Which is why you roll it on wood instead of metal; metal flattens the knurls. [No wood? Try the sole of your boot.])

Now clean the hole in the fuel pump or carb; get it really clean.

Obtain some high-strength loc-tite (the green stuff, often called 'sleeve retainer') and a can of loc-tite primer. Prime both the hole and the brass tube. Put a drop of green loc-tite on the end of the tube, making sure it spreads all the way around the tube. Now tap that puppy into the hole.

(In theory, you should wait 24 hours. If someone is shooting at you, give it fifteen minutes.)

The moral of this story? Modify your fuel pump and carb to use threaded aircraft-type flex lines. Push-ons are fine for a low-cost, high-volume production line, and they'll usually get you there. But AN-type fittings will ALWAYS get you there. Alive.

Fuel Tank Upgrade

A guy at the local VWAPS mentioned to me that it's possible to shoe horn a 15 gallon gas tank from a 68 into an earlier bus (I have a 58).

 # 1) Is this true?

Yes.

 # 2) If so what's involved?

Put it in, secure it, provide for venting, make up a suitable filler-neck.

 # 3) Would the gas tank from a 68 Double Cab have the same proportions?

I don't know.

I pulled the tank from a '72 loaf (14.7 gal vs. 10.7), installed it in my '65, got some suitable rubber hose from a truck repair place, connected the filler-neck. To secure the tank I folded plastic food wrap around folded sheets of news paper, slid the 'books' in, top & ends, used foam-in-place urethane foam to lock the tank in position by poking the nozzle of the foam between the newspaper. The plastic-wrap prevents the foam from getting a grip on either chassis or tank but does not prevent it from conforming to the shape of either. Should I need to remove the tank I can chunk-out the foam with a hack-saw blade or whatever, pull the foam free. The original tank straps are too short to go around the new tank. Straps from the new tank use a different method of attachment.

Roland Wilhelmy didn't like the foam idea. He extended the original metal straps, making up new fittings for them to bolt to.

Roland's first "72" fuel tank didn't fit. It looked different from my '72-tank. He found another tank that looked like mine (two vapor recovery outlets plus a central, rearward-facing fill-vent) and it slipped right in.

You must also fabricate a new vent & vapor recovery system, sealing up any vents you do not use. I vented my tank to the atmosphere, making an anti-syphon loop of quarter-inch copper tubing extending up into the driver's-side cooling-air intake, which places the high-point of the loop about a foot above the fuel tank, then ran it down, through a drilled, grommeted and sealed hole in the left-rear wheel well. The copper tubing was well-secured at all points of contact with the chassis, attached to one of the tank's vapor-recovery vents with a sleeve of rubber tubing. Roland used a similar arrangement but his came out looking a lot neater, thanks to the straps and generally better workmanship (see 'The Stainless Steel Craftsman' in the 'sermon' file.) He made a simple jig that allowed him to form clips to hold the vent-pipe in position, made up a batch of steel clips and secured the vent-pipe at several points so it can't rattle. I used pieces of split hose, some safety wire and lots of RTV to accomplish the same end.

The extra four gallons of fuel represent a 37% increase in capacity.

The old fuel-gauge sender fits the new tank and functions normally.

Fuel, Rust & Filters

Fuel Tanks, Rust, and Filters or, Conventional Wisdom Strikes Again!

One bit of bad advice you'll frequently hear is to install a fuel filter in your fuel line between the fuel pump and the carb. The reason is that the pump can blow a CLOGGED filter out of the line, drenching your engine with gasoline. If you happen to have some marshmallows with you, fine, otherwise there's little you can do but stand by and watch it burn. The rule is quite simple: Never install a filter on the PRESSURE side of a fuel pump.

Because of the age of the typical Volkswagen, the fuel tank and fuel lines are generally quite rusty; that is the source of the residue you find in the carb bowl. The solution is not a filter but to deal with the rust, the root problem. You can resurface the interior of your fuel tank using a chemical sealant commonly called 'sloshing compound.' You pour it in and slosh it around, then allow to dry. Be sure to remove the strainer first. This is some very tough stuff, used in metal fuel tanks on aircraft. It is available from J. C. Whitney.

A rusty fuel pipe is a more serious sort of problem since the location of the pipe within the central hump makes replacement difficult, best done when the body is removed from the chassis. I've mentioned another fix, the use of an externally routed replacement fuel line, in one of my earlier sermons.

A filter in the fuel line will buy you a little time but PLEASE DO NOT install it within the engine compartment. Under the fuel tank is the safest place, followed by under the rear seat deck (ie, near the nose of the transmission). Veedubs love to burn; they're very good at it.

Your fuel system already has two strainers installed, one in the fuel tank, the other in the fuel pump. The latter is often overlooked as a maintenance item. On the late model pumps it is under the top cone, in early pumps it's behind the big brass nut. When you have a rusty fuel system you should clean the fuel pump strainer when you do your oil change. (But be careful, remember the fuel will flow by gravity once the system is opened.)

Rust forms in the fuel system due to an accumulation of water vapor from the atmosphere. When it condenses it collects in the lower–most stampings of the fuel tank, a depression around the fuel outlet fitting, where it produces pin–hole leaks. VW fuel tanks are not made of terne–plate (lead–coated steel normally used for tankage by American auto manufacturers) but are common mild steel sheet. Once liquid water is present in the fuel system it's difficult to get out without draining the tank THROUGH THE FILLER OPENING (ie, up–ending the thing). As a general maintenance item the usual method is to add a 'dryer' to your fuel, as frequently as dictated by your local climate. Gas 'dryer' is nothing more than wood alcohol (methyl methanol?) and is available at any auto parts store. Being hygroscopic, the alcohol mixes with the water and, if there isn't too much water, will be burned as fuel.

The water/rust problem is less frequently seen on veedubs fitted with the full array of pollution control devices, since the fuel tank is not vented directly to the atmosphere.

If your fuel tank is seriously rusted, the wiser course is to replace it rather than repair it. (I'll pause here and wait a minute until all the weldors stop rolling on the floor with laughter.) Replacement fuel tanks are available although the workmanship is rather shoddy; they often arrive already rusty. If you buy one it's a good idea to treat it as if you'd made it yourself, removing the existing paint, smoothing up the welds (bloody dangerous!) and repainting it with a high quality epoxy. The interior should be sloshed as a matter of course. Serious rebuilders have their new or repaired fuel tank powder–coated, which bakes the enamel to both the interior and exterior surfaces. The super–serious (and wealthy) have a new tank fabricated from stainless steel or aluminum.

Working on the fuel tank is one of the easier tasks of VW maintenance since it is so accessible, held down with just four clips&bolts, and at waist level. (This isn't true for '68 and later models; the filler neck is especially difficult to re– seal.) Be sure it's empty before working on it — seven pounds per gallon can make a heavy load — and that you have new fuel line on–hand. The existing fuel line under the tank will probably break like a stick when you try to disconnect it. (Lift one side of the tank, peek under, reach down and wiggle it loose.)

Pulling the fuel tank also gives you an opportunity to remove the fifty pounds of sand & gravel that accumulates on the 'smuggler shelves' behind the wheels when you take the short cut between San Ignacio and La Parisma.

Oil Bath Air Cleaners

George,

You have been misinformed as to the principle of the oil–bath air–cleaner. There is no vaporization and condensation of the oil bath. I suppose horse-hair may have been used for an air filter by someone but it was not Volkswagen.

The oil–bath air–cleaner is a classic example of a 'two–stage' filtering element, removing virtually all particulate contaminants from the air at all engine speeds.

Incoming air is forced to follow a vertical descending path toward the pool of oil then drawn upwards. Having a mass several million times that of a molecule of air, the inertia of the dust particles makes it impossible for them to follow the abrupt change of direction in the air–stream, causing the particles to strike the pool of oil where they become trapped. This works best at high rates of air–flow.

The coir filter element, which forms what is termed a 'labyrinth filter', applies the same principle but in a different manner. The coir element forces the air to change direction many times. The fibers are coated with kerosene. Dust particles collide with the fibers and are trapped by the kerosene.

The spec for cleaning the coir filter is to immerse it in kerosene, allowing it to soak for up to half an hour. It is then sloshed repeatedly and allowed to drain. This was done twice a year under normal driving conditions, as often as deemed necessary under dusty conditions.

In use, particles of dust trapped in the oil bath cause the level of the oil to rise. Under severe conditions it may require cleaning on a daily basis.

Under Volkswagen's original apprenticeship training program the effectiveness of the oil–bath air–cleaner was demonstrated by removing the sludge from a the oil–bath and coir filter, flushing it with solvent and examining the residue. A low–power microscope was needed to observe the smallest particles.

The same principle is used to clean the air for large stationary engines and for air conditioning applications, in which a recirculating water–bath may be used instead of oil, and the air may be forced past as many as two dozen up–down baffles, removing even microscopic particles of low density such as pollen. In some systems the water–bath is sealed with a thin film of mineral oil. Trapped particles fall thru the oil and are removed by the recirculation of the water beneath the oil film. I understand special silicone–based oils are used in modern HVAC systems but non–human applications such as large stationary engines continue to use mineral oil. Residential HVAC systems typically use labyrinth–type filters, designed primarily to catch fibers rather than particles.

Paper and foam filtering elements are based on the labyrinth principle. The effectiveness of the oil–bath air–cleaner is superior to that of the typical paper or foam filtering element. Paper air–filtering elements came into use when they became effective at trapping particles of a certain size. Oil–bath filters will trap smaller particles but there is no evidence of accelerated engine wear for particles below a certain critical size.

Air filters for rough service (armored vehicles, farm machinery, etc) where an oil–bath would be unsuitable, and high–volume applications (turbines, etc) use the same physical principle of mass–differentiation, typically drawing the air through several stages of centrifuging during which the greater mass of the dust particles causes them to be separated from the air–stream. Although such air–cleaners may be powered or static, they are often called ‘turbo’ air–cleaners. They are often used in conjunction with disposable labyrinth–type filters. For Volkswagen owners running off–pavement, the static type of ‘turbo’ air–cleaner used on Ford tractors has proven most effective.

Recent air–pollution legislation enacted here in California requires automotive paint shops to reduce their emission of vapor and particulate material. I mention this because the most cost effective means of doing so involves the use of high–volume, low–pressure spray–painting systems in conjunction with a multi–baffle water–bath air–cleaner that uses exactly the same principle as the air–cleaner on an early Volkswagen.

–Bob

PS — Coir (pronounced ‘core’) is the fiber from the husk of the coconut. The porous fibers are typically triangular or star–shaped in cross–section. Other vegetable fiber such as sisle, abaca and hemp may be found in reusable air–filters but the greater surface area of coir produces a better filter. American and British auto manufacturers developed metallic labyrinth filter elements but none proved as effective as coir. Animal fibers are generally unsuitable for automotive air filters because of their small surface area, although Ford conducted some experiments along those lines with chicken feathers or perhaps the quills from chicken feathers. (Coir and other coconut products was largely controlled by German interests.) –rsh

Oil Bath Air Filters

The only truly reusable filter is an oil–bath type, and even that requires the coir baffle to be washed with kerosene from time to time, the oil bath changed and so forth. Filters of treated paper are almost as good at trapping small particles as an oil bath. Once trapped, they are discarded. 'Reusable' filters that do not include some disposable element for trapping fine particles are suspect, since the particles you want to worry about are too small to be removed by conventional cleaning methods.

Oil bath air filters are based on a fundamental principle of physics, wherein the greater mass of any particulate matter, as compared to the mass of a molecule of air, prevents the particle from negotiating the sharp bend introduced in the air stream, causing the particle to collide with the pool of oil and become trapped.

Paper, cloth or other filters are based on the labyrinth principle. In tests, oil–bath (or water, for large stationary engines) have proven to be more efficient, albeit larger and messier and requiring more maintenance.

Off–roaders use paper filters only because oil–bath types do not stand up to the jolts. Military 'off–road' equipment such as tanks (!) use a combination of centrifugal and labyrinth principles. The centrifugal filters are either active (ie, consuming power) or passive, using ducts and vanes to create a vortex in the air–flow. Labyrinth filters usually have a reusable outer filter and a disposable inner filter, the former for coarse material, the later for fine.

Your Volkswagen's oil bath air cleaner may look clunky and out of date, but if properly maintained it does a better job protecting your engine than a paper air filter.

Pre-34 PICT Carburetor Basics

(Not for 34 PICT-x)

What exactly does a pilot jet do?

I wish they weren't called 'jets'. They aren't jets at all, they are metering orifices. And the term *pilot* is used in the sense of leading the way — of going first.

The pilot jet is what supplies fuel for slow-speed operation, typically at idle or just marginally above. Except when the choke is closed.

If the choke is closed, the pressure will be low enough to draw fuel up thru the emulsion tube to the normal (ie, high speed) discharge-tube (that thing hanging out there in the middle of the carb's throat above the throttle plate).

But when the choke is open/off/standing straight up, *and* the engine is turning at low speed, the discharge tube is at nearly atmospheric pressure so no fuel flows thru the high-speed circuit. Below the throttle plate however, the pressure is very low due to the suction of the engine. *(Remember, the engine is running slowly, the throttle plate is closed or nearly so [also remember — this is* ***not*** *for the 34PICT].)* That's when fuel is drawn thru the pilot jet. Understand, all fuel except that coming from the accelerator pump flows thru the main jet, but beyond that point, at slow speeds the path is thru the pilot jet, bypassing the emulsion tube, then out the one or two fixed low-speed ports (depends on which model carb) *and* out the orifice controlled by the volume control screw (on early carbs) or the by-pass screw (on late carbs).

Clear as mud? :-)

There's actually two things going on here, both involved with a reduction of atmospheric pressure along the course of the barrel of the carburetor. At high engine speeds there is sufficient flow of air thru the venturi of the carb to produce a significant drop in air pressure *(recall, the venturi accomplishes this by* ***accelerating*** *the air-flow).* The pressure difference between the open throat of the carb *(the thorttle-plate causes very little restriction when fully open)*, in which rests the mouth of the discharge tube, and the upstream end of the emulsion tube, which is at atmospheric pressure, sucks the fuel straight from the main-jet, up the emulsion tube and out the discharge orifice.

But at low engine speeds the throttle is closed and we have low air-flow. Low air flow means there isn't much drop in the air pressure. Under these conditions the emulsion tube and discharge tube are effectively at atmosphereic pressure, the same as the fuel in the float-bowl. To make the gasoline flow we need a pressure *differential* but at low engine speeds there isn't enough air flowing through the venturi. So we create the differential we need in another way, using the vacuum created by the cylinders.

Downstream from the pilot jet, which gets its fuel from the passage common to both the main-jet outlet and the emulsion-tube inlet, there are two or three orifices located on the side of the carburetor's throat which are ***under*** the throttle plate when it is in the closed position.. At low engine speeds with the throttle closed *(ie, at an idle)*, the pistons are sucking fuel out those openings while sucking air down past the edge of the throttle plate. It isn't very efficient but it provides enough fuel/air mixture for the engine to run at an idle.

(This type of slow-speed mixing results in very poor vaporization which is one reason carbs tend to run 'dirty' at an idle. The 34PICT uses a different slow-speed system and burns much cleaner. The popular 'fix' to make the 34PICT work with a centrifugal-advance distributor ***defeats*** *the cleaner-burning features of the 34PICT and converts it into a bad copy of a 32PICT.)*

If your engine won't run smoothly at idle when warm it means you most likely have a problem in your low-speed circuit — probably grunge in one of the fixed orifices or the adjustable screw has buggered it's orifice — it may even be broken off in the orifice if a 34PICT (very bad design, that adjustment screw).

There's no mystery to single-barrel carbs — if they're clean, they work, assuming nothing is broken or buggered-up. They're not very efficient but they're extremely reliable. If yours is giving you trouble you need to establish a baseline — start by cleaning it properly, which means soaking it overnight in carb cleaner then installing the new gaskets and float-valve from the rebuild-kit. The instructions are in the kit. The kit does not include jets. You get those from the dealer, should you need one.

But if your problem is mechanical, such as a buggered adjusting screw or a worn shaft hole you'll need to repair the damage or replace the damaged part. In some cases, on early carbs, it's impossible to repair certain things. The carb must be replaced.

After driving on the freeway my tailpipe is always black and sooty. Does this mean my main jet is too large?

Too large a main jet *could* account for those symptoms. But so could a dirty air cleaner, improper timing or worn valve guides. If mileage is normal you're using the proper size jet. But if you have seriously sooty tail pipes ***and*** rotten mileage you're probably running too rich. If there is no obstructions in the air path and the timing was dead-on then it would be wise to check the jets.

If you really want to know what's going on during the combustion cycle you're going to have to use instruments that can extract data from the exhaust gases.

A sooty tailpipe alone is not a definitive symptom. Modern 'oxygenated' fuels typically leave a sooty residue — the tree-huggers figure carbon is a wiser planetary contaminant than boron or lead — the stuff that used to give us those pretty grey to tan tail pipes. Modern fuels give us black tail pipes.

My engine has a flat spot coming off idle but only when the choke is off. During warm-up there's no flat spot. Is this an accelerator pump problem?

It could be. But it sounds more like a problem with the slow-speed circuit. It it were the accelerator pump you would have noticed a stumble with each gear-change.

Progressive Carb

I'm in the process (to a certain degree, Hoover inspired!) of doing a complete rebuild of a spare engine recently bought. (And might I say, having a really good time & learning loads)

However, the engine came sans carb. Having just read the 'Dual carb' sermon I'm wondering whether it would be a good idea to get hold of a secondhand progressive carb (Datsun?) from my local scrappy or get a rebuilt/secondhand VW carb elsewhere.

Is the progressive the way to go?

Actually, this may be a case of comparing apples to oranges. The article you cite had to do with the superiority of a progressive carb over the typical low-cost dual-carb set-up.

As a general rule, a progressive carb will always be more suitable than a single-barreled carb. Another general rule is that a single-carburetor set-up will always be less trouble than a multi-carb set-up. A third rule is that the carb must match the manifold.

With that as the foundation, to determine which carb — or combination of carbs — is best for your particular needs, you should base your decision tree on the engine size & type, the vehicle's role (ie, the type of loads & traveling you have in mind), the availability of spares, cost benefit (if any) and so forth.

Any carburetor must match its manifolding. I mentioned using a progressive carb from a tiny (I think 1200cc) Datsun engine. What I didn't mention was the ten days or so it took to fabricate a suitable manifold.

The stock Volkswagen engine has been optimized — it's cam, chamber design, valve area vs manifolding, and carburettion — to work as a cohesive whole. If you want best reliability at least cost, the wiser course is to accept the design as it stands — to take advantage of the engineering that comes built-in with each VW power-train. Proper fitting-up during assembly, insuring the components are balanced to a standard above Volkswagen's rather loose range, and taking pains to insure proper volumetric balance, will usually realize a gain in output of 8 to 12 percent over the stated specs. Such gains are 'free' in the sense the engine has not been modified — you have simply adopted higher standards of precision and accuracy in its assembly. There are of course some costs involved — balancing is best done by an experienced professional having the proper equipment — and the care needed to achieve proper volumetric balance, while capable of being done by anyone, calls for pains-taking repetition, doing a number of trial assemblies until you've achieved the best possible fit.

When you modify a Volkswagen engine, even by so slight a change as altering the exhaust manifolding for two of the cylinders — which is in fact what happens when you bolt-on an 'extractor' exhaust (the two forward cylinders, bound by the restrictions of the heat-exchangers — remain unchanged), you upset the optimized design. It may work a bit better along one edge of the envelope but will probably be worse along several other parameters.

Using a progressive carb, typically a small-throat Weber properly jetted for your engine's displacement at a given speed, is one of those areas where you can extend the Volkswagen engine's envelope slightly without adverse effects in other areas. What you're doing is improving carburettion efficiency. The progressive design of the carb gives you a more uniform fuel/air ratio across a wider band of the engine's operating range. The downside is the added cost of the more complex carburettor and the need for a different manifold, air-cleaner and so forth.

I hope you see the goal I'm trying to lead you toward — modification of your engine in any area results in anomalous lobes in its performance envelope. This can result in having you 'chase' proper performance, changing first one thing then another. The wiser course is to stick very close to stock — or start from scratch with an engine of your own design. The latter course usually involves beginning with displacement and rpm, altering chamber shape, valve size, cam timing & overlap, exhaust manifold diameter, inlet manifolding, carburettion, rotating mass of flywheel and crankshaft... You really are designing your OWN engine when you begin departing from the stock specs. If your goal is a smooth-running 100 horsepower 'volkswagen' engine that idles sweetly yet accelerates strongly to above six thousand rpm — you can do it. But you probably can't afford it :-)

Typically, modifications are limited by cost, our decisions swayed by the thought gaining additional power simply by bolting on some inexpensive device. This is a myth. Low-cost bolt-on performance enhancements are the bread & butter of the after-market crowd, none of whom have ever won a race and most of whom drive Toyotas :-) In fact, most 'enhancements' — except for a very narrow definition — are detrimental to overall performance. It may be louder but produce less power. Or it may produce more power... but will not idle. Or it accelerates quickly.... and will not idle at all below 1,200 rpm.

The oddest point in all this is that, being children, many Volkswagen owners are delighted with their loud-but-unreliable machines. Conventional Wisdom says it is wise to bolt things to your stock engine. As a general rule, this is not true.

You've made a wise move in opting to work on a replacement engine. As the mechanic in charge, the final result will reflect your evaluation of the various factors involved. I believe you'll derive more satisfaction from this experience if the resulting engine places enhanced reliability ahead of enhanced performance.

To return to your original question: If a progressive carb of the proper type — and suitable manifold — is within your budget, its use should produce a modest improvement in efficiency with only a minor increase in maintenance cost over the years as compared to sticking with the stock carb. However, since the costs — initial cost plus Weber-specific carb re-build kits, non-stock manifold gaskets, different air filter, etc — will be partially offset by the improved fuel efficiency, slightly better top-end performance and so forth, the decision to go to a progressive carb is not as clear-cut as it might seem. I'll leave you to figure it out :-)

Rusty Fuel Tank

In an earlier sermon I mentioned the use of sloshing compound to resurface a rusted tank. I erred in failing to mention you should remove the rust before sloshing.

Buy an after–market replacement. Slosh it. Use gas dryer. It's less expensive and less dangerous than cleaning your old tank. You use acid to clean a rusty fuel tank. Acid is dangerous stuff. Working with it calls for you to follow some very specific rules. Failure to follow the rules, even misunderstanding them, can leave you scarred for life. But for all the masochists who absolutely, positively LUST for acid, read on.

Dig out your official VW manual, look under Fuel Systems, and read about 'Treating Corroded Fuel Tanks' (Sec. 3, para 1.3 in the Bentley manual). They mention two methods, one using a phosphoric cleaner (like Lime–Away toilet bowl cleaner, or Naval Jelly), the other using hydrochloric acid, also called muriatic acid. You can find muriatic acid at a good hardware store or a swimming pool supply company. Use the Yellow Pages and your imagination. The phosphoric acid method is the best and least dangerous.

If you buy the 'Liquid Fuel Tank Liner Kit' from J.C.Whitney (97– –5714NF) it comes with a phosphoric cleaner, a neutralizer, and a sloshing compound (ie, the sealant). Price is $25. I've never used it but I'm going to assume it's similar to stuff I've used in the past.

If your tank has pinhole leaks (look for fuel stains around the outlet fitting) you MAY be able to repair it with sloshing compound. But since you have to remove the rust before you slosh the tank, and since you use acid to eat the rust, chances are the acid will complete the job, making the holes so big they can't be sealed with sloshing compound. You also have to deal with the fact your fuel tank will be LEAKING ACID while you're trying to clean it. (One solution is to seal the pinhole leaks with tissue paper and wax. Sounds crazy but it works; the acid doesn't readily attack the wax and if the holes aren't too big, the sealant closes them. Of course, that means the integrity of your fuel tank depends on a layer of sealant . . .)

An experienced weldor, knowing the hazards involved, can repair a rusty tank if the rust isn't too extensive. Minor pinholing can be brazed or even soldered, but it's best done by someone familiar with tankage. Using a torch around a tank that has held gasoline is always a dangerous proposition; your first mistake could be the last one you'll ever make. Balancing the hazards against the cost of a replacement fuel tank, the wiser course is to replace rather than repair.

If the tank isn't leaking it's a good candidate for sloshing, and that brings us to working with acid.

Acid Etching a Rusty Fuel Tank

Here's how I do it. Remove the drained tank and put it on a pair of sawhorses on dirt or gravel, someplace where the draining acid can be neutralized and flooded with water. Acid eats concrete, kills grass and makes a mess of blacktop. Even the vapor is dangerous; you don't want it in your shop. Or your lungs.

Remove the strainer. I'll leave you to figure out how; I tear about half the ones I touch; they like to corrode themselves into the outlet. The strainer has a gauze–fine mesh and does a good job keeping sand and larger particles out of your fuel pump (which has another strainer, one you should clean every 6,000 miles). Get the strainer out, put it aside, then figure out how you're going to plug the tank. I put the original fittings back in, attach a piece of neoprene hose and put a clamp on the hose. This allows me to control the draining of the tank. However you plug the tank, test it before playing with acid. If it starts to leak after you've filled the tank with the acid, you've got a problem.

Remove the fuel gauge. Make an accurately drilled plate to close the opening. If you use aluminum for the plate, paint it with an acid–resistant paint. You can use the original gasket if it's in good shape, make a new one if not. If you're working on a bus tank, close the filler neck and work through the fuel gauge opening to keep from pouring concentrated acid onto the bare metal. When the tank is nearly filled (see below), install the plate and finish filling through the filler neck.

If the tank is seriously rusty I may slosh it with hot water, detergent and a gallon of cracked gravel (!). By balancing the tank on one sawhorse you can rock it back and forth. The gravel serves to scour the interior of the tank. But don't expect miracles; it takes an hour or more of rocking to clean things up. Adding Lime–away (ie, a phosphoric household cleaner) will speed things along but it reacts with some types of gravel and may not do much to the rust.

Okay, tank is scoured, and plugged. You've bought a quart of muriatic acid at the hardware store. You've also bought the following: Rubber gloves. Rubber boots. A plastic or rubber apron that covers you from neck to instep. Five pounds of bicarbonate of soda.

You're wearing old clothes, long–sleeved shirt buttoned at neck & cuff. A watch cap or other head covering. Safety goggles.

Near at hand you have a garden hose under pressure fitted with a spray nozzle. You also have a box of bicarb cut open, ready to use. You also have a bucket in which you've dissolved a pound of bicarb in a gallon of cold water. (If you get concentrated acid on yourself you won't have time to open cartons, mix neutralizer, etc. Neutralize the spill immediately then flood it with water. Seek immediate help if it's a serious burn.)

Are your sure you wouldn't rather buy a replacement fuel tank?

Okay, stick the nozzle into the tank and turn it on. While the tank is filling, get into your costume. When the tank is half filled, shut off the water, remove the hose, and SLOWLY pour the quart of muriatic acid into the half–filled tank. SLOWLY. That means, REAL SLOW. Rock the tank a little. (No, not while you're pouring the acid! Pour it a little at a time.) When you've added the quart of acid to the half–filled tank you'll notice the tank is a lot warmer than when you started. If you pour the acid too fast you can cause an intense local reaction that cause the water to boil locally, enough to spatter you with acid. You have to give the acid time to disburse throughout the water. That's why you rock it, to help it mix.

Now fill the tank full of water. DON'T USE THE SPRAY NOZZLE. You don't want to risk splashing the acid. Use a nice, laminar flow of water; pouring from a bucket is good.

Fill the tank to within an inch of the top of the filler neck. (Plug the vent with wax.) Leave the cap off the tank. As the acid reduces the rust back to oxygen and sulfides of iron, it's going to generate some gas. Cover the filler neck with something; a plastic food container or tin can; something loose. Then leave it alone.

You can get out of your costume now, but keep the bicarb handy. The acid is now diluted about 20:1, if you get some on you, you've bought a little time. Bicarb is a poor–man's acid neutralizer; you want it nearby in case you get acid on yourself, or your tools, or the cat.

One quart of muriatic acid in a fuel tank of water is about 42:1. Depending on the strength of the acid you began with, the dilute mixture should be enough to de–rust your tank in twelve to twenty–four hours. You can check the progress of the reduction with a flashlight, peering into the tank through either the filler neck or the fuel gauge opening (but drain it down first if using the fuel gauge opening).

Heat will speed the reaction but don't do anything silly. Here in southern California the nuclear furnace in the sky does a nice job of keeping the tank warm. If filled in the morning, the tank is usually cleaned up by sundown.

Now you have ten gallons of dilute hydrochloric acid to deal with. Good luck.

My place has adobe soil. We use acid to free iron from the soil, to make it available for the citrus trees. This has taught me that it's relatively safe to drain acid into a trench, flood it with water and cover it over when dry. So that's my solution; you'll have to work out your own. There are commercial neutralizers, much less expensive than bicarbonate of soda but not so easy to find. Commercial shops use commercial solutions; used acid is recoverable and, in some cases, recycleable.

Once the tank is clean you must neutralize the acid still clinging to the interior. Use two pounds of bicarbonate of soda in one gallon of water. (Hint: Remember the one–pound–in–a– gallon? You figure out the next step.)

As the acid is draining you'll want your hose running, to dilute the drained acid but also to flush the interior of the tank, to get out as much acid as possible. If you've used my trick (ie, hose on the outlet) things go slowly, a good idea when playing with acid. Let the tank drain empty at least twice, going back in with the hose to make sure all of the dilute acid has drained away. Now put the plug back in. Pour your neutralizer into the rinsed tank immediately, don't let the tank dry out. If it does, it will rust. Put the lid on the tank and slosh it, side to side and end to end, including at least a couple of roll–overs. (You're going to do the same when you apply the sloshing compound so look on this as a training exercise.

Now let it sit, give the neutralizer time to work.

Mix a quart of Pine Oil with two quarts of warm water. You can also use machinist's water soluble oil but it's harder to find. (Welding supply houses carry it, as do machinist hang–outs.) The emulsion will protect the bare, acid–etched metal from the atmosphere. Without protection it will rust so quickly you won't believe it.

Go back to the neutralizing. Flop the tank over some more, slosh it some more. I won't get into Ph testing so you're going to have to trust to luck that you've neutralized the acid. (Are there any chemists out there? Help us out. Did we get it neutralized properly?)

Drain the neutralizer and again, flush the tank with fresh water. (Now you're trying to get rid of the bicarb!) Put the plug back in and pour in the emulsion–mix. Put on the cap and slosh the tank, including end–o's and roll–overs. Drain it out.

Now the clean, acid–etched, neutralized fuel tank is protected by a thin emulsion that will prevent the metal from immediately rusting. It's still going to rust, just more slowly. And you've got goop in the tank. So let it drain and dry.

The sloshing compound won't stick to water–soluble oil, you'll have to flush it away. Once the water has dried, the emulsion may be removed with gasoline or mineral spirits. Use whatever thinner is recommended for the sloshing compound you're using. I use a gallon of mineral spirits (white spirits, paint thinner, what–have–you, according to language, locale and disposition), slosh it for about ten minutes and drain. Like the emulsion, it's reusable (as is the dilute acid, if you've some means of safely storing 10+ gallons of the stuff).

The last major step is to coat the interior of the tank with an sealant that gasoline will not dissolve; the sloshing compound. There are several types; price and performance vary. I use 'Randolph 802,' an aircraft product I've used for years. Bikers use something else, antique car buffs swear by Indian Head shellac, and so on. They all do the same job. Select one for the type of fuel you're using and follow the instructions. I've a hunch most of you will end up using something available from J. C. Whitney. Your comments on completion would be of benefit to us all so don't be shy.

Now that you know how much fun it is to acid–etch a fuel tank, I hope you'll go out and buy a replacement tank instead.

Using Acid to Clean the Fuel Pipe

I've never done this, it's just an idea. I've got some little pumps around the shop that can handle corrosive liquids. I've often thought of recirculating five gallons of dilute acid through a fuel pipe. Phosphoric acid, rather than muriatic, since I wouldn't want to risk clogging the pipe with sloshing compound.

I would rig the pump to push the acid through the pipe, returning it to the container. Given the surface area of the pipe, it should clean up in an hour or two, but it would be safe to run the phosphoric solution for a couple of days.

Replacement Fuel Tanks

I've never seen a VW fuel tank made from terne–plate, the stuff we use to make fuel tanks here in the States. Terne–plate (or it's modern–day analog) doesn't rust. All of the replacement VW fuel tanks I've seen were mild steel, the interior unprotected, guaranteed to rust. Sloshing a new tank with sealant makes good sense.

The paint on most after–market fuel tanks is embarrassingly bad. Since the underside of the tank is exposed to anything the front wheels care to throw at it, it's a good idea to refinish the tank with a high quality paint. I've found two–part epoxy for both primer and finish gives the best service.

Bloody Dangerous

The seams of all the stock VW and after–market fuel tanks I've seen use a form of roller–welding that leaves a rash of tiny steel fibers sharper than any razor. If you touch them, you'll bleed. I wear leather gloves when handling a fuel tank, then I dress down the seams with a stone.

Sermonette

When I was 12 I was working in a radiator shop, hot–tanking cores. I was wearing all the usual protective gear and it was a safety conscious shop, but I happened to lean my butt against a bench where the cans were soldered back onto the cores, and on which someone had spilled acid. The protective gear only covers your front. That was nearly half a century ago. I've got the scar to this day.

Like explosives, acid is useful stuff and every mechanic comes to rely on it for certain tasks. But it's dangerous stuff, not to be taken lightly.

I would warmly welcome comments with regard to acid use and safety from someone with a good chemical background. Passing one's life–experience into younger hands is one thing, putting out bum dope another.

Checking Heads

I'm gonna be doing new (rebuilt) heads here in a couple of days, any suggestions for other things to check/replace?

Check the height of the valve stems. They should be all the same. Small difference lead to big changes in the rate of wear on that valve's powertrain (cam lobe, lifter, rocker, etc) For equal wear you want equal height. This is achieved by having that valve stem ground. Don't overdo it. If one valve is really low, like .125" or more, send the heads back — it needs a new valve seat.

Dismantle the heads after checking stem height. Inspect the valves, guides and seats. If all okay, lap-in the valves, clean up the abrasive, re-assemble and check. Install stem seals when reassembling. All real FLAPS carry stem seals, chain-store FLAPS will just give you a silly look.

Get a 50cc syringe from a vet or pharmacy, level the head and do a rough check of the chamber volume. The object is to get a reasonably accurate idea of their volume. Do all four. Take their average. Use it when computing your compression ratio. (If the chamber is larger than 50cc, put a marble in it. Use the same marble in all four chambers.)

Measure your deck height and compute your compression ratio. Make sure your compression ratio isn't too high. Anything over 7.3:1 is liable to have trouble with today's fuels. If too high, add a spacer under the cylinder. If you don't have the formulas handy, ask me.

If either deck height or chamber volume varies radically, you'll have to do something about it. If that is beyond your skills, use the largest chamber volume and the smallest deck height when computing your compression ratio.

Check all of the studs. (There are eight of them on a Type I head.) Check the spark plugs threads. Check for cracks where the guides are installed, both in the valve gallery and in the intake & exhaust ports. Any crack is grounds for rejection. Ditto for any bad stud. If you have a bad spark plug thread, reject the head. Helicoils or sleeves are not an acceptable repair when it comes to spark plug since they upset the heat flow.

Check the valve cover sealing surface for nicks & gouges. Using a mill-cut fill pressed lightly against the sealing surface, make the surface truly flat. Champer the edges. Spend a little time here and you'll seldom be bothered by leaky valve covers.

Check for casting flash in the fins around the exhaust stacks. Use long drills to open up the passages. This is the hottest part of your engine, you want to make damn sure it cools as it was meant to.

Check to insure the metal deflector plate is installed in the lower part of the fins between the combustion chambers. If it is missing, the heads will overheat wildly, it is a very critical little piece of tin. You can make one or pick one up from a junkyard.

If the heads pass the above inspections they are good enough to use or to do further work upon. You can polish the chambers if you wish. It will improve the efficiency by some small factor. If you have the tools you may wish to do a bit of porting, although it's a good idea to practice on junkers. Check Bill Fisher's "How to Hotrod Volkswagen Engines" for basic porting instructions. The photos are invaluable.

EGT & CHT

An exhaust gas temperature gauge monitors the combustion process, typically of a single cylinder. If you monitor the combined gases of several cylinders the reading is not only cooler, since it must be measured farther from the exhaust valves, it is also a compromise, making it impossible for you to tell if the reading is the result of all cylinders running a little bit off or just one cylinder running a whole lot off — 'off' meaning too rich or too lean. In most cases one cylinder will give you all the data you need to adjust your mixture, which is the fundamental purpose of the instrument.

Why adjust your mixture? Because in an airplane it is common to make radical changes in your altitude and thus in the air density. Flying from San Diego to Modesto, I'll typically climb to 8,500 feet. Driving there, I'd stay below 200 feet elevation, except for the hour it takes to cross Tejon Pass (4,400 ft)... during which the engine in my 1965 VW bus would be running a bit rich... and therefore a bit cooler than normal, which isn't a bad thing, climbing a grade.

The combustion range for gasoline is quite wide — from about 10:1 all the way up to near 20:1. 'Perfect' combustion is determined by the stoichiometric ideal, which as you'll recall from your high school chemistry class is the condition in which the TOTAL quantity of reactants combine, leaving nothing left over. The process of gasoline combustion isn't quite that neat but we still use 'stoichiometric balance' — about 14.7 pounds of air to each pound of gasoline — as our goal even though we seldom achieve it. We never achieve that goal because not every tank of gasoline is the same, nor even every pound of air. We do our numbers using 'standard air', which means its temperature is 59 degrees on the Fahrenheit scale and its density is equal to 29.92 inches of mercury. But rather than analyze every tank of gas or monitor the oxygen content of the air, we simply set the gasoline on fire and monitor the resulting temperature of combustion. Too low? We're giving it too much gas. Too high? We're giving it too much oxygen. (And if this sounds like what you do to your engine during a tune-up, it should :-)

Alas, the oxygen content of our atmosphere is not a linear function with density (ie, altitude). At 8500 ft the air-mass has about half the oxygen content as does sea-level air, dictating the need to adjust my mixture. If I leave the mixture at its sea-level setting, I'll burn far too much fuel, acclerating cylinder-wall wear and running the risk of fouling my plugs. So I tweak the mix until the EGT sez I'm doing the best I can.

This sort of dynamic engine management makes little sense in an automobile. The emulsion tube and metering jets in your carb will keep you close to a stoichiometric burn within plus or minus 2500 feet of the altitude for which the car is tuned. If you live in Denver (about 5000 ft elev.) you'd tune your car accordingly. Ditto for Mexico City (about 7500 ft) or Bogata (about 10000 ft above sea level). But you wouldn't do such tuning as you drove — and you would have no need to monitor your EGT.

The situation with cylinder heat temperature is similar. Most airplanes depend on their forward motion for cooling. Climbing out, you assume a fairly high angle of attack and a relatively low air-speed... and keep your one eye glued to your CHT (your other three eyes are watching out for traffic :-) During climb-out it's common to run a bit rich since you know you're going to be pushing the temperature envelope. If the CHT creeps into the yellow you flatten your climb (ie, increasing your forward speed) to cool things down but you keep climbing — airplanes keep to certain altitudes according to their direction of travel and when climbing you're 'crossing traffic' — you need to get to the proper altitude as quickly as possible. So you push it. The CHT tells you if you're pushing too hard.

Once you reach your cruising altitude you do your housekeeping, which inlcudes your engine management chores. You use your CHT, EGT and engine oil temperature to set-up the proper engine operating conditions for that particular flight. You may spend half an hour tweaking the controls, convincing a Cessna it really can ride 'the step'. And you may need to adjust things by some small amount during the course of the flight as the air-mass changes its temperature or humidity.

Your Volkswagen's cooling system uses a blower. So long as the engine is running, it's getting the proper amount of cooling air, barring a loose fan-belt, which you check with your thumb, not a gauge :-) If something goes awry during the course of your trip the change in oil pressure and temperature will give you more than enough warning. Climbing a grade will cause the CHT... and your oil temp... to rise, reflecting the fact you're pulling maximum power. But so long as you observe the shift-points and operating instructions in the owner's manual, a CHT gauge is simply along for the ride.

As a general rule, the more data you have on your engine's operation, the better you can manage the engine, which is why all of my Volkswagens have oil pressure and temperature gauges. But a guage that is useful in managing an aircraft engine, such as EGT or CHT is not necessarily of value in managing an automobile engine.

When it comes right down to it, the most important engine management 'instrument' is a good dose of common sense. Money for unnecessary guages would be better spent on improving your ignition system or adding a full-flow oil filter.

- -Bob Hoover (No, not THAT Bob Hoover. But I solo'd in 1949 and have flown once or twice since then :-)

Head Job

Left to its own devices, your stock VW engine will self–destruct. It commits harakiri (harry–carry for you round–eyes) by swallowing its own #3 exhaust valve, hammering it through the top of #3 piston, shooting the residue of piston, valve and combustion products around the inside of the engine until it is totally trashed. For a Grand Finale, it often launches one of the rods through the crankcase, vomits oil and sets itself on fire.

At highway speed, the whole scenario is played–out in about three seconds. When it's over, you will have re–joined the ranks of pedestrian America.

For a casually rebuilt engine, maintained with equal casualness, Sudden Valve Death usually occurs somewhere between 30,000 and 50,000 miles of service. Before this happens your engine has been sending you coded messages saying it isn't feeling well. If you're lucky, the last message will be when #3 exhaust valve warps or splits, before the head of the valve pulls off the stem. This last message is hard to ignore, as is the curious sound and puny power of your new three–cylinder engine. If you are wise enough to heed this final warning, you will save a bundle; your engine can still be overhauled. But once it commits harakiri, it's dead. Oh, there are some heroic measures that can be applied, such as welding the case, align–boring and re–machining the spigot–holes, but magnesium alloy has a 'memory.' The future of such an engine will be filled with nightmares.

Things Valves Do

There is a swirling three–thousand–degree inferno in your engine. In fact, you've got four of them. Your exhaust valves must stick their heads into this inferno to do their thing. As you might imagine, they get hot. When they snap closed the heat flows into the cooler metal of the head, and up the valve stem where it's conducted to the walls of the valve guide by the molecular dance of oil.

If your valve guides aren't too worn, they'll soak up a lot of the heat; if your valves are still a gas–tight seal on their seats, the seats will draw the heat away so that when the exhaust valve gets its head stuck back into the fire, it will be ready to soak up more heat. But when it can't pass the heat to someone else, it begins to melt; to deform like wax. The stem begins to stretch and the rim of the valve's head usually splits. After that, a lot depends on luck. And on how well you've maintained your engine. In the worst case, the Sudden Valve Death scenario gets played–out and you get to stand by the side of the road and watch your bug burn to death.

Karma

Here in southern California we're waiting for The Big One, a cataclysmic earthquake. Thanks to paleoseismology, we know that for the last 8,000 years Big Ones have occurred every 147 years, on average, with a minimum of 87 years and a maximum of 212. The last one occurred 138 years ago. Big Ones are a natural thing; there's nothing we can do to prevent them.

If your engine — stock or not — is still running an up–right cooler, its karma is to swallow its #3 exhaust valve. But unlike the Big One, your engine's fatal rupture can be prevented. First, by going to a better cooling system, secondly, by replacing the valves BEFORE they can fail.

God Bless America

Replacing your valves means pulling the engine, getting dirty and not being able to go to the beach. Most of us let someone else do it; it's the American Way. We put our trust, faith and money in the hands of a guy with black fingernails ('Bob' on his shirt) with wistfully hope that our $300 will buy us more than a valve adjustment. But unless we sit there and watch him do the work, which means we can't go the beach anyway (aaagh!), we don't really know.

The only way to be sure is to do it yourself. Here's how: (This only works if you're running stock jugs.)

Buy a set of new heads from J.C.Whitney. They'll cost you about $90 each. Along with the heads get an overhaul gasket set; you'll need the little rubber grommets for the push–rod tubes, new gaskets for the valve covers and those metal jobbies for the heat exchanger and muffler. Since you'll have to pull the muffler to replace the heads, get a muffler installation kit — those clamps and asbestos rings; yours are rusty as hell and you can't re–use the rings anyway.

If you've got the right tools, the whole job will take you maybe four hours… or fourteen, if you've never done it. But when it's done, you'll know you've got new heads, with new valves, and new valve springs and new keepers and gaskets and the thing is a lot cleaner since all the grease rubbed off on your shirt.

You'll also have four heads; two new ones on your bug or bus, and those filthy, crappy looking things over there under the porch. But you'll also have about a hundred bucks you didn’t have to give to the guy with black finger-nails. And before you head for the beach and blow the C–note on beer, let us reason together.

Doing a Valve Job

Use some of your money to buy a big bucket of carb cleaner. Stick the old cylinder heads in it. Put the money in a jar. Now you can go to the beach.

A couple of days later, pull the heads out of the carb cleaner and scrub off all the gunk; the baked–on stuff will come right off, thanks to the carb cleaner, which, if you get any on you, will cause you to have two–headed babies and vote a straight Democratic ticket. But it cleans up heads a treat.

First thing you do, check for cracks. Look between the spark plug hole and the valve seats, and between the valve seats. Find some? Sorry, Charlie, the head’s a deader; I can’t teach TIG welding and valve seat replacement via e–mail. But if there are no cracks, smile! You’ve got yourself a pair of rebuildable heads.

Use lots of hot water and soap to clean your heads. Get down in the fins; make them shine. Use aircraft drills and Swiss files to get rid of all the flash; open up the air passages around the exhaust ports; you can IMPROVE your heads. Then squirt some WD– 40 on them and figure out how to take the springs off the valves. (See the manuals; buy more tools. You’ll needem.) When you get the springs off, don’t try to remove the valves. And don’t lose anything. Get the springs and the keepers and the retainers off then call me; I’ll be over there under the tree.

When you have the springs off, you need a whetstone, a little one, like you’d use for a pocket knife. You’re going to use this thing all the rest of your life around cars so go ahead and buy one.

Feel the grooves around the end of the valve stems. Notice how sharp those edges are? Make them dull. Use the whetstone and a little WD–40; go on; you can’t hurt the valves (much!).

When the stems of the valves are nice and smooth they’ll slide easily down through the valve stems, which are made of soft, heat absorbent bronze. If you pushed the valves through without removing the burr of metal around the grooves, they would scrape the inside of the valve stems and ruin them.

Have you got a micrometer? (Why are you laughing?) Okay, go buy one. Ten bucks, from Enco; mebbe twenty bucks if you spring for a good one. (Mine cost $60 in 1958; you figure out how important it is to have a good one.) Enco is at 5000 W. Bloomingdale, Chicago, IL 60639. Call them at 1–800–873–2626; ask for a catalog or flyer. Tell them you need some machinist's tools, some reamers; crap like that. You can also get a micrometer from J. C. Whitney, or Harbor Freight (1–800–423–2567; ask for a catalog). If you want good stuff, look for Mitutoyo, Brown & Sharpe, or Mauser, but keep a grip on your wallet. Best bet is to start with an inexpensive house–brand mike, go to the good stuff when you know how to use it.

You also need some new valves; buy four new exhaust valves. Carbon steel is okay this time, and J. C. Whitney's are as good as anyone elses. While you're ordering, get four new valve guides; they'll cost about two bucks each, the valves between six and seven.

Use your micrometer to measure the stem diameter of your old valves. The VW manual will tell you the proper dimensions, but I want you to use your NEW valves as a gauge; I want you to actually SEE the difference between new and worn parts, because the difference is so damn small in most cases there ISN'T anything to see — you've got to trust your mike. (Make a little leather wallet for it; treat it nice.)

Another tool you need is a dial indicator. You're going to use it when you set the end–play on your engine, measure cam–lift, determine deck–height — you need a dial indicator (machinist's call them 'clocks'). But the best clock in the world is useless unless you can fasten it to the work, so plan on buying a boxed Apprentice Set. It will have an inexpensive dial indicator along with all the appliances you'll need to fasten the clock to the engine or head or cylinder. Expect to pay about $50 for the kit but shop around.

If you'll fasten a dial indicator to the cylinder head in such a way as to touch the stem of the valve, wiggling the valve back and forth will tell you the amount of wear in the valve guide. You can do the touchy/feely by comparing the feel of a new valve in a new guide, vs new valve in an old guide. Surprising, eh? That's what we're going to get rid of, that wiggle. We're going to replace the guides.

Replacing the Valve Guides

Hokay, more tools. You need a step–drill, to drill out the old valve guides. You can get one from Johnny's Speed & Chrome (p/n 10–7100). You'll also need a valve guide installation tool (call JSC and ask them; I can't find the part number).

The trick is, you don't drill the old guide all the way, you leave a step at the top of the guide. (You drill from the combustion–chamber side of the head.)

To remove the guide, which is an interference fit in the head, you drill the guides then put the head in a 400 degree oven for an hour. The step–drilled guides will drive out of the heated head with one blow from a 3– pound hammer; use a drift that matches the drilling. And just one blow. The head needs to be well supported on a wooden base, with provision made for the guide to drop free. Wear heavy weldor's gloves and rehearse what you're going to do, then hustle the heads — one at a time — from the kitchen to the shop, pop out the guides, and chuck them BACK INTO THE OVEN.

While all this was going on, the new guides have been laying in the freezer overnight. They are cold. The heads are hot. Guess what happens next.

The valve guide installation tool is a heavy drift with an 8mm pilot that matches the bore of a new valve guide. The tool has been in the freezer with the guides.

The new guides are driven into the hot head from the valve side; replacement guides have a small lip at the top, drive them in until the lip is flush against the head. But again, you want to do the driving with a minimum of fussing about. You put a guide onto the tool, position the head on a suitable support (you'll need two, one to hold the head chamber–side up, the other valve– side up; wooden ones are best; make your own). The instant you touch the guide to the hot head it will start soaking up heat, which you don't want. So act fast. Position, aim, deliver a single blow that PUSHES the guide fully into the head.

If you're quick, you can do two guides before the head needs to go back into the oven. And in most cases, you'll only have to do two; the guides on the intake valves wear less and may not need replacement.

Zen and Valve Guides

So it took you half a dozen whacks with a hammer to get those suckers flush; it's alright. You did okay. Some guys pick up the one–blow trick right off, some never get it. The results are about the same. I spent seven years in Japan, mostly making a fool of myself but studying some martial arts, too. There's a knack to focusing your energy. I think about the valve guide sort of slipping into the head. And when I give it a whack, that's what it does, dead–flush; you couldn't get a ten–thou feeler between them. I'm proud of myself for being able to do it and worry a little each time that it won't happen, but it does and I'm thankful and the heads never crack and the guide is deformed so little they often don't need reaming.

Didn't I mention the reaming? Sorry. Back up about a thousand words and order an 8mm hand reamer from Enco when you get your mike. Or get it from some other machinist supply house. And get a handle for it, if you don't have one. Hand–reamers have the end of the shank squared so you can grip it with a handle; chucking reamers are straight, or have a taper to match your lathe or milling machine.

Working from the chamber–side of the head, flood the newly installed valve guide with cutting oil and gently twist the reamer through it with one smooth motion, always twisting the same way and at the same rate. This too is another tricky bit but one anyone can do with a bit of practice.

The head is at room temperature, propped on the bench so the guide — and reamer — are horizontal. If the guide hasn't been buggered up too much by pounding, the reamer will slide through it with a light drag. Keep rotating the reamer as it goes in and comes out. Wipe it down, flush the guide with WD–40 or kerosene, and slip a new valve into it as a gauge. You want a free–sliding fit, neither too tight nor too lose, but looser is better than tighter.

When you think it's done properly, use your dial indicator to check. Remember how sloppy the old ones were? See how easy it is to do a nice job? (Few shops bother to heat the heads, they hit the sucker with an air hammer, spend mebbe two minutes per head, if that. Squeezing the guide into the head with an air hammer sets up some tremendous stresses that often reveal themselves as cracks after a few hundred miles of use. The factory heats the head, chills the guides; no cracks.)

The cutting oil seems to have some effect on the smoothness of the finished bore. I use Sul–Tex, a Texaco product that other machinists tell me is really too heavy for reaming bronze. But it works for me; I've used it about twenty–five years. Before that, I used a couple of different things; I like Sul–Tex best. (Ask for a 'high sulphur cutting oil,' take what you can get.) I also hand–hone my reamer with a hard white Arkansas stone but don't try this unless you can get a machinist to show you how. Honed and kept clean, your 8mm reamer will out–last you. (I used to use a Mauser 8mm reamer with a slight spiral flute, given to me by a VW mechanic. I dropped it one day and it shattered like glass.)

Free Horsepower

Before doing any more work on the valves, it would benefit your engine if you'll polish the combustion chambers. The polished surface acts as a heat reflector, delivering more energy to the piston and allowing the engine to run slightly cooler. The polished surface also picks up fewer combustion products; your rebuilt heads will give like–new performance longer than unpolished heads. Best of all, polished heads seem less prone to cracking.

You can start with fine sandpaper on hobbs chucked into your drill motor, finish with felt buffing hobbs and polishing compound. A low–speed motor, like an electric drill, is better at this job than a die–grinder or air tool. The proper finish will give an illusion of depth; aluminum can be polished as bright as chrome so don't stop too soon.

Fitting the Valves

Wire brush the heads of your intake valves and mike the stems. If they are within tolerance (they probably are) and pass the wobble test, you can re–use them, and the guides as well. But throw away the old exhaust valves. (A lot of rebuilders don't.) You want your heads to give you at least 50,000 miles of service. The weak link is the exhaust valves. Use new ones; it's cheap insurance.

Check the valves against the valve seats to see if they are true to one another; use some Prussian Blue, or pencil marks; press the valve against the seat and give it a slight twist with your thumb while pressing down. If you get a nice even smear all around the seat, they are true. If the valve shows a few gaps, it is not true and needs to be reground (intakes only, please). If the seat shows a few gaps, it is not true and needs to be stoned. Take the head to a shop and ask them to stone the seat. Read your Bentley; tell the dude at the machine shop you want a seat–width of .05" on the intakes and .07" on the exhausts; that the thing is for a Formula Vee, or an airplane, or some damn thing.

Once you are sure the valves and seats are concentric (your new guides have something to do with this), you can lap them in. Use the finest grade of lapping compound and just enough motion to get an even band around the face of seat and valve. Once lapped, the valve is married to that particular valve seat; don't lose track of what goes where. Remove every single trace of lapping compound when you are done. It is carborundum, hard as a diamond; you don't want it any where near your engine after this.

Final Touches

Check your springs to make sure all are straight and of equal height. Springs are inexpensive and they weaken over time so use new ones if you can. If you have to mix old and new, put the new ones on the exhaust valves.

With the springs installed, pour a little kerosene in the exhaust and intake ports (but not at the same time) while you check for leaks into the combustion chamber. If you get a wet spot, back up a step and re–lap that valve;

you want a concentric, gas–tight seal.

When the valves are fitted, position the head so the cylinder mating surface is horizontal and measure the capacity of the chambers. You'll need a plastic plate that fits snugly into the combustion chamber; it must have a hole in the middle. Use a wipe of vaseline on the polished surface of the chamber to get a fluid–tight fit then fill the chamber with colored water, measuring it carefully. Do each chamber at least three times and average the results.

Ideally, all four chambers should match within .5cc. This effects the volumetric efficiency of your engine and isn't especially important for a pair of replacement heads. But what is important is knowing the chamber volume. If yours are not closely matched you're giving away horsepower.

To achieve a match, your only option is to increase the volume of the smaller chambers to match the larger. There are a lot of ways to do this — sinking the valves slightly deeper in their seats is one of them, but most are too complicated to describe with words alone; rotary filing will of course open up the chamber but it is critically important that you only open them up in certain areas. If you want the sweetest engine you can build, you'll have to solve this puzzle for yourself. (Reading 'How to Hotrod VW Engines' is a good place to start.) But in any case, measure and record the volume of your chambers; you'll need that information when you set your compression ratio. Mark this information on the heads.

All Done! (Or nearly so…)

With the chambers polished and the valves fitted you may remove the springs, grease the valves and seats, and bag your heads for storage. It's wise to keep all the parts in the same package; you may not use them for a couple of years and entropy makes things wander. I use 5 mil construction–grade plastic, about three wraps, sealed with duct tape. The longest I've ever stored anything in that fashion was three years; there was no signs of rust or corrosion.

The pair of heads you have just rebuilt are better than the new ones you installed. The new ones probably weren't lapped; they may even have a leaky valve. That is the reality of mass production versus one–off craftsmanship. (Hint: Dismantling and lapping a new head is time well spent.)

In overhauling your heads you have acquired the skills to do the job again; you've also acquired the basic tools. But it would be wise to scrounge another set of heads and do it all over again as soon as possible, hopefully with someone else paying for the parts. Overhauling one set of heads won't make you an expert, and one–time skills dull quickly. Repetition of the tasks will give your hands time to remember. It sounds silly but your hands are often better at remembering things than your head.

No sermonette. This thing is too damn long already.

Hydraulic Valves

Actually, that's a misnomer. The valves are solid steel (unless you're running sodium–filled jobbies); the hydraulics are in the cam–follower, the 'tappet,' or 'lifter' down in the engine case.

Hydraulic valves are the second smartest thing you can do to your engine at overhaul time. A full–flow oil filter is the first but the object is the same: to prolong the life of your engine.

Periodic oil change is a compromise between theory and practice. Ideally, our engines should be lubricated only with new oil, circulated once through the engine then thrown away. Periodic valve adjustments are a similar compromise. Ideally, we should adjust them at the first sign of wear, which means every few seconds at highway speed. Of course, that's not very practical so we do the best we can. A full–flow oil filter doesn't give us new oil but it assures the oil is at least clean each time it circulates through the engine. Hydraulic cam followers 'adjust' the valves each time they are actuated, which I think you'll agree is better than doing it every thousand, three thousand, or whatever.

The bottom line is that hydraulic cam–followers prolong engine life and improve long–term performance while reducing your maintenance costs. But as with a full–flow oil filtration system, hydraulic cam–followers are not a bolt–on item; the VW engine was not designed to used them.

Mini Tutorial

In the VW engine the cam–followers not only actuate the valves by transferring motion to the push–rod, they are part of your lubrication system, serving to channel pressured oil into the hollow push–rod for delivery to the rocker, where drillings carry it to the rocker arm. The oil always present in the valve gallery picks up considerable heat, carrying it away as the oil returns through the push–rod tubes. The oil for the right–hand side of the crankcase gets there via the center cam bearing web. I mention this to put the following into context.

While drop–in hydraulic cam–followers will work in some cases, you'll hear more tales of woe than success. Complaints include excessive noise, lubrication failures and overheating. All of these problems point toward an inadequate oil supply.

Modifications Needed to Allow Hydraulic Lifters to Work

To make hydraulic cam–followers work properly you have to improve the VW's lubrication system to insure a larger supply of oil to the right–hand side of the case. The oil passage through the center cam bearing web is too small to provide sufficient oil to four hydraulic cam–followers, at least, not under all conditions. Indeed, on both sides of the case the oil galleries feeding the cam–followers is a bit too small for hydraulics; you need to open them up as well. This is done by pulling the plugs on the flywheel–end of the casting and re–boring the passage. I'm not going to give you dimensions, the purpose of this sermon is to make you aware of the problems and their solution, and as a response to certain subscribers who flatly declare that hydraulic cam–followers don't work. They work marvelously well, which is why every modern push–rod–type engine uses them. The Type IV uses them, along with a full–flow oil filtration system, but hydraulic valves were just a gleam in an engineer's eye when the first bugs hit the road. The failure of some drop–in hydraulic cam followers to perform as advertised under all conditions merely reflects the fact the engine was never designed to use them.

Once you've modified the crankcase by opening up the oil galleries you'll find the stock 28 psi is too low. And the stock oil control valve doesn't provide all the control it should. So you modify the control valve. By throwing it away and converting it into a ball–valve(!). To keep the steel ball (it's about half an inch in diameter) from pounding out the magnesium alloy, you open up the control valve port and install a bronze sleeve. All references here are for late–model cases. Cam followers should not be used with early cases having small oil passages unless you open up ALL of the oil passages, a hell of a chore.

The best cam–follower to use is the Volkswagen part intended for the Type IV engine. It is slightly larger than a cast iron lifter so you'll have to modify the crankcase to suit. That's when you'll notice the oil gallery doesn't line up with the oil ports in the new cam–follower, so you modify them as well, cutting an angled groove, a very tricky operation in the tight confines of the cam–follower bore. You will also have to adjust the length of your push–rods. If you're looking for maximum durability, install bronze inserts in the cam–follower bores and hone for a sliding fit after re–drilling the gallery and cutting the oil grooves, which work best if tear–drop shaped, tapering in depth. The grooves are not full circles, just enough to get the oil to the port area of the cam–followers, which already have a circumferential groove. Remember, the cam–followers rotate as they move up & down. You want the nicest possible fit to prevent loss of oil pressure.

On assembly, set your valve lash to zero PLUS about one turn, the necessary pre–compression that allows hydraulic cam–followers to work properly.

You won't have to adjust them again until you tear down the engine.

Installing hydraulic cam–followers sounds like quite an operation and it is, for the home machinist doing just one engine. But shops here in southern California have converted thousands of VW engines to use hydraulic cam–followers. You won't get any change back from a two–hundred dollar bill but the price includes all the parts and there are quite a few: stiffer springs (to prevent lifter 'float'), modified push–rods, different control valve springs, the lifters themselves and a new cam. (You may be asked to provide a core for the push–rods and cam.) You'll get more than your money's worth; you won't have to adjust your valves, your engine will run so quietly you won't believe it and you'll get consistently better milage. If you pay someone to adjust your valves, you'll recover the cost of hydraulic cam–followers in about a year. Indeed, when fitted with electronic ignition, platinum plugs and hydraulic cam–followers (which dictates a full–flow oil filtration system), your periodic maintenance is reduced to an occasional lube job and oil change, plus a fan belt now and then. (We've really got to do something about those fan belts.)

Sermonette

Automotive engines are dynamic, their needs change according to speed, load, altitude and a host of other factors. Variable speed engines must incorporate methods of dynamic change to insure best performance as those factors change. We see this principle in the ignition system as it adjusts spark timing, and in carbs with multiple throats and separate circuits for different speed ranges. Hydraulic cam–followers are an elegant mechanical solution to the problem of maintaining perfect valve lash in a push–rod engine under changing conditions, which is why all modern engines use them.

Loose Spark Plug

Second, what are the most common causes of a spark plug that repeatedly works itself loose? This is a bus I just bought last weekend, and I've discovered this twice now on #3 sparkplug. I can tell it's loose when it starts making a chirping noise like someone else was describing on his 81 Vanagon; I go back and check, and sure enough, it's loose again. Tighten it down, and the chirping subsides considerably (although not altogether).

The threads in the spark plug hole are probably damaged (90% likelihood) or the compression washer on that spark plug is mashed flat, missing or broken.

New spark plugs come with an un–compressed compression washer. The plug is meant to be tightened to 22 ft/lbs, which compresses the washer. The constant tension provided by the compression washer prevents the plug from coming loose.

Try a new plug, properly torqued. Dealers of Champion spark plugs usually carry kits of compression washers. Good mechanics replace the washer each time they remove a spark plug.

If a new plug, properly torqued, comes loose it means the threads are damaged. Best repair procedure is to replace the head.

More Polishing Manifolds

David's point is valid. Porting and polishing is done to optimize air flow, and works very well. But the flow bench is pumping air, not a mixture of air and fuel.

If I had a Cray instead of a PC perhaps I could resolve the matter but until then I'm forced to use empirical evidence, such as signs of liquid gasoline at the manifold gasket flanges . . . and the fact such evidence is missing in those manifolds I've smoothed.

Despite Conventional Wisdom, polishing is only of benefit where heat is involved, such as the combustion chamber and exhaust stack. As a youngster one of the most frustrating aspects of trying to break the land-speed record in my '41 Ford was my inability to reproduce the marvelous improvements claimed in many magazine articles that would result from polishing the runners of my three-carb manifold to a mirror-like finish. For years I thought I was a bad mechanic, outside the privileged circle of super-wrenches who could get 500 horsepower from a lawnmower engine just by polishing everything in sight.

I felt better after discovering a paper by Pratt-Whitney on wall-effects of fuel-air flow in smoothed vs cast induction runners. The bottom line is that no significant improvement was found beyond surfaces smoothed with #600 grit paper/flap wheels. This confirms some of my experiments using epoxy coatings as a means of achieving a glass-smooth surface inside a cast aluminum manifold. (Perhaps St. Muir read the same paper.)

With dual-port manifold ends it takes about an hour with a die-grinder and flapper wheels to achieve a uniformly smooth inner surface. The use of clay and other tricks lets you 'see' the match between the manifolds and the heads. (Insuring a smooth transition is a necessity.) With no other mods, you'll discover your engine idles smoother with a lower volume control screw setting yet maintains the same rpm. A slight drop in the hydrocarbon count tells me the thing is burning a little cleaner.

Plugs and Compression Test

I would think that the danger of damaging threads is greatest when *installing* the spark plugs. So...logic says if you're worried, perhaps...

The damage occurs when the plug is removed, not when it is installed. After undergoing a series of heat cycles expansion of the aluminum heads and iron spark plugs bring the aluminum threads into intimate contact with microscopic irregularities in the soft iron threads of the spark plugs. If the spark plug is loosened while it is hot (ie, expanded) the aluminum threads are liable to be locked so tightly to the plug that the loosening torque will exceed the shear-strength of the aluminum threads. The hotter the engine, the more likely this shearing will occur. If the head is allowed to cool to a temperature comfortable to the hand, the chance of stripping the threads is greatly reduced.

When dissimilar metals are torqued together (the spec for spark plugs is about 22 ft/lb) it is vital to use some type of anti-sieze compound. In the case of spark plugs for air-cooled engines the compound must be one with a very low thermal resistance, such as copper, aluminum or graphite, in that order of preference. Lead-based compounds should be avoided.

When conducting a compression test all of the sparking plugs should be removed. It is important to clean the area around the plug so rotation of the engine during the compression test will not suck debris into the combustion chambers.

The engine should be cranked a uniform number of turns for each cylinder. The compression gauge should be the averaging type attached to a fitting that threads into the spark-plug hole to form a gas-tight seal.

It is unwise to perform a compression test on an engine that has not been operated for some time as the lack of lubrication on the cylinder walls can give a falsely low reading and may, in the case of engines coming from prolonged storage, result in damage due to undiscovered rust on the cylinder walls. (Engines should be stored with the valves closed.)

Compression testing yields the most uniform results when the engine has been recently operated and is warm to the touch. Since oil is normally added to the cylinder prior to taking the 'wet' compression reading, it is wise to reinstall the spark plugs and operate the engine for a few minutes immediately after the compression has been checked.

Due to variations in compression ratio and other factors compression testing is at best a befuddled step-child of leak-down testing, wherein the cylinder is brought precisely to TDC and the combustion chamber charged with compressed air, the dissipation of which is timed and observed with stethescopes and/or microphones to identify inproper sealing of valves or rings. Due to its static nature, leak-down tests may be performed for so long as it takes to accurately diagnose the condition of the rings and valves.

Polishing Intake Manifolds

Regarding Mitch Covington's question about the benefits of polishing the cast aluminum end pieces of a dual-port manifold system:

It's very rare that all of the gasoline in the intake charge is fully vaporized. It is finely divided into small droplets of liquid by the action of the carb but complete vaporization is seldom achieved.

A droplet of gasoline, however tiny, has a million times more mass than a molecule of air. The greater mass makes it difficult for the droplets to negotiate the bends encountered on the way to the combustion chamber causing a portion of the fuel charge to strike the walls of the intake manifold or cylinder head casting and to form a film of liquid gasoline. This process occurs more easily if the surfaces are rough.

Polishing the inner surfaces of the aluminum casts eliminates the rough surfaces that promote impact condensation. Some engine builders spend hundreds of man-hours polishing the manifold's inner surfaces but tests have shown no appreciable benefits over a mirror surface to one smoothed with #600 wet & dry sandpaper.

DP manifold castings are not only too rough to begin with, they often build up a spongy layer of combustion residue from backfiring or a gummy layer of gasoline residue. At the very least the manifold castings should be cleaned. Sand paper is one method of accomplishing this and will produce a smoother average surface as well.

Re-Torque Heads?

A question has come up in our local VW club and I'd love to hear your opinion of it. The short version of the question is, when is it necessary to retorque your heads?

The club guy wrote an article saying there is never any need, as any kind of routine measure, to retorque heads.

No Bentley manual says to do it, folks at Gene Berg say not to retorque, calls to senior VW engineers (of course the main office folks were no help) return the idea that VW never recommended retorquing heads as any kind of routine.

I've sometimes got the impression that folks like to retorque their heads occassionally. If you'd like to address this issue, I'd appreciate it!

Initial break-in is not the question here. I've done it to an inherited engine of unknown provenance, though whether it did me any good is a question I can't answer.

This came up because a shop wanted to retorque someone's heads to "keep the engine in top performance." The shop wanted less than $100 and said it would take less than an hour. The wise woman who owned the car thought about it awhile and wanted to know if it was possible to remove the engine and all the tin in order to access the studs hidden by the dp intake manifold and put it all back together in less than an hour. Her guess was they were only torquing the studs you could reach with the engine in, which sounds like a pretty stupid idea.

So the article writer came to these conclusions: -you don't need to retorque -you can't do it with the engine in, anyway -only retorquing the lower ones is a bad idea.

Thanks for any input.

The Volkswagen engine sandwiches cast-iron cylinders between a magnesium crankcase and aluminum heads. During warm-up and cool-down there is relative motion between these parts due to their different rates of expansion. The effects of this thermal cycling is quite evident on high-time engines, which often have one or more loose studs when cold. The upper/outer studs (ie, those nearest the exhaust stacks) are usually those you'll find to be loose.

Engines built without proper thermostatic controls experience more frequent thermal cycles and cycles having a wider temperature range. I think it's fair to assume such engines will accumulate the effects of thermal cycling more quickly than properly assembled engines.

All VW engines show evidence of 'shuffling' where the cylinder spigots into the crankcase and heads. In worse-case situations this leads to oil leaks at the crankcase and compression leaks at the heads. Although there are other factors involved in the shuffle/leak syndrome one or more loose studs is always present in worse-case examples. By comparison, properly built engines which are periodically re-torqued show less evidence of shuffling and rarely suffer such leaks.

Based on my experience I consider periodic retorquing of the heads a necessity but I can't offer any hard & fast figures for how often retorquing may be required. The need appears to be involved with the number of heat-cycles the engine has experienced. Lacking hard data, I retorque my heads whenever the opportunity offers itself.

For example, the little engine in the bus presently has 540 hours of service in that chassis, much of it accumulated on runs which I've documented in trip reports and for which there are witnesses to verify the performance of the vehicle. I've re-torqued the heads four times during that period, once when it was initially installed, the other three times in conjunction with other maintenance. (Rebuilding out-board gear-boxes in '95, replacement of the throw-out bearing in '96 and replacement of the transmission for one having a lower gear ratio in '97).

Back in the late 1950's I paid scant attention to such details as perodically retorquing the heads. Over the next ten years it's fair to say I blew up more than my share of engines, learning from each failure. Somewhere along in there I began retorquing the heads whenever I had an opportunity to do so. I also began using auxiliary oil cooling, full-flow oil filtration, electronic ignition systems and a host of other techniques and modifications. Over the last thirty years I've not blown up an engine other than when conducting experiments on the test stand.

As a general rule, I like to swap heads when I replace the clutch, typically somewhere between 40,000 and 50,000 miles (ie typically between 750 and 1,000 engine-hours). Both the heads and clutch will last quite a bit longer but I don't like surprises. Swapping the heads naturally involves re-torquing them.

Given the evidence, and based on my personal experience, I'll continue to retorque the heads and do other things that I've found contribute to reliable, trouble-free transportation. What others do, and their reasons for doing them is their own affair.

Experience has taught me that some things work... for me. I've also learned that experience is expensive — often painful — stuff. I've tried to share my experience and, within reason, I'm willing to explain the basis of my opinions. But having told someone the stove is hot, if a third party insists it is cold I see no merit in debating the issue.

Rebuild Your Heads

Buy a pair of new heads from J. C. Whitney, about $90 each. Buy an overhaul gasket set. Buy a muffler installation kit. Buy four new valve guides (2 bucks each). Buy a VW valve guide step–drill from Johnny's Speed & Chrome (p/n 10–7100). Get a VW valve guide installation tool from them at the same time (p/n 10–7015). Buy an 8mm hand–reamer from any good machinist supply house; MSC, Enco or similar; costs about eight bucks. You'll need the handle (same thing you use with a tap). Order a set of Elephant feet from J. C. Whitney (cheep) or Berg (Aye! Christo!!). Order/steal/make exhaust stud nuts w/ brass or stainless steel washers. Scrounge up some copper–based anti–sieze compound.

Drop the engine one evening. Sit and look at it for a while if it's the first time. When you get over the thrill of it all, take your wife out to dinner. Next day, clean things up, do all other minor chores, pull the tin, pull the heads, (Spray them with WD–40, put them in heavy plastic), check the push–rod tubes, stretch them out, install new gaskets. Put everything back together, sneaking up on your torque by working from side to side. The new heads came with new valves, springs and keepers, all assembled, all ready to go. Re–mantle the engine (good time to replace the screws with bolts). All clean? Did you remember the air deflectors? Tranny all cleaned up? Axel boots okay? Adjust your valves. Now check your adjustment. Then put the engine back in. Work slow, take your time, you'll be done by supper–time. (More to do? Give yourself more time; take a couple of days.)

Some time over the next few months, whenever you get around to it, overhaul your old heads. (If you ask, I'll tell you how.) Put the new valves in the new guides and bag the heads in heavy plastic, sealed with duct tape. Leave the springs off but keep everything together. Store them away (remember to date them; we're fallible critters).

The economics here are pretty simple: Once you have the tools and the skills, you can do an infinite number of valve jobs. With two sets of heads, you can keep your engine at peak performance; the savings in fuel alone will more than justify the cost of the tools. If your heads are properly torqued, if the engine isn't abused, If you keep your valves adjusted, if you're running platinum plugs (ie, infrequent removal/installation), your heads won't crack; will last a long, long time.

You throw away your exhaust valves and use new (about $9 each for top–line quality). You can re–grind your intakes if they need it, or just wire brush them and hand–lap them. The second time around, you can take the heads to the shop, have the guy stone the seats back to truth, re–grind your intakes. No rush and no pressure; he'll wait until he has someone in a hurry, do yours at the same time, won't charge you as much. You take them home, do the fitting–up, lapping, assembly, preservation, bag for storage. Maybe do a few extras for your friends; you got the reamer and the tools; you've been there; done that.

Make a case for the reamer out of plastic tubing, another for the step–drill. The other tools can knock around your tool box without getting hurt.

If there is no pressure on you to finish, head–work can be done in handy little slices, a pleasant way to spend a rainy afternoon. You end up with better heads; your car ends up running better. And you spend less time/money keeping it that way.

Rocker Shafts

As you've probably noticed, stock VW rockers have drilled oil passages. Unfortunately, the part of the rocker-arm shaft facing the crankshaft is starved for oil due to the constant pressure from the pushrod and valve spring. Poor lubrication results in rapid wear on that part of the shaft and on the contacting surface of the rocker.

To compensate for the asymmetric wear the rocker-arm shaft is normally rotated 180 degrees when you do a valve job, presenting the new, unworn face. If the rocker-arms are not worn beyond spec (check with a snap gauge), they may be reused. But once both surfaces of the rocker-arm shaft have been used, it should be replaced. If you prowl the junkyards and check any rocker-arm shafts you see (they dismantle in less than a minute with only a screwdriver to pry off the hairpin clip), you'll often find shafts that are only worn on one side. If you install them with the unworn side down, they will make a suitable replacement.

To improve oiling, some mechanics deliberately groove the lower side of the shaft. I've found that this appears to accelerate wear in the rockers-arms.

I don't know why anyone would want to bead-blast a rocker-arm shaft. It is a precision ground shaft. Bead-blasting would destroy the polished surface. Unless rusted, they clean up fine in carb cleaner.

Every rocker-arm shaft comes with its own built-in gauge. The portion under the tower reflects the original dimension of the shaft. Make sure the stud hole does not have a lip — if it does, polish it away — and try a new rocker-arm on that part of the shaft. The amount of play is what the rest of the shaft should feel like. Compare the unworn portion to the worn parts, and you old rocker-arms to the feel of the new one. If the amount of wear does not appear excessive you can reuse the parts.

I don't know the dimensional spec, I'm sure it's lurking somewhere in the manual. But the inspection method above will provide the information you need, plus you can pick-off the dimension of the shaft from the unworn portion.

I keep a few unused, original VW parts as gauges, picking dimensions from them instead of looking them up. Trial fitting a known-good part is often the best way to determine if the part it is being fitted-to is worn beyond spec. Measurement by inspection, or trial fit, is a valid procedure often called 'gauging.'. Using a gauge is faster than using mikes or dial calipers and saves wear & tear on your precision tools.

Swivel Foot Adjusters

Elephant's Feet, the Panda's Thumb And Volkswagen's Valves

A standard maintenance item on Volkswagen engines was replacing the valve adjuster screws every couple of years. The slot would get buggered from the screwdriver and the face, a nicely cambered curve, would become faceted. They were inexpensive and the parts man at most VW dealerships kept them bagged in sets of eight and near the counter. "Adjusters?" Toss, clink. "Thanks" and out the door you go.

The top of the valve stem is flat. The adjuster screw is cambered; you create a point-contact between them when you adjust the valves. The contact area is quite small and wears down rapidly, hence the need for constant readjustment. But once you'd faceted the face of the adjuster screw — once you no longer had a neatly cambered curve — the life of the adjuster is over. Any future adjustments will fall on the 'corners' between the facets; you will have brought a dull knife-edge to bear against the tip of the valve stem instead of a smooth curve. Such an edge will wear with remarkable speed, often in less than a hundred miles. And it doesn't do the valve any good, either. The point-of-contact between the adjuster and the valve stem is offset toward one edge of the valve. Actuating the valve in that fashion causes it to rotate, insuring a good seal against the valve seat. Since the wiping motion of the rocker is distributed around the circumference of the top of the valve stem, the wear is distributed; the valve stem stays fairly flat. But if the point of contact is an edge rather than a smooth camber, it wears a groove; the top of the valve becomes dished, causing the stem to mushroom, often to the point where chips will break off. Very complicated things, those valve adjusters. So we replaced them often, as VW intended.

(People often forget that regrinding the stem of a valve is the first step in refacing the valve. The regrinding returned the stem to a flat surface. The better mechanics then burnished the ground surface with an India stone.) [But on the intakes only, please; VW exhaust valves should be replaced rather than reground.]

The proper valve lash is zero. We set the VW's valves at something greater than that to insure proper lash at operating temperature; there will always be some gap — and some noise — but you don't want too much or the impact of adjuster against valve stem will hammer the stem into a mushroom, even if the face of the adjuster is a cambered curve.

Due to their self-adjusting nature, hydraulic cam followers provide zero valve lash, in effect adjusting themselves each time the valve is actuated. That's why hydraulic cam followers provide maximum valve life, and why they run so quietly.

In the 1960's Ford of Germany introduced a new kind of adjuster, one having a flat face. It accommodated the wiping action of the rocker because the flat face was in a ball-and-socket joint, a tricky bit of mechanical engineering. VW enthusiasts quickly adopted the German Ford adjusters because we saw immediately that without the cambered point-of-contact we could achieve a more accurate adjustment, the flat foot wouldn't wear as fast, and we wouldn't have to adjust the valves so often. We called them 'Elephant Feet' and smiled, even though a set of them cost about twenty dollars (big bucks in the mid-sixties, especially with VW adjusting screws going for two bits). We hustled back to the shop, re-threaded our VW rockers (the Ford adjusters used a different thread) and enjoyed the freedom of adjusting the valves only once or twice a year instead of every week. And you never had to replace those things; they lasted just about forever.

Nowadays you can get swivel-foot type adjusters specifically for the VW from a variety of sources. Even J. C. Whitney has them (p/n 37—8589A, $16). If you aren't using them, you should be.

Gene Berg sells a swivel-foot adjuster that adjusts with an Allen wrench instead of a screwdriver. They are a dream to adjust; the Allen wrench is like the pointer on a micrometer's dial. But if you're running hydraulic valves, you'll only need to adjust the adjusters ONCE, when the engine is assembled. And in that case, it doesn't really matter if the things use an Allen wrench, a screwdriver or the handle off a screen door. (The Whitney-type of adjuster last longer than Gene's, apparently due to the larger bearing surface.)

Sermonette

The first 'Volkswagen' engine belched fire sometime in 1932. A lot of things have changed since then. In this, and more than two dozen other sermons uploaded to the net, I've pointed out some of those changes that can be applied to the Volkswagen engine for the purpose of improving its performance and longevity. In each case, the improvement — and my opinion of them — is the result of direct personal experience gained over nearly forty years of tinkering with Volkswagens. Alas, many of these improvements run counter to the flow of Conventional Wisdom espoused by the various VW-specific magazines and endorsed by the 'owners' of some of the VW-specific lists on the Internet.

I urge you to think for yourself, reading all such opinions (including this one) with the critical eye of a skeptic. If you have questions, ask; anyone ex-pressing an opinion should be willing to justify it with additional data.

(All reference to the Panda's Thumb has been deleted from this posting as Inappropriate Material for readers of this list.)

Swivel Foot Adjusters—NOPI

The engine I've hauled to Kent, Washington for the purpose of hauling me home, uses a brand of swivel–foot adjuster I've not used before. They arrived with other components from NOPI.

The new adjusters look like Berg adjusters, but only from a distance. Adjustment is made using a 3mm Allen wrench, more convenient than the stock slotted type, and the swivel foot is a real 'foot', rather than a flattened portion of a ball. But on close inspection I saw that the feet were not finished. Tool marks were clearly evident, even a central pip on several of the feet.

On Berg adjusters the foot is polished flat after heat treatment. On the adjusters from NOPI there was no sign of polishing or flatting. The things were heat treated but on those with a pronounced central pip, this resulted in a hardened point the size of a pencil lead that would probably wear the valve quite rapidly.

Using stones, I polished the contact face of the adjusters until they were flat. The hand–grinding took about an hour.

Swivel–foot adjusters upset the geometry of the rocker due to the greater length between the valve stem and the rocker arm. The NOPI adjusters, like the Berg adjusters, come with a stack of shims that must be placed under the rocker–arm towers to restore the proper geometry. But they were rather poor quality shims. Some had turned edges and none were a tight fit on the stud.

Getting rid of the turned edges took a few minutes with a stone, after which I gave them a quick rub on #600 wet & dry sandpaper to check for high spots.

Since the shims were a sloppy fit on the studs I cleaned them with acetone and pre–assembled them onto the studs with a dot of sleeve retainer between the layers of shims. Aligned and torqued–down, they welded themselves into a single shim–stack. During final assembly I wouldn't have to worry about loose or missing shims.

During the engine's few hours on the test stand the new adjusters wore at a fast rate, apparently at the ball & socket. I had soaked them in oil overnight before assembling the rockers, and the rockers produced a good oil spray within the valve gallery, but some of the adjusters were wildly out of adjustment after only a few minutes of running. This flattened out as the engine gained hours but it remains a worrisome thing to me.

I'll keep you posted as to how well the adjusters perform on the trip home. If the fragile foot doesn't snap off they should just do fine. Price was less than $20. And of course, if the foot DOES break off it wil bugger–up the valve stem; the $20 could prove a very expensive economy.

Bob

PS – This was written while riding back & forth on the Seattle ferry. Good coffee, a nice place to work and great scenery.

Valve Stem Height

Is it important to have identical valve stem height? I noticed that the valve stems on my rebuilt heads don't have identical heights. One of the exhaust valves is about 2mm lower than the two intakes, and the other exhaust is about 1 mm lower.

Will this affect me when I am trying to setup my rocker arm geometry?

Valve stem height is extremely important in determining the volumentric efficiency of your engine. A change in valve stem height alters your valve timing, changing both duration and lift.

Having some valve stems at different heights results in volumetric imbalance which in turn leads to unequal power pulses and a marked reduction in engine performance and efficiency.

With regard to automotive mechanics, with cam-actuated poppet valves, equal valve-stem height is a fundamental assumption on the same order as 'wheels are round'. It is something so basic and widely understood it is rarely mentioned.

As to your specific question YES!

Here again, basic assumptions are involved, one being that the engine assembler understands the significance of the rocker-arm to the valve stem. When setting-up the valve train the standard is to insure the center-line of the adjuster falls upon the center-line of the valve stem at 50% of the lift of the cam. Instructors love to baffle you with the math inherent in this mechanical fact of life but the bottom line is that setting-up the valve-train geometry in this fashion insures it will absorb the least amount of energy to do its job. But get the geometry off by even a small amount and the amount of energy needed to actuate the valves spikes up to something like eight times (!) the optimum value. And that's assuming the engine is volumetrically balanced to begin with. Where does that extra energy go? Ultimately, it appears as heat but the interesting part is how that mechanical motion gets converted into heat. A lot of it comes from the energy dissipated by the misaligned rockers as they scrub the valve-stem against the side of the valve-guide. The net result is a hotter-running, less efficient, less durable engine.

Other even more basic assumptions involve the relationship of the cam to the crankshaft. With stock VW components there isn't a lot you can do in this regard but given even normal variations amont cranks, cases and cams you should at least check that the components you're using meet the published spec for lift & duration, which are of course relative to the postion of the crank. If they are wildly out of spec you can shop for a different cam, an off-set key-way or an adjustable cam-gear or perhaps fiddle with the valve stem heights a bit, depending on how they depart from spec.

As a general rule, with stock components and all eight valve stems of equal height, you'll only have to worry about the rocker alignment. But you should also know that there are a couple of horse-power's-worth of wasted performance lurking in the stock VW valve train geometry. Proper assembly can saddle those horses and put them to work for no greater cost than careful attention to detail. But you gotta know a latigo from a chingadaro... and it helps if you know how to ride :-)

Valve Stem Seals

I'm installing new valves in a set of new heads. I Ordered the valves, etc. from MOFOCO. I also asked them to send me a set of valve stem seals. They said that these are not needed. Is this so? Won't I be burning the oil that leaks down along the stem? If I do need them are they included in the standard engine gasket kit?

Let me start with a bit of background noise.

When your valve stems and guides become worn, opening the intake valve will cause some oil vapor to drawn into the combustion chamber from the valve gallery via the worn guide. When the exhaust valve opens some combustion products will be blown INTO the valve gallery. Stem seals reduce this process but can not prevent it entirely. (noise off)

Valve stem seals are not included in the standard VW engine overhaul gasket set.

The purpose of a valve stem seal is to close off the valve guide when the valve spring is compressed. The seal normally rides on the valve stem just beneath the keepers, comes in contact with the head of the valve guide when the valve is open.

The Catch–22 about stem seals is that they are of little value when the guides and valves are new but are very useful in preventing excess oil burning and exhaust blow–by when the guides become worn. The catch is, it's impractical to tear down a worn head just to install stem seals. Since you have to tear down the head, you may as well rebuild the head.

The answer is that most mechanics, the good ones anyway, install the seals when they rebuild the heads. For the first twenty thousand miles they probably do little good but neither do they do any harm. And between twenty and forty thousand miles, about the maximum safe life for a VW exhaust valve, they do a great deal of good.

All real auto–parts stores carry stem seals and 7mm is a standard size, although some provincial parts clerks may not know that. Take a valve with you, make sure the seal is a snug fit.

Valves and Muir

I need to check the gap on tappets and have recently bought John Muirs book to help me in doing this. Although it is for "the complete idiot", I think I am missing something somewhere (a few brain cells maybe).

The book explains to line up the distributor with the notch on the side of the distributor. Then the fan pulley notch lined up with the crack in the cranck case giving TDC. The book words it as if the two alignments happen at the same time. Mine do not. When the distributor is aligned the pulley notch is about 15 to 20 degrees clockwise round.

Can someone explain this and where I should go from here. If you have the book, its on chapter 10 and the very first exercise.

You've encountered one of the many errors scattered through John Muir's book.

In early editions John states "...the distributor rotor points to the line on the rim and the notch (and paint mark) lines up with the crank in the crankcase. This is top dead center (TDC) for cylinder No. 1, where No. 1 cylinder fires."

This is not correct. The engine does not fire at TDC. It's not a very critical error, a mechanic would know what John meant to say but a novice would not. But since John's audiance — and supporters — were mostly novices, and since John took comments from professional mechanics with a grain of salt, the errors remained uncorrected, year after year.

But by the thirteenth edition the fateful term "...where No. 1 cylinder fires." vanishes... only to be replaced by an illustration that says the same thing: "NOTCH Mark where No. 1 Fires" and the illustration showing the rotor aligned with the firing point and TDC aligned with crankcase split. (Sigh...)

In fact, what your engine has told you — that the thing wants to fire when the pulley is yet some distance away from the split in the crankcase, is correct... for your engine. The firing point for most early VW's is before top-dead-center, not on it nor after it.

What you're running into is part of the Secret Language of Mechanics. Top Dead Center is the mechanical reference you should use when adjusting your valves. A handy way to arrive IN THE VICINITY OF TDC is to use the firing-point on the distributor. The fact the firing point and TDC are DIFFERENT is part of the secret. All mechanics know this so well they never bother to mention it. Indeed, they may use TDC as a kind of short-hand when they mean the firing-point, the context of their comment preventing confusion... when speaking to another mechanic.

But that's an informational problem. Your engine would like its valves adjusted, please, and you are the only wrench in sight. So lets deal with that.

Does your pulley have a good, well-defined TDC notch? Is the distributor pointing toward the terminal of the wiring that goes to #1 cylinder. If so, align the TDC notch with the split in the crankcase and let's get on the with the job. You are adjusting valves, not adjusting your timing. The two are related but not the same — and do NOT occur at the same time. After we have the valves nicely set we will come back and adjust the timing to take advantage of the renewed precision of your valve's actuation.

Go ahead with the valve-adjustment procedure — John's instructions are as good as any and better than most. If you have another question, ask. I'll be over there under that tree :-)

Welding Heads

Ever known anybody to weld a head cracked in between the spark plug holes? Think I can pull this off?

Making welded repairs to VW heads is easy as pi... IF you have the right tools/skills.

First, get that puppy really clean. Use walnut shells or other non-abrasive media. Now get a cup of water handy. Using mig or stick, run a bead around a quarter of the inside of the valve seat. Run another bead directly opposite. Quick like a bunny, throw cold water on the seat. Assymetric shrinking pops it right out. Remove both seats.

Using drills and rotary files, grind out the crack so as to leave a nicely shaped trench, not too sharp on the bottom. Make sure the top of the trench is at least half an inch wide. If the repair involves the spark plug hole, and most crack repairs do, hog it out to a generous cone, big side toward the chamber. Pop the head in the oven, set to 450. Go mow the lawn.

Set up your TIG rig same as for welding 356-T0 high strength aluminum castings. Filler rod is the same stuff you use for 3003-H3. I like the Linde rods best.

Suit up, turn on the water & gas, pull the head out of the oven, get it positioned and make sure the ground is good. Sit down, get comfortable and weld that puppy up. Build up a nice bead, we'll machine it away later. Be careful not to leave any porosities. I run straight argon, block off the spark plug hole, plug up the intake & exhaust ports so the gas will pool in the combustion chamber. Work in a dam-box if doing a lot of heads.

Punch out the valve guides and press in new ones. Using the valve guides as guides, remachine the valve seat spigots. Remachine the spark plug hole. (It's best to use a jig for this. The valve guides provide a good reference.) Put the head back in the oven. Put the new seats in the freezer. Or mebbe not... see below.

You'll need a mandrel to install the seats. Turn one up out of mild steel. You'll need one for each size seat you're doing. Some guys just tap the seats into place with a hammer, working it in a little at a time. If you use the hammer method, don't bother chilling the seats — they heat up long before they are seated. If you use the mandrel you can usually install the cold seats into the hot head with a couple of whacks from a 3 lb hammer. Make sure the head is firmly supported at the proper angle. Keep the seat-end of the mandrel cold.

Make yourself a straking tool that matches the OD of the seats, about 1/8" beyond the max diameter. You'll need one for each diameter of seat you plan to replace.

With the valve seat properly seated and the head very firmly supported, make repeated passes around the seat with the straking tool, forging the aluminum firmly against the seat. Use a ball-end chisel or smooth faced straking tool to close your tool marks. Use rotary files to remove any excess welding. Polish things up, make them look nice.

Piloting on your newly installed guides, stone the seats as per spec.

Rebuilt head. Easy as pi. And don't forget to replace all of the studs.

Personally, I buy upright rebuilts from Jack Riddle (SIR), Type IV's from Mark Stevens. Overhauling just one head is going to take all of the tooling you'd need to do a thousand heads, plus about ten man-hours, most of which will be spent setting up the milling machine and tooling. The wiser course is to wait until you have a couple of dozen junkers then rebuild them all at once. You'll only need to set up your tooling once for each step. I think you'll find about two dozen is the minimum practical volume to justify the tools and set ups. Even so, each head is going to require about two man hours, minimum, probably twice that as an average.

Jack Riddle's shop (RIMCO) does heads in batches of 1,000, probably spends no more than .5 man-hours per head, on average. Big shop. Proper tools. Correct tooling and the needed skills. Tough combination to beat.

-Bob

PS — the reason you have to pull the seats is because a surface-weld just won't do. If the crack propagates under the seat, which it will even if surface welded, the valve seat will come loose and you're liable to lose the whole engine when it lets go. I know — there are guys out there squirting a teenie-tiny little bead from a low-buck migger in an ittie-bitty little grove they've grouged into the top of the crack. Polish the thing up, it looks good as new, mebbe even better. But the crack is still there, underneath that pretty, polished surface. And like someone said, "Owl bee bock."

Worn Rockers

My '71 bus's driver side rocker shaft keeper pin broke about three months ago, along with one of the big spring washers, ... I had an old rocker shaft lying around, so I cobbled the keeper pin and spring washer off of it, put the whole thing back together and off I went. Well, two days ago, the same thing happened again!

Failure of the keeper was caused by failure of the spring-washer (ie, warpy washer), which itself probably failed due to accumulated wear on the flat washers between which it is installed.

When this type of failure occurs it usually indicates ALL of the flat & warpy washers have reached the end of their service life and should be replaced, along with new keepers (ie, hair-pins).

I think it would be a good idea to dismantle your rocker arms and inspect them very carefully to insure the oil passages are clear and neither the rockers nor shaft are galled.

The only tool you need for inspecting the flat washers is your fingernail(!) If the washer is so worn that your fingernail catches on the ridge, it should be replaced. (The washer, not the fingernail. :-)

The hair-pins should be installed with their un-worn side toward the washer. If the hair-pins (ie, the keepers) are worn on both sides, they should be replaced.

The rocker-shaft towers should be checked with a mike. As the towers wear they allow the rockers to move closer together, upsetting the relationship between the adjusting screw and the valve stem. This is also true for the boss on the rocker-arm.

When assembling your rocker-arms you may use any amount of moly-based grease you wish on the washers but do NOT get the grease in the oil passages in the rockers. For the rockers, you want to use oil rather than grease.

Your push-rods also serve as oil galleries, carrying oil from the cam- followers out to the rocker-arms. Be sure they are not blocked and that the ball-ends are secure in the push-rod. Pumping them full of oil just before re-installing the rocker-arm shaft is generally a good idea. A pump-type oiler does a good job.

Be sure to torque the nuts to spec. If the rocker-arm is not perfectly parallel to the cam you can get some really odd-ball failures.

Installing swivel-foot adjusters and adjusting the height of the rocker-arm shaft should have no effect on the wear of the warpy-washers, flat-washers and keepers.

So long as your valve train components receive adequate lubrication, they wear at a fairly slow rate. But they do do wear. The failure you've described sounds like the results of old age rather than some fundamental fault.

Advance Curve

Does this mean that after *full on* there will be a flat spot until the engine *gets up on the pipe* From what I understand this can be the case with my 2.0L w/weber and 009

Not necessarily.

A 'flat spot' is normally defined as when pushing down on the acceleartor results in no acceleration. On a distributor's advance curve such a 'spot' is truly flat, or nearly so.

A perfect advance curve describes a nice straight line from idle speed and zero degrees of advance to the maximum advance for that distributor at some higher speed. Advance mechanisms based on springs, bob-weights and centrifugal force are also responsive to harmonics and certain physical principles which, at certain speeds, cause energy to be stored in the advance mechanism instead of being transmitted to the advance-plate.

Plotted on a graph with degrees of advance as the vertical axis and rotational speed as the horizontal axis, such harmonics appear as relatively flat sections on the otherwise linear curve. If the flat spot is more than a few hundred rpm in 'depth' it will be perceived by most drivers, most of whom will make the situation worse by depressing the accelerator still further instead of waiting for the physics of the system to catch up to their foot.

If you use an ignition system with a mechanical advance mechanism it is vital that you chose a system that does not include such harmonics within the normal shifting range. Since the harmonic is a reflection of mass and mechanical principles such as the energy absorbtion and release of springs, you can normally move the harmonic — the so-called 'flat spot' — by changing the mass of the fly-weights, changing the tension of the springs, reducing frictional losses in the system or any combination of these things, including the use of asymmetic fly-weights and springs.

Unfortunately, moving the flat-spot above the normal shift-points will give you a very unresponsive advance curve, while moving it lower will demand an extremely skilled toe on the accelerator, rewarded by a baulky shift each time you miss your points. Often times the best solution is weights of unequal mass and springs of unequal tension. The change in rate of advance will still be there but the sharply defined 'flat spot' will have blurred in a generally acceptable 'soft spot' on the curve. (This is what we did back in the late '50's when we plugged an -010 centrifugal distributor from a bus into our bugs. We wanted the steeper advance curve of the -010 so we could go fast/make noise... but it was nice to be able to shift, too.)

And we haven't even gotten to the carb as yet.

Some carburetors also display a 'flat spot' — a movement of the throttle-valve that does not result in an immediate increase in engine speed. This normally occurs in a very narrow range of manifold pressures and air-flow rates when the carburetor is transitioning from low-speed to high-speed operation. In a properly tuned carb the transition is smooth, most drivers are never aware of it. But if the carb is not properly tuned and the transition should occur in conjuction with the harmonic of a mechanic-advance mechanism, you can end up with vehicle that is almost impossible to drive, other than flat-out down the freeway. A good percentage of bugs and buses I see fall into this catagory.

Doesn't the 2.0L 's substantial torque compensate for this by the fact that I will be able to shift at lower RPM?

You will have to tell me the answer. The advance curve for after-market -009's is all over the ballpark, and mechanical advance distributors are high-maintenance items with lots of friction points, their springs rangeing from very temperature sensitive to very stable. If you're running a mechanical-advance distributor and you haven't kept it cleaned & lubed, the odds are you've no idea what your advance curve is. Often times complaints of 'flat spots' are nothing more than symptoms of poor maintenance, the hesitation vanishing when the distributor is overhauled.

If your combination of carb and distributor works, fine. But that's no assurance someone with the same after-market componenets will be able to reproduce your results. Based on my experience I can tell you what SHOULD work, or perhaps, what I have gotten to work, but in the case of after-market components we are both up the same tree — what rolls for me may not for thee.

I would be interested in seeing some data on shift points, power band RPM range, and redlines for various setups.

Me too. (But the number of possible combinations is painfully large.)

I can't recall seeing this info posted.

Me neither. (See above :-)

Thanks

You're welcome

-Bob Hoover -16 May 1997

PS — Do you want clean, crisp shifts without hesitation? Want a vehicle that always pulls away smoothly from a stop? Want a nice, clean advance curve? Want a low-maintenance distributor? Want a system that senses and responds to changes in load rather than speed?

Get a distributor using vacuum advance, or a hybrid vacuum-centrifugal. Volkswagen did. So did all the other automobile manufacturers. — rsh

Alternator Stand

The fan shroud will not not pull down to where it needs to be to install the 2 hold down screws. One side will go in, but not both. It seems like the new stand is too high.......I measured it as almost an 1/8 th" taller than the original generator stand. Called the vendor, So Cal Imports. The fellow there wasn't real helpful....."Never heard of *that* before......mail it back and we'll check it......but it must be OK, we sell a bazillion of 'em...." etc., etc.

Could it be a bad stand? My next move is to try and locate one locally, and compare it to the one in hand. I actually attempted to modify the old generator stand - and found out after 3-4 hours of wasted effort why they make new ones...........

Yes, you could very well have a bad stand.

Carefully check the saddle that accepts the barrel of the alternator. Good conversion kits use an alternator stand that has a machined saddle. Cheap kits use a stand where the saddle is 'as-cast'.

The saddle should fit the diameter of the alternator like a glove. But in the case of 'as-cast' saddles this is rarely true. In the worst cases, there will be irregularities in the saddle that will cause the alternator to be cocked or even raised out of position.

Another problem I've seen is after-market alternator towers in which the plane of the saddle was not parallel with the base of the casting. Often times the only 'machining' done to the base of after-market alternator towers is to rub them against a belt-sander. In two cases I found the base sanded to an angle, throwing the alternator wildly out of alignment with the blower housing.

The best solution is to use a real Volkswagen alternator stand, which is always machined. If you must use an aftermarket generator stand, and if it does not fit, you will have to file and hand-scrape the curve to achieve a proper fit. If the base is angled it must be machined flat and a spacer fabricated to bring the centerline of the alternator to the spec'd height.

Finally, while I've seen a few bad after-market generator towers, the problem you've described can be caused by an unnoticed ding or bend in your tin-ware, an improperly fitted thermostat rod, and so forth. Make sure you have a good tower but do not ignore the other possible causes.

Alternators and Generators

Kris,

Keep plugging. (Let's see… first one bug, then another, then a bus and a Thing and a Ghia convert…)

Alternators and generators are the same thing. Both make alternating current as a result of passing a coil through a strong magnetic field.

In a generator the alternating current is chopped into pulsating direct current by the action of a rotating mechanical switch called a commutator. In an alternator the chopping is done electronically with diodes.

In a generator the magnet field remains stationary while the coil is moved throug hit. In the alternator the coil remains stationary while the magnetic field is moved through it.

Alternators and generators both have two brushes. Generators use them on the communtator, alternators use them on the rotor.

Alternators and generators both use regulators that sense battery voltage and adjust the strength of the magnetic field accordingly.

No new concepts involved. Same–o, same–o.

Alternators came along before generators. They called them 'dynamos' (and most of the world still does). It's the nature of power generation through mechanical means to create an alternating current. Only chemical reactions produce non–alternating current directly.

Modern alternators use solid–state rectifiers and solid–state voltage regulators. The solid–state components are small enough to fit entirely within the alternator. The 100 amp Leese–Neville alternators fitted to Ford police cars ('Radio Cars') in the 1940's and 50's used an external stack of copper oxide rectifiers and an external voltage regulator.

If you want to add depedability but maintain the bone–stock appearance of a 36 hp (6v gen) you can obtain a solid–state 6v regulator for about $10. Ditto for 12v (or 24vdc).

Old concepts.

(It has been argued that there is nothing truly original in automobiles, everything having been developed in another field first. Check it out; it's a pretty good argument. Indeed, if you read your history correctly you will see why in 1971 I predicted with perfect confidence (and accuracy) that computers would find their way into cars within ten years, and that analog gauges would give way to ‘glass’ cockpits. This kind of prediction is like shooting fish in an industrial–economic barrel; you can’t miss. Here’s some more: You’ll see photovoltaic panels built–in to automobile windscreens and rear windows. Automotive sound systems will equal the performance of component systems in the home. Automobiles will interact with the roads they travel upon. [Lecture given at a think–tank near Detroit.] Some of these have already been tried.)

[A photovoltaic panel can be transparent to visible light and still produce electrical power.]

Backward Distributor

The distributor is installed 180 degrees out. I've swapped the wires, 1 to 3, etc. The question I have is this, is there any logical reason why an engine would run any different set up this way?

Yes, and a very important reason, too. If the engine is fitted the up-right oil cooler, #3 cylinder is bathed with the heated air coming from the oil cooler. This means #3 is going to run hotter than the other cylinders, wear faster and its exhaust valve will be the first to fail. To alleviate the problem Volkswagen grinds three two degrees of retard into the #3 cam lobe on the distributors used in all engines having up-right oil coolers. That translates as four degrees of retardation at the crank and my be observed by hooking a stroboscopic timing light to #3 and observing the firing point on a degreed fan-pulley.

When the distributor is installed backwards and you swap the wires around to make it run, you end up timing the engine using the #3 cam lobe in the distributor. Things seem fine but you have just built a time bomb, because if you time the engine at seven and a half degrees BTDC, cylinders 2, 3 & 4 will be firing at 11.5 degrees. And at full advance, on a hot engine, with that much advance you will experience detonation. At the same time, #3 is going to be cooking itself to death. It is just a matter of time before you trash the engine.

The proper fix is to time the engine to #1, pull the distributor driver-gear and install it correctly.

Battery Isolator

You’re in luck! The battery isolators used for 12v systems are much, much simpler than those used on 6v :-)

Call J. C. Whitney (312) 431-6102. Tell the young lady you would like a battery isolator; that you don’t have the catalog but you wrote down the number: 12VT9422T, twenny buks. (page 96 of catalog #572R, order code NLFA1). Pay an extra two bucks, they’ll get it to you the next day. (The isolator comes with instructions.)

A battery isolator is nothing more than an industrial-grade diode that will allow you to charge two (or more) batts from one alternator but will prevent the batts from discharging into each other. And the standard automotive variety works just fine on 6, 12 or 24 volt batteries.

Whitney offers a large number of isolators and kits of parts. But you can do just as well using locally procured materials. #10 wire will handle the charging current to your auxiliary battery. Be sure all fittings are soldered as well as crimped and make sure both battery and wiring are well secured; if it can shake, it will break.

Blown Fuse Indicator

Thar She Blows!

The day after the geezer in Sandy Eggo posted the sermon on changing a fan belt in the dark you stuffed a flashlight and packet of fuses in the door pocket of your bug. The sermon was kind of eery. It sounded just like the time you blew the fan belt coming back from Las Vegas, right down to the part about dropping the fan pulley nut and having to play patti-cake to find it. Now you're prepared for anything. New fan belt. Couple of tools. Flashlight. Even got some fuses. Drive on!

So you're purring along at seventy-five on the long straight stretch of I-10 between Somewhere, California and Nowhere, Arizona and your right headlight goes out. It's blacker than the inside of a coal mine cat and you've got one headlight. Things could be worse, except when you cross the Arizona line the odds are the AZ highway patrol will do what they can to bring the matter to your attention.

No problem. You are equipped with both flashlight and fuses. You pull over at the next rest stop, fight off the quasi- religious kooks wanting to sell you a stale sandwich, and start playing with your fuses. Nope. Nope. Ah ha! Ummm... nope.

After twenty minutes you've managed to break a good fuse pulling it out, dropped two of them on the floor but finally have both headlights working again. Even with the flashlight and spare fuses it wasn't quite as easy as you thought, mostly because you couldn't tell which fuse was blown. (Yeah I know, they got a headlight symbol on the fuse block cover, but the cover was lost about five owners ago.)

There's a better way. It will take you a couple hours but it's the sort of thing that never goes bad and never wears out. Here's how it works: When you blow a fuse — and even when one is just loose — you peek under the dash and there's this LED glowing back at you. The bad fuse is just above it. You wiggle it (if it's loose), replace it if it's bad and drive on. No mystery. No fumbling. Costs you mebbe two bucks. Cheep.

The reason it works is because you've wired an LED across the fuse. Don't worry about shorting anything out because you put an itty-bitty 1,000 ohm resistor in-line with the LED. Twleve volts across a thousand ohm load isn't enough juice to worry about, twelve-thousandanths of an amp, just enough to make an LED glow. As in DIM glow; you'll need to peer at it through a rolled up paper tube to see it in the daytime (or use a smaller value resistor).

At night it's okay; shows up fine; tiny red spark.

So why doesn't it glow all the time? Ah ha! I'm glad you asked. Because when there is a good fuse in parallel with the LED and limiting resistor you have TWO circuits. And as everyone knows, when you've got circuits in parallel Eye-tee is equal to eye-one plus eye-two, which means... Which means it won't glow. But when the fuse blows (or comes loose) the load — let's say a headlight — tries to draw its current through that itty-bitty resistor. It can't do it, of course. But it draws enough to make the LED glow. (The electrical formulas are interesting; they'll help you solve some of your veedubs trickier problems. But you don't have to know the principles of electricity to make it work for you. Go on, see if I'm right. Plug in your coffee pot. Or turn on your headlights. See?)

Go down to Radio Shack and buy a handful of LEDs. I used red ones because I had'em. Also buy a handful of resistors, 1000 ohm for a dim light, 750 ohm if you want it to be brighter, 680 is brighter still. (I used seven-fifties.) If you don't have a soldering iron, pick up a cheap one. Also some solder. If you've never done this sort of thing before, throw yourself on the mercy of the clerk, odds are about five to one he will know what a soldering iron looks like. Have you got a little pair of needle nose pliers? Okay, try using a BIG pair of tweezers; not as good but they'll work. And toenail clippers. The fingernail kind will work too; toenail clippers are better. All electronic types use toenail clippers.

After you get home I'll let you in on a little secret: I NEVER shop at Radio Shack. See those LEDs you just bought? They cost a nickle. The resistors are a penny each. No, I don't want to hear it; you paid a fair price for onesy-twosy quantities, all neatly bubble packed. But if you're a hairy-chested electronics type (and that applies to females as well) you hang out at electronic swap meets and buy LEDs by the bushel for a nickle each and eighth-watt resistors by the pound. But even at Radio Shack's wildly inflated prices this particular mod shouldn't set you back very much.

Like building engines, electrical work is actually pretty easy. The hard part is building an engine that runs (!) and doing electrical work that doesn't look like a tornado in a wire factory. The success of your signal lamp installation (that's what we're doing) will depend on how neatly you make the soldered connections to the prongs that hold the fuses.

The fuse holders are brass. Dirty brass. So clean it. Take the fuses out and make the brass shiny. Try Brasso polish and a coarse cloth but don't let the Brasso run all over; it's corrosive; first it cleans, then it eats.

Nice and clean? See if you can get the prongs to accept a little solder. Plug in your iron, tin the tip (melt a little solder on to it — wiping it with steel wool

will help) and get the brass prong hot enough so the solder melts and flows across it in a smooth, silvery film. Down where it goes into the plastic insulator — yeah, that thing you just melted all to hell with your soldering iron. (Joke! Joke! DO NOT melt the black plastic thing!)
Did the solder flow? Good; move on. No flow? It's not clean enough. Try rubbing it with triple-ought steel wool. (No, you can't use an SOS pad!) Plain steel wool. With mebbe a little bit of your wife's fingernail polish remover (it's mostly acetone). Now try again. The success of this mod depends on good electrical connections. There's very little strength in solder, it's just tin and lead.

The electricity usually comes IN to your fuse from the bottom and goes OUT through the top. (Okay, it's an over simplification, but let's use it for the sake of those other guys. [Can someone please check me out on this? I want to solder the LEDs to the battery-side of the fuse.])

Look at your LEDs. Notice that one leg is longer than the other. Also notice that there's a tiny flat spot on the little flange around the base of the LED. (Can't see it? Then FEEL for it; it's there.)

The electricity goes IN the long leg and comes OUT the short leg, the one by the flat spot. That's how we want to connect them to the prongs of the fuse block. But first, we want to add a limiting resistor to the short leg, and here is where I want you to be very careful.

Take an LED in your right hand and hold it in front of your face with the top toward you, the legs away. Roll it in your fingers until the flat spot is toward your right. Use your tweezers or needle-nosed pliers to grasp the shorter right leg about 3/8" of an inch (10mm) below the base of the LED. BEND the leg at 90 degrees; make it point toward the ceiling. Now grab the longer left leg about 1/2" (13mm) below the base of the LED and bend it to the left until it is perpendicular to the other leg, toward the left wall. Make the bends very sharp, no radius at all.

Now we'll put on the limiting resistor. It goes on the short leg, the one pointing up; the one by the flat spot. Using your toenail clippers, cut off the leg about 1/4" (6mm) up from the bend. use your tweezers or pliers to make a short hook in that end of the leg being careful not to disturb your bends. Take a resistor and cut off one of the legs about 1/2" (13mm) from the body of the resistor; either end is okay. Make a similar hook. Hook the hooks together! Squeeze them tight, both of them. Lay the thing on the table keeping the resistor straight (it will flop around the hooked connection) and solder the connection — the place where they are hooked.

That's the basic circuit; LED + a limiting resistor.

(These things are hard to hold for soldering; try a pair of pliers with a rubber band around the handles as a vise; pad the jaws with tape. Or use wooden spring-type clothes pins (the plastic ones will melt).)
You need to make two more bends in the legs but you want to make them after you try the thing for size against the fuse block. The idea is to position the resistor between the fuses. The left leg will go against the lower fuse prong on the side nearest the floor. The leg coming off the end of the resistor (the one you haven't cut) must be bent to fit against the upper fuse prong in a similar fashion. You figure out what works for you, bend the resistor's leg and cut off any excess length from both the LED's leg and the resistor's leg.

The completed assembly doesn't cover as much area as a postage stamp and there's nothing critical about the bends. But it must be securely soldered, and you must be able to see the LEDs. Do whatever works, so long as you don't create a short.

The circuit will be easier to solder to the fuse prongs if you first tin the legs, so lay it on the table and do it. Just a little. Be careful not to melt the joint you've made nor to overheat the LED. If it gets too hot, it won't work.

Okay, now make as many LED's & resistors as you have fuses. Late bugs and buses have a dozen of the things. And make two extras. (I'll tell you later.)

All made? Okay, now we test them. It would be easier if you made up test leads with alligator clips but plain wire will work okay. (Some people even use store-bought test leads! [Shudder.]) You can hold the things together with your fingers for testing; your skin resistance is too high for 12 volts to harm you. (You car's battery thinks you're made of plastic.)

When you apply 12vdc to the free leg of the LED and ground the leg of the resistor, the LED should glow. No exceptions.

No glow? You did it backwards, you got the LED too hot, you aren't making good contact or you aren't feeding it 12vdc. Again, no exceptions; these things are pretty simple. Figure out what's wrong and try again. If you need help, we're right over there inside the computer.

Solder one circuit into place on the car. It helps if you have three hands, one growing from the middle of your forehead. Or a prehensile tongue. (Hint: Hold the thing in place with a cloths pin while you solder the other end, then bend it into place and solder.)

When you have one circuit installed, add the fuse, turn the key and test that circuit. The LED should be out when the circuit is on. Then pull the fuse.

The LED should light. You're in business. Do the others the same way.

All done? Nope. You've got to insulate the exposed wire. (I know, Volkswagen left the prongs uninsulated. We're not Volkswagen.) Get some fingernail polish — you can even get it in black nowadays. Paint the wires and the resistor; thin coat, please. And don't get it on the LED. Let it dry tacky and put on a second coat. In fact, put on as many coats as you want, just keep it off the prongs where the fuses go and don't get it on the LEDs. In the years to come the wires would otherwise corrode. Most modern fingernail paint is urethane lacquer with a very nice electrical dielectric; it makes good insulation. And it will keep things from vibrating. Vibration is hell on soldered joints.

Clean up. Re-install your fuses. (Use the new Buss GBC-type, please.) Test. Enjoy.

Blow a fuse on a dark & stormy night? No problem, just look for the glowing LED, replace that fuse and drive on.

What's that? You say What size? Oh. I guess I overlooked that. You see, some veedubs use a combination of 8 amp and 16 amp fuses. Others use just a single value. If yours uses just a single value for all circuits there's no problem. But if you have a '67 bug, the two headlight fuses are 16 amp, the others eight. So you install two LEDs on those particular fuses. Make one yellow if you wish, or install the second LED above the top prong. Or install them ALL above the top prong and put the extras by the bottom prong. The LED circuit couldn't get much simpler, and the principle remains the same for one or two LEDs.

Blow a fuse on a dark & stormy night? No problem, just look for the glowing LED. (Ummm red/yellow on the end; better use a 16 amp fuse...) And drive on!

Sermonette

Too long already. Just be kind to your Bug. Or bus. Kids, too. And stop kicking the dog, we all have accidents now and then.

Blue Coils

Can this unit safely be used with a Bosch blue coil? The instuctions state that optimum performance is achieved by using a stock ignition coil. The use of high ratio coils is actually suppose to hurt performance of the module. Since this is a universal CDI module, is the blue coil really considered "high voltage" compared to most coils or is it merely a step up from the old stock coil?

The superiority of Blue Coils vs Black Coils is another example of VW Folk Myth.

Ignition coils having a higher output typically have a higher INPUT as well. But the stock VW coil is already using as much current as the points can handle and still deliver a reasonable service-life. If you were to install a coil that demanded more current you would have to install points having more contact area. But the blue coils do not come with 'blue-coil points'. And the stock points last just as long with a blue coil as with a black coil.

There's no such thing as a free lunch, especially so with the laws of phyics. If the input current of an ignition coil remains unchanged, changing the turns-ratio to produce a higher voltage in the secondary means that higher voltage will contain less energy — it won't be as 'hot'.

In fact, the resistance of the windings of both the blue and the black coils is the same, meaning they will use the same amount of current and produce the same spark voltage and energy. So what's different? (Besides the price :-) And if the blue coils are so much better, why didn't Volkswagen use them as stock items?

The blue coils apparently use a different insolation — Inovar (sp?) and polypropylene — than the black coils, which use varnish and tar. The different insulation is supposed to allow the coil to run cooler. When a coil heats up, its resistance increases. Higher resistance means lower induced voltage in the secondary winding. If the coil can run cooler its peak induced voltage will be higher.

The CDI module from Universal will work fine with a blue coil. It will work equally well with a black one, and do so up to at least 6,500 rpm.

As to whether you NEED a blue coil... probably not. I've tried them, in both 6 and 12 volt, and couldn't detect any change in performance. So long as good, used BLACK coils remain available from most junkies for a buck apiece it's pretty hard to justify paying a premium price for a coat of blue paint.

I am vitally concerned with the performance of my engines. If I can prove something enhances performance by even a fraction of a percent, I'll use it, because in the life of an engine, that fraction of a percent can mean thousands of 'free' miles.

Every time I post something that runs counter to the Conventional Wisdom as espoused by the VW-specific magazines, I get a lot of messages pointing out the Error of My Ways. Perhaps you're right. I know I am often wrong. But my conclusions, right or wrong, are based on direct personal experience, not something I read in a magazine.

If you like blue better than black, then by all means use a blue coil. Or a red one for that matter. And if you have some marvelous tale of miraculous improvement in your engine's performance after installing a blue coil, I'm sure you're right. I'm equally sure your old coil was probably suffering from shorted windings or corrosion or what-have-have... and that a new BLACK coil would have produced exactly the same results.

Distributor Clearance

Is the distributor clamp supposed to be flush with the engine case? Whenli but the bolt that holds the clamp the case the clamp is about 1/16" off of the case.

The exact depth of the distributor's placement depends on end–play in both the distributor and its driver–gear, which alters according to wear, type of distributor and type of crankcase.

Insure the small compression spring is present in the top of the driver–gear then test the engagement of the distributor by installing it without the clamp to see how far into the case it will seat. With hand–pressure on the distributor shaft to remove any axial play, first determine the zero–axial play location then subtract the clamp thickness plus .020" — the maximum allowed end– or axial–play.

If the clamp will not allow the distributor to be installed within this range (ie, max. .020" tolerance), adjust the clamp (ie, bend it and/or open up the bolt–hole for the crankcase stud).

Engagement of the dog–gear and end–play of the driver–gear are important for smooth running at low speeds. At higher speeds the effects of wear, excessive end–play or even poor assembly are often masked by inertial effects. A poor idle and 'jumpy' timing are among the symptoms of a worn or improperly fitted distributor.

If the distributor sits too high, the ears on the dog–gear will wear at an accelerated rate while too much end–play will produce erratic timing. End play of the driver–gear is adjusted through the shims placed under the driver–gear. End–play in the distributor is adjusted in a similar fashion using two sets of shims plus a fiber washer that acts as an oil seal. Dismantling the distributor will reveal their location. Proper end–play within the distributor is assumed in the tests above (ie, fix it first if end–play is excessive). If the distributor is installed too low — with zero axial play in the gear train, both the driver–gear and the distributor shaft will wear at an accelerated rate due to poor lubrication. Zero–lash installations are common on dragsters but have no place on daily drivers.

This type of fitting–up and end–play adjustment is a normal part of pre–assembly inspection when building an engine. When replacing the original distributor the tests above allow you to arrive at the proper engagement depth and test for excessive end–play in the distributor's gear train.

End Play & Timing

I need to do a rear seal and set the end play...You have already taught me about this in your sermons and I have the right tools...all of 'em...clock, seal installation tool (my neighbor bought it from Berg). Is the end play setting just a band-aid? If this needs to be set, is my engine already senile and this is just life support? The reason I ask is that my timing jumps around about 5 degrees at 3000 RPM (.009 distributor). Will an endplay correction help this?

Boy did I blow this one. Nowhere in my articles have I mentioned the point you've just made.

Firstly, No — adjusting end-play is not a band-aid, it is a vital periodic maintenance item. You need to re-set end-play each time you replace your clutch-disk. Eventually the thrust face of #1 main bearing will accumulate so much wear you'll have to replace the bearings but by then the engine is usually ready for an overhaul.

The point I failed to mention in my 'sermons' with regard to end-play is that excessive end-play will cause your timing to 'hunt' by as much as ten degrees(!) This is because the timing gear on the Volkswagen crankshaft, a steeply inclined bevel gear (the narrrow bronze gear) that engages the distributor's driver-gear at a 1:2 ratio, is positioned so that any fore & aft motion of the crankshaft will be transmitted to the distributor's driver-gear. Even a small amount of end-play can cause the driver-gear to lag or lead the actual rotation of the crankshaft by a few degress. This is multiplied by the fact the driver-gear is driven at one-half engine speed. That is, it has 12 teeth, the timing gear on the crankshaft has only six. As seen from the distributor's driver-gear, end-play appears to be rotary motion of the crank, in that the end-play causes the driver-gear to rotate.

I have seen engines with end-play as much as .120", pretty far removed from the .008" maximum allowed (!) All of these engines included erratic timing among their other symptoms.

The engagement of the timing gear with the distributor's driver-gear is such that, within the range of normal specs, the small amount of allowed end-play will not effect the engine's timing. Indeed, as wear accumulates, these factors tend to balance each other out. But when end-play becomes excessive it begins to effect the engine's timing. The wiser course is to keep the end-play within spec, use a new timing gear at each overhaul and so forth.

Finding Firing Point

Hiya, Kris!

Nice to hear from you. And good news about the job.

Top Dead Center occurs twice per engine revolution in a 4 cyl, 4 cycle engine. If you align the TDC notch on the pulley with the centerline of the crankcase, you are at TDC… for ‘a’ cylinder, the trick is to know which one. That’s where the distributor comes in handy. Checking the distributor should tell you which electrode is within the firing arc of the rotor. Using #1, and putting a notch on the distributor body is fine, if the distributor and the driver–gear have been properly installed.

Without reference to the distributor, you watch the SEQUENCE of the valves as you rotate the engine in the running direction. When the exhaust closes, then the intake closes, then the mark comes up on the centerline, you are at TDC for that particular cylinder.

Do not trust the looseness of the rockers to be a good guide for TDC, use the centerline of the crankcase.

If doing a tune up, pulling all of the plugs permits the engine to turn over very easily. You can pop the right valve cover, get your head right down near the ground while your hand is on the fan belt, and watch the valves as you rotate the engine. When you see the I–then–E sequence of valve actuation, bring the mark to the centerline then dive under and do the valves for #1. Then rotate the engine BACKWARDS 180 degrees and do the valves for #2. This saves you all that crawling around. Put the valve cover back on and you’re done on that side. Rotating the engine BACKWARDS another 180 brings #3 to TDC so crawl under, pop the cover and do #3. Another BACKWARDS 180 and #4 is at TDC. Do the deadly deed, put the valve cover back on and you are all done under the vehicle. Should take no more than a few minutes.

Back topside, rotate the engine BACKWARDS another 180 degrees and you are back at #1. You can pull the distributor now and install the new points, making sure the gap is perfect. Leave the clamp attached to the distributor; loosen the nut that holds the clamp to the crankcase and pull out the distributor and clamp as a unit.

With new points installed and properly gapped, plug the distributor back in, reinstall the washer & nut securing the hold–down clamp and clip your static timing light to the points–lead, the other end to the alternator B+ or some other source of 12v. I like to leave the key off when I’ve got my head around the fan belt. All that long, silky blond Surfer God hair, you know.

Now you can loosen the clamping nut.

Rotate the engine to align the timing mark with the crankcase centerline. Now grasp the distributor and rotate it a little, back and forth, hunting for the precise point when the lamp first comes on. Tighten the clamping nut. Put away the static timing light and connect the points–lead to the negative terminal on the coil.

Now you can put in your new, properly gapped sparkplugs. Verify their leads as you connect them and inspect their air seals, replacing any that have hardened.

The engine will now run and should idle, if the carb is properly adjusted. To verify your timing, connect a stroboscopic timing light to the #1 spark plug lead and examine the timing dynamically. If it needs a bit of tweaking, loosen the clamping nut and GENTLY rotate the distributor. Also look for any jitter in the timing, which could indicate a worn distributor shaft or gear train.

I've written this out in detail for the purpose of contrasting it with what follows. Because of the rapid rate of wear between the stock valve adjusting screw and the valve stems, your valve adjustment is nothing more than a compromise. You must adjust your valves frequently to keep your engine's performance near the peak of its curve, and that means as often as every thousand or fifteen hundred miles. I know, the manual sez 3,000 is fine. Unfortunately, that number is also a compromise.

If you have installed swivel–foot rockers you need adjust your valves only half so often, since the larger contact area of the swivel–foot wears at a much slower rate than does the stock rocker. And swivel–feet are easier to adjust, too.

If you have installed plantinum–electrode sparkplugs they will last up to four times longer than conventional plugs, saving you both time and money.

If you have installed a CDI module, your points will last longer than the rubbing block — up to 50,000 miles. You will have to adjust them once or twice during that period but they need not be replaced until the rubbing block is toast.

And of course, had you installed hydraulic lifters at overhaul time you would never need adjust your valves again.

Finding TDC

Top Dead Center is when a piston is at maximum height in the cylinder AND both valves are closed. This last does not apply to all engines but DOES apply to air-cooled VW's. On Volkswagens, Top Dead Center (TDC) of #1 cylinder is used for timing purposes. The fan pulley is USUALLY marked with a notch at TDC but this rule has been violated by some of VW's industrial- and special purpose engines. Since the fan pulley from one engine will fit on another, you may run into 'alien' fan-pulleys from time to time.

When you have an alien pulley, one having no notches or such an array of notches that it's impossible to determine which indicated Top Dead Center, use the following procedure.

1. Remove all of your spark plugs.

2. Remove the valve cover from cylinders #1 & #2.

3. With the transmission in neutral, poke your finger into the #1 spark plug hole while you crank the engine over using a 21mm wrench on the alt/gen pulley nut. When both valves are closed you will feel a rush of air past your finger as the piston approaches TDC.

4. Insert a long wire into the spark plug hole. Check the pulley to see if you are near an identifiable mark. Keep an eye on it as you crank the engine BACK AND FORTH. Hold the wire loosely with your fingers, allowing the piston to push it out of the hole. If the piston is descending, crank the opposite direction.

You are searching for the point of reversal, that moment when the piston stops advancing. When you have identified that point make a discrete mark on your fan pulley. Now search for the point where the piston starts descending. Perform the back & forth cranking several times to insure you have found the correct moment and make another discrete mark on the fan pulley.

TDC is mid-way between the two lines you've just made.

To verify that you are at TDC, check your valve lash. Both valves should be loose, or about .006.

Your distributor should be pointing toward the vicinity of #1 plug contact.

Use all of this information to identify and confirm Top Dead Center.

When you are sure you've identified TDC, mark your pulley in an unambiguous manner. To set your static timing, measure 3/8" along the rim of the pulley in a clockwise direction and make another distinct mark. Time you engine to this mark, rotating the distributor as needed but not more than one eighth turn. If more rotation is needed your distributor driver-gear is probably installed incorrectly. You will need a driver gear puller to remove it. Rotate it one full tooth and reinstall.

This form of static timing will allow your engine to start and idle but you MUST use a dynamic timing light to fine tune the adjustment. See my several posts on timing and timing lights. Volkswagen abandoned the use of static-only timing in 1962. Pay no attention to the rantings of St. Muir in this regard, VW is not out to 'trick' you into paying higher tune-up costs, you really do need to use a stroboscopic timing light.

Improperly assembled engines often have the distributor driver-gear installed one or more teeth out of position. This can be corrected by pulling out the gear (actually, it's a short shaft with the gear machined onto the bottom) and reinstalling it correctly. Be careful not to drop the thrust washers that should be on the bottom of the gear shaft.

Proper alignment of the distributor driver gear as well as establishing proper end-play on the driver gear are two of the basic steps in engine assembly and are usually accomplished when the crankshaft is fitted to the crankcase. Non-professional mechanics often overlook these steps but they are vital. Improper endplay results in unstable ignition timing, while improper driver-gear orientation can lead to heating problems on #3.

If you have a fan-pulley with confused markings you may wish to consider replacing it with a full-size (not a 'power-pulley' after-market pulley having clearer timing marks. If you use a low-cost 'degree-wheel' type pulley you'll find the marks are simply painted on. To etch them in place, soak that edge of the degree wheel in vinegar for about two hours. Neutralize with baking soda then give the etched aluminum a spary-coat of clear lacquer.

Finding Firing Point

In a recent message Jonny Miner discovered he had an alien pulley on his engine and asked how to find TDC. Once he knew that, he needed to know how to locate the recommended timing point for his engine, which was 7.5 degrees before Top Dead Center.

Using this system, once I find TDC, how do I know where 7.5BTDC is?

You can figure it out. The stock VW steel pulley has an outer diameter of 6.995" — 7" for the arithimetically challenged :-)

Circumference is 2 x pi x the radius or pi x the diameter, which is 21.975".

There are 360 degrees in a circle and in this case the circle is 21.975" around so we just divide 360 into 21.975 and we'll get about .06104" inches per degree. Multiply that by seven and a half and you've got .4578". Round that to .46" or about 29/64ths of an inch.

Lay that out on a piece of paper or something else you can bend to follow the contour of the fan pulley and score a mark on the pulley at the 7.5 degree point, which will be to the right of the TDC mark when you are facing the pulley..

Easy as pi :-)

-Bob

PS — Another way to skin this particular cat is to take a protractor and some cartridge paper and lay out a degree wheel the same diameter as your pulley. Position the paper degree wheel atop your pulley aligned with TDC and transfer any mark you think you may need onto the pulley. For example, total advance at engine speeds above 2,000 rpm should never exceed 32 degrees, so you might want to put a red dot at that point and perhaps a yellow dot at 28 degrees, a safer number for normal running.

For adjusting your valves it's handy to know Bottom Dead Center, that is, 180 degrees from TDC for #1 cylinder. The degree wheel will let you locate this number with confidence.

Don't try holding the paper degree wheel against the pulley, it will only slip and you'll put the mark in the wrong place. Glue it to the pulley. Seriously. Cut out the center of the degree wheel so it will fit over the pulley nut then dob some rubber cement on the pulley, let it get tacky and press the paper degree wheel onto the pulley, being careful to keep it aligned with TDC.

We used to do this all the time when dialing in an after-market cam, back before aluminum degree-wheels were commonly available. It's old fashioned but it works, and once you know how to do it you'll never be without a degree wheel again since you can make one up with just a few minutes work. — rsh

Fuses

Every Volkswagen bug or bus has a few fuses. Fuses are the original 'solid state' device. They were invented by somebody, who thought of them about ten seconds after the first electric motor melted down. Fuses are the weak link in the electrical chain; draw too much current and the link breaks (actually, it melts; same difference).

If you have an elderly Volkswagen you've got eight fuses; 1966, they hid another in the engine compartment. If your ride is middle–aged you've got ten of the things on the fuse panel, plus a couple hidden out here and there. The youngest Volkswagens have an even dozen fuses, plus a few more, the stragglers always placed in the last place you look for them. (That's Hoover's Law for Finding Lost Stuff: It's always in the last place I look.)

The Volkswagen fuse is a foreign–looking thing; a ceramic body with a bit of fuse–metal strapped across it, right out there in the open. Americans prefer Buss fuses; when they blow, they do so inside a sealed glass tube. A fuse becomes incandescent just before it blows. (Why do you think we say they 'blow'? A big cartridge–type fuse can go off like a hand grenade.) If you have an unshielded fuse in an explosive atmosphere, the fuse will set off the bomb. (Why do you think we call them 'fuses'?) Buss fuses are better; they don't blow things up. Or set them on fire.

If you're still using the Seimens–type fuse, shame on you. Ditty bop down to the auto–parts shop and buy yourself some Buss fuses. Look for type GBC–8 and GPC–16, the numbers reflect the amperage rating. And if the guy behind the counter sez there's no such thing, take your business elsewhere; he just told you what he thinks of Volkswagens.

The GBC–style Buss fuse is pointed on the ends, like the Seimens (or Bosch) fuse; it will fit in your Volkswagen. Buy some extras; keep them in the door pocket. Even so, when you need one of the buggers it will be in the last place you look. (I wonder how they do that?)

Generator Stands

Just as a thought, would a 12v generator fit our 6 volt stand? That way things would look kind of original. I really would like to switch the Webasto heater to the ’65, and install a solar panel too, so it isn’t just the tunes!

That’s a neat point because there is a 6v generator that is the same diameter as the later-model 12-volt units. Go out and measure the diameter of your generator. If it is about 3.5" diameter, forget it — you need the later-model tower, which accepts a generator about 4" in diameter. There was a ‘fat’ 6v generator — a high-output unit — available as an option. When 12v generators became standard in ’67 we all went crazy scouring the junkyards for ‘fat-towers’.

Alternator towers have a saddle that accepts the 4" diameter generator but the larger diameter of the stator coils — that fat section on the pulley-end — demands the saddle be narrower fore&aft, the casting have a slight step-back to accomodate the stator coil area. This is rather amusing since the remainder of the ‘alternator’ is empty, needed only to support the shaft... which drives the blower.

An interesting point here is that a 12v generator can be installed on an alternator tower but the opposite is not true.

A good arguement can be made for switching to a 12v alternator rather than a generator because the generator is no longer being manufactured and no one truly rebuilds the things. What they do is turn down the armature and — hopefully — send it out with new bears and brushes. In a real re-build the armarture is actually re-manufactured and the diameter of the commutator returned to spec. No one does this because it costs more than a complete alternator kit.

However, if you have a couple of good 12v generators and don’t need the low-speed output an alternator can provide, sticking with a generator may be a good idea.

You are but one of several people presently considering converting to 12v so I’m going to make this a public post.

-Bob

PS — Some VW industrial engines had neither starter nor generator, being started with a crank and using a magneto for ignition. They continued to use the skinny 6v-type tower, mounting what was basically an empty generator housing, serving only as the bearing-carrier for the blower-shaft. Nor did such engines have heat exchangers, coils, anti-dieseling solenoids or automatic chokes. The Volkswagen Industrial Engine Division (USA) used to have an office in Chicago. I don't think they were part of Volkswagen of America. They offered their own line of manuals which as you might guess were dovoted entirely to the engine.

VW industrial engines were used in farm machinery and to power pumps, generators, blowers and so forth. You could get them set-up for gasoline, kerosene and a variety of gaseous fuels (LNG, propane, etc). — rsh

High Output Coil

Please, puh-lease enlighten me.

You'd be wise to stick with the Bosch coil.

'High-output' is a relative term. The Bosch coil provides about 38,500 volts at idle, dropping to about 20,000 volts at 4,500 rpm. (The output of the coil is a function of the magnetic field it can build during the time the points are closed.) This is more than enough for most conditions. If you wish to maintain the high voltage output at higher rpms you should consider installation of an after-market Capacitance Discharge Ignition (CDI) module. Because the CDI unit uses 400 volts to charge the coil, the magnetic field — and thus the high-voltage induced by the collapse of the field — will remain about the same from idle to over 6,000 rpm.

So-called 'High-output' coils are typically 'high-input' coils as well, drawing more current than the stock Bosch coil. You may end up with a higher output voltage at idle but coil efficiency, which appears as heating due to hysterisis losses during the build-up and collapse of the magnetic field, usually dictates the level of the sustained high-speed output, which in the case of after-market coils tends to be LESS than the Bosch coil, which is extremely well made and very efficient.

All of the current drawn by your coil must pass thru the points. If your 'high-output' coil draws more than the Bosch coil your points will not last as long.

Coils are not 100% efficient. The difference between the input and output energy will appear in the form of heat and must be dissipated by the coil. A flat black coil is ten times more effective at getting rid of waste heat than one of those chrome plated jobbies you see on the kiddie cars.

Jittery Distributor

Where exactly is the driver-gear and how would I go about checking it. More importantly, what should I be looking for and what variations in the endplay mean what in terms of something good/bad.

You need either the Haynes or Bentley manual, or — specific to engines only — Tom Wilson's excellent "How to Overhaul Volkswagen Air-cooled Engines".

Blow-up illustrations will show the distributor-driver gear, a short shaft with an intergal gear machined near its lower end that engages a spiral gear installed on the crankshaft and thus picks up its rotary motion, and serves to drive the distributor by transmitting that rotary motion to the distributor via the groove on top of the driver-gear that engages the dog-gear on the end of the distributor's shaft.

When any shaft rotates in bearings it will display two types of clearance — radially in the bearings in which the shaft rotates, and axially along the axis of the rotating shaft. There must be a degree of freedom in each of these axies for the thing to do its job but too much play — too much clearance — is as bad as too little — there is a range of allowable clearance or end-play. When the shaft operates within that range it is said to be within the normal operating specifications or within 'spec'. Outside of that range, something must be done to return it to spec.

Your distributor was designed with a rather loose axial/end-play tolerance. Anything from .002" to .020" is within spec although something on the order of .010" is about as much as you really want. To measure the end play directly you need a micrometer or caliper but it may also be measured indirectly using some sort of fixture and a series of feeler gauges. The fixture can nothing more complicated than a pair of blocks set up on a flat surface. Push the distributor shaft to the maximum of its play or extension and mark that point with a block, the other block stopping motion of the body of the distributor. Pushing the shaft in the opposite direction and measuring the resulting gap between the shaft and the block will reveal the amount of end-play.

But what I meant in my message was to simply pop off the distributor cap and pull up & down on the distributor shaft. If the motion is appreciable you probably have an end-play problem and should rebuild the distributor. That means driving off the dog gear, dismantling the thing, cleaning it and reassembling it with a combination of shims and spacers so as to return the end-play to spec. The manual shows the orientation of the parts and where the shims are to to. Junked distributors are one source of replacement shims

— the kit of spares once sold by Bosch is no longer available from VW dealers. A bit of ingenuity will reveal other sources of repair parts since the shims are fairly common items.

End-play of the driver-gear is measured in a similar fashion. However, a distributor — with ITS end-play within spec — is used to hold the driver-gear in position when measuring the amount of end-play. Two or more shims are installed under the driver gear to adjust the end-play, the spec of which is in your manual — I think it's .016" (or its metric equivalent). But for a quick field-test you simply reach down into the distributor-shaft bore with a flat bladed screwdriver and test the driver-gear for rotary motion. When the end-play is proper there is virtually no slack (or lash) between the driver-gear and the spiral gear. If radial play (ie, lash) feels sloppy the most likely cause is improper end-play. This can be adjusted on a trial and error basis WITHOUT dismantling the engine by removing the driver gear (you'll need a special puller), miking the existing shims (which are removed with a magnet) and making up a shim-stack of greater thickness, going through several iterations until the lash feels about right. (I know — I'm sorry, things like just slip out — I've been working on these things for more than forty years. '..about right'' means tighter than it was before. The need to have the distributor installed when making this measurement — which is normally done during engine assembly — makes it impossible to provide more precise data.)

In the top of the driver gear there should be a compression-type coil spring. It's purpose is to maintain positive pressure on the distributor's shaft during all degrees of rotation — there are pressure lobes and cycles as things spin around due to the nature of the engine — so as to insure an adequate oil seal. Without the spring the shafting will have an excessive amount of axial play resulting in accelerated wear to the shims. If the spring is missing, replacing it may result in a dramatic improvement in your engines performance but the chances are, if it has been missing for any length of time, your shims have become seriously worn and you should consider the repair procedures I've outlined above.

Old Batteries

A point often overlooked when installing an auxiliary battery is that an old battery, incapable of providing the surge of current needed to power the starter-motor is often perfectly capable of providing many years of service at a lower rate of discharge.

The reason for this has to do with the nature of lead-acid batteries in that the amount of current available per unit of time is a function of plate-area. Batteries designed to START something are often capable of delivering up to three hundred amperes of current... for a few seconds, whereas batteries intended to RUN something often provide eight or ten amperes of current for up to thirty hours. The difference between them is the size and number of their plates.

As a car battery ages its effective plate-surface-area becomes smaller due to sulfation and spalling. When the plate area becomes too small to provide the burst of amperage needed to start the engine, the battery is replaced. But the thing will still run your lights, water pump and so forth.

Why bother to mention this? Because you can often pick up such batteries for three to five dollars — their salvage value — from a local junkyard. Indeed, when you consider that every vehicle to arrive at a junkyard usually does so with a battery on-board, and that in the case of newer vehicles junked for collision damage, if the battery was not damaged or tipped over in the collision, junkyards make a very practical source for both primary and auxiliary batteries.

Plug Wires

I was wondering if anyone has any recommendations about where to get high quality plug wires. What do I look for to determine high quality?

The standard insualtion factor for plug leads is 600 volts per mil of insulation, a spec easily met by all spark-plug wiring sets when they are new. But only silicon-based insulating material stannds up to the high temperatures and voltages over prolonged periods of time, which is why all modern carmakers use silicon spark plug wires.

To Volkswagen owners the spark-plug air-seal is far more important than the particular type of wire.

I use the El Cheepo silicon plug-wire sets available from J.C.Whitney. The ones especially made for Volkswagens come with the Corvair-style air-seal, a thousand times better than the things VW used. The wires use graphite conductors and may be shortened (at the distributor-end) by carefully prying off the connector, stripping back the insulation, folding the conductor over to contact the connector, and re-attaching the thing. Examine the factory-end before removing it to see what I mean.

Although these wires cost only about ten dollars per set they have provided excellent long-term service. Even with the higher spark voltage from the CDI modules and even when left out in the weather, as on my Baja, in more than ten years of use the only problems I've experienced had to do with aging/cracking of the air-seal, which is easily replaced.

The Corvair-type air-seals do best on single-port engines. On dual-ports the angle of the spark-plug access holes in the cylinder-head tin-ware makes it difficult to install the air-seal properly. My solution was to cut off a bit of the insulating sleeve that fits over the spark plug. The sleeve has a molded shoulder that fits the air-seal. By shortening the sleeve it allows the molded shoulder to be pushed a bit farther onto the spark plug, after which the air-seal can be pushed a bit deeper into the opening.

In the vehicle it is difficult to properly install the air-seal on #3 & #1 on DP engines due to the location of the manifold but you'll find they go in quickly enough if you use a little green soap or rubber lubricant.

If you will install platinum-tipped spark plugs (about two bucks each in my area) you'll probably have no need to remove the things for several years, making the difficulties of installing the superior air-seals a minor point.

Given the importance of insuring adequate air-flow in the vicinity of the exhaust valves and the very poor performance of the stock air-seals, I consider the use of the Corvair-type air-seal a necessity. When modified, this air-seal also works on Type IV's. (You need to enlarge the center hole to accomodate the insulator on two of the leads.)

When Ford of Germany introduced the swivel-foot valve-adjuster they were immediately adopted by ever serious VW owner. The same was true for Corvair air-seals — we'd buy two sets (Beldan ?) and end up with three sets :-)

I thought everyone used this type of air-seal. The stock thingee not only doesn't work very well, it doesn't last very long. I think I'll make this a public post. Bad spark plug air-seals are a major cause of overheating.

If you have a constant load that draws high amperage, such as half a dozen 100 watt halogen headlamps or a 12vdc ‘fridge that can freeze a case of Tecate before you get out of town, then you should be very kind to your alternator, for it is frying.

A generator is only about 50% efficient at converting rotary motion into electrical energy. Alternators are more efficient, which is why they run cooler, but they still generate a lot of waste heat.

The maximum output of an alternator or generator is always touted loudly in the ads. But the DUTY CYCLE is seldom mentioned at all. If you’re one of those picky types who reads the fine print, you’ll discover that the loudly touted maximum rating is often only good for one minute out of ten (10% duty cycle), and then only for some ridiculously low temperature, such as 59 degrees Fahrenheit. So you run your finger down the column to see what output you can count on for 100% of the time and.... ummm ’10A’. 60 Amp alternator that’s only good for 10 amps? Can that be right? Yup. Except, this is just a fer-instance; check your own alternator’s specs. Or, as a rule of thumb, use one-fifth the maximum output as a safe continuous-output level, that is, 12 amps in the hypothetical case here. And down in the ultra-fine print below the fine print there’s usually a ‘correction factor’ for temperatures higher than 59 degrees Fahrenheit.

So you work it all out and discover that on a hot night in Baja you have exactly enough juice to run one tail-light and a cheap CB radio set on Receive-Only. No headlights. But they’ve thoughtfully included a white cane with your alternator kit. Alas, white canes are not too handy when you’re bounding through the boonies at a rate of knots.

So what happens when you turn on your six Flamethowers? Eventually, they’ll live up to their name.

What to do? Carrying a spare alternator is a good bet. Something off a Ford or GMC truck. The bigger the better. Make a bracket so you can run a second belt off your pulley, leave the original alternator in place to drive the blower. Drive on!

So why aren’t we eating alternators left and right? The truth is, we are. The Mean Time Between Failure (MBTF) for a new Bosch alternator is something like 5,000 hours. In theory, you wouldn’t wear the thing out until you’d driven a quarter million miles. But exceed the spec — let it run a little hot — and it’s life is shortened. Exceed the spec by a whole bunch and it’s life is measured in tens of hours instead of thousands.

The other reason why your alternator holds up is the simple fact that nights are cool. Drop the ambient temp to forty Fahrenheit and your alternator can pump out twice the normal continuous rating. Drop the mercury down to freezing and you can probably run an arc welder off your alternator without causing a bit of trouble. Heat kills. So does air-conditioning.

Air conditioning places a heavy electrical demand on your alternator when the outside air temp is at its hottest. On an American cars equipped with factory-installed air-conditioning, part of the package is to replace the stock alternator with one having a higher rating. Work the numbers out for yourself. You'll see that, at least according to the specs, the stock alternator should do just fine... except it will be running close to max in order to do so. It is the fine print, the stuff the dealers don't like you to read, that sez yer crazy unless you install a humungous alternator along with your gas-guzzling air-conditioning system.

Is there no hope for the innocent? No. Well... maybe. You can reduce your air-conditioning load by about half if you — or someone — would only insulate your vehicle better. (I've got a post on that. Somewhere.) But factories don't do it because the insulation would have to go in as part of the basic body assembly, long before the chassis got far enough down the assembly line to know if it was going to be blessed with air-conditioning. So they sell you an uninsulated tin can, then hang a huge air-conditioner on it. The other way is to sell you a well insulated tin can with an itty-bitty air-conditoner that would keep you just as cool. Of course, that would call for a bit of pre-planning, which in Detroit means where to go for lunch.

My own favorite Wild Idea #237 is to install a one-cylinder auxiliary power unit — a little Honda 6cid engine with an automatic electric starter and all the trick sh... stuff. Use it to run a refrigeration system. A REAL refrigeration system. A chest-type reefer (the ones with doors are a lame idea inside a hot bus) AND an air-conditioning system. Boats do it. Custom RVs do it. Why can't we do it? Another principle seen in other vehicles is to power ALL accessories with 110vac (or 440vac in aircraft) and to use your auxiliary power unit (APU in airplane-speak) to generate the required power. When you land, dock or park, you plug into shore power and everything continues to work. Some of the sceani-cruizer-size Luxury Tub RVs are designed this way, picking a page out of executive aircraft manuals. But the concept appears alien to the typical VW van owner. I don't know why; most of the components to assemble and install such a system are available as of-the-shelf items. All it takes is money.

The trend in automotive designs is toward greater complexity. The downside is that unless the owner is a rocket scientist about all they can do is steer the thing and pay the bills. Big bills, too. Adding additional electrical loads to the existing automotive electrical system not only increases its complexity, it can shorten the life of the alternator or generator. The same holds true when we task our engine with powering both the vehicle and a refrigeration system. The truth of this is self-evident just by opening the hood of any modern car; Tarzan himself couldn't survive in that python's nest of hoses, let alone the typical mechanic. Nowadays, keeping your car alive and well is liable to require the services of a whole squad of specialists.

Our older vehicles have survived — and will continue to roll — primarily because of their simplicity. Each time we ask more of them, we take a step away from that broad and simple path. Read the fine print. It's a jungle out there, folks.

-Bob

ps — You'll notice I've made no mention of propane-powered absorbtion-type refrigeration units, just as Volkswagen (and others) have been careful not to make any mention of absorbtion-type units that use waste heat from the exhaust system. (Cheap, efficient and effective... so long as the engine is running.)

Tri-powered absorbtion-type refrigeration units exchange efficiency for convenience. If you want your typical VW reefer to work like a champ, dismantle it, convert it to a chest instead of a closet, and insulate the hell out of it INCLUDING THE DOOR. Providing better airflow over the condenser coil — using evaporative techniques if needed — can turn the typical camper 'fridge into freezer chest.

Reality of Distributors

Then, this past winter, I stopped at a VW shop in Yuma, AZ and the guy told me that what I'm really after is proper timing at running speeds, so I should just check for total advance (32 deg?) at 3,500 RPM with a strobe light. This sounds brilliant tome - however your dist. advance system is working, you'll always have the proper advance at driving speeds right? I haven't been able to confirm that this is a good idea with anyone else though (Actually I've only asked half a dozen folks and they had never heard of the method). Care to give me - or the list your thoughts?

The procedure you describe is in fact the standard procedure. I'm sure you'll find several mentions of it in the archives. I know I took particular pains to describe the 'Never Exceed' timing point in an article on degree wheels. Or perhaps it was just a message posted to the list.

But there are two points in your description that trouble me. One is revving the engine to 3,500 rpm — the fellow in Yuma was giving you a 'one-size fit's all' solution'. You need only rev to a speed at which you know your distributor has cranked in its maximum amount of advance. On most vacuum advance distributors that will occur by the time you reach 3,000 rpm. For mechanical distributors you will be 'full-on' in as little as 1,200 rpm, which is why they are useful on the drag strip but clumsy on the street. The rule here is to determine when your particular distributor is 'full-on' and check the timing at that speed as a final test each time you adjust your timing. Your ear and the position of the throttle-arm will serve to put you in the ball-park, after you've measured your speed once.

The second point is the amount of total advance. 32 to 34 degrees is an average figure and is probably safe to use, assuming a stock cam and a distributor with no more than about 12 degrees total advance and a static-timing point of about eight degrees... but that's for a new, factory-built engine and includes a host of assumptions, such as standard atmosphereic pressure (29.92" Hg) and temperature (59 degrees Fahrenheit) and fuel of a reasonable octane.

Guys who have built their own engines and know what they're doing often push the envelope a little, dialing-in a bit more total advance. But guys like me, who know God loves a good joke, tend to dial in a little less.

(In whatever it was I wrote earlier on this subject I mentioned putting distinctive dots of paint at your Never Exceed and Normal Tune points — easier to see with a strobe in the day-time than the actual degree-reading itself... especially on the stock pulley :-) ...but the article also told how to find those points on a stock pulley using a paste-on degree wheel you could make yourself)

The reason for making this a public post other than to wonder aloud if anyone read my previous post about timing wheels, has to do with the question of distributor's themselves, and an apparent lack of understanding about them among Volkswagen owners.

The World-Car

Here's an interesting problem. You want to build a vehicle you can sell in every country of the world. It must operate reliably on every imaginable grade of gasoline, on every kind of road — pokey, unpaved tracks to high-speed freeways — at temperatures from thirty below to a hundred-twenty above and elevations from below sea level to over 12,000 feet. To keep down production costs you want all of the engines to be identical — same cam, carb, pistons and so on — even though the vehicle weight ranges from 1,300 pounds to 3,500 pounds.

The solution? Plug-in different distributors having advance curves — rate of advance and total advance — to match the local conditions and vehicle weight.

You live in Bolivia. You've never seen a paved road. The elevation is 12,000 feet. The best gasoline locally available has an octane rating of 70. You drive a Volkswagen.

You live in tidewater Virginia. You've never driven on an unpaved road. The elevation is thirty feet and humidity is usually very high. Regular-grade pump-gas is 87 octane. You drive a Volkswagen.

Mechanically, the engines in the examples above are identical, as are their accessories... with one exception. They have different distributors. And they are timed differently. (The bug on the Altoplano might have smaller jets in the carb. Or it might not.)

Neat, eh? Identical engines, assembled in an identical manner, even to the plugging-in of the distributor. The only thing that changes is the particular type of distributor that is plugged-in.

Over the years Volkswagen used more than 125 different Bosch and VW distributors. They all look pretty much the same. Here in America we saw about a dozen different types, each suited for a particular engine in a certain type of vehicle driven in a specific region of the country. They all ran just fine and no one paid much attention to the details — the part-number of the distributors was usually the same except for the terminal character, a letter-suffix the significance of which could be learned by looking up the spec, something you didn't need to bother with because your Volkswagen dealer took care of all that.

Nowadays the best joke in the automotive world is the articles in the VW-specific magazines that insist one distributor — and a pretty bad one at that — and one timing-setting works just fine for any Volkswagen, sedan or bus, on any fuel, in any part of the country from the shores of the Salton Sea in summer to the highlands of Colorado in winter. Hilarious! As are the incantations and machinations of mechanics struggling to get some useful work from their bastardized mish-mash of after-market carbs and distributors.

The Real Answer

If you have a bug or bus with the original distributor and carb, rejoyce, for you can keep the thing running forever simply by maintaining it to the factory specs. But if your vehicle has been 'improved' by the addition of a centrifugal distributor or after-market carb(s) or extractor exhaust or a hot cam or any of the other kewl mods, you are on your own, hanging off the edge of reality. Factory specs no longer apply. And don't look for any help from the magazines or your friends on the internet — what works for one CAN NOT be applied to all.

So What's the Answer?

If you're looking for a quick & easy answer, there isn't one. But if you're looking for a solution, you can work it out.

If you know the advance curve of your distributor it's a simple matter to calculate the maximum timing point for your engine. Just take the distributor's advance in degrees, mulitply it by two to get crankshaft degrees (the distributor runs at half the speed of the engine) and add the result to your static timing point. For example, a stock vacuum advance distributor (-050P) gives ten degrees total advance. That's twenty crankshaft degrees. The static spec for our imaginary engine is 7.5 degrees giving a maximum advance of 27.5.

That's the paper solution. Now crank-in the fuel-factor. Low octane? Retard your timing. High altitude? Advance it. High ambient temperature? Retard it. Heavy-load-hot-day-bad-gas? You figure it out. Plague of toads? Wind from the south? Timing is a COMPROMISE not an abosolute.

But you can’t take the published static timing point for your model-year as carved in stone. When Volkswagen published that spec it was specific to the distributor that came with your engine. If you do not have the stock distributor, you can not rely on the stock spec for static-timing information. So what to do? Start small and work up. Start at zero — at TDC. Check for maximum advance. Adjust your timing until you approach 28 to 30 degrees. Want to go farther? That’s between you and your engine.

And don’t take the published advance-curve of your distributor for granted either, especially not if you read it in some magazine. The advance curve of brand new mechanical advance distributors from Brazil can vary wildly from unit to unit. Have it checked or check it yourself — a strobe-light and a degree wheel, with a conservative static-timing point as the base-line... will tell you what you need to know.

So where did this ’32 to 34' figure come from? From the spec for the stock VW cam, which determines the relationship — the amount of overlap — between the intake and exhaust cycles. The cam defines the soul of an engine and dictates what will and won’t work with regard to timing.

‘Timing’ is the generic term we use to describe when we ignite the fuel/air mixture. The cam defines a range of time when we can light the fire and obtain useful work from the resulting combustion. If we light the fire too early or too late we will degrade the performance of the engine, often catastrophically. The specific timing point we use must be the best possible compromise, keeping ignition well within the allowable envelope. Factors such as temperature, air density or octane rating change the shape of the envelope. If we set a firing point too near the edge of the envelope, when the factors defining the envelope vary we can find oursives beyond the range of safe operation. How this will effect your engine depends on the vector along which you depart the envelope of normal operations. In one direction you get doggy performance, in another, poor mileage. But depart the envelope on the wrong vector and you will get destructive detonation. Seeing an engine explode makes for good entertainment at the dragstrip. It’s a lot less fun when it happens to your daily driver. Thirty-four degrees reflects a near-maximum as the point where you can light the fire at normal speeds for a stock engine.

Factory-timing reflects the best definition of the normal operating envelope, taking into account the widest range of variables. To insure maximum reliability and safe operation, the factory-spec is conservative, the firing-point well-centered in the envelope, away from the edges. If you know what you’re doing you can ‘push the envelop’ a bit, getting a little more performance from a stock engine. If you don’t know what you’re doing... buy a Toyota.

Sermonette

Tell a person they have to sit down and study solar radiation, skin cancer and decontamination procedures before they can hit the beach, they'll stay home. But talk Fun, show them pictures of smiling, naked, greasy people basking in the sun, you got an instant winner. Of course, a few of them will develop fatal melanomas, and a few more will become infected with hepititis from splashing around in raw sewage but that won't happen for a while and mebbe not even then an' in the meantime they might get laid...

Life is strange.

Distributors are less strange than life. They perform a function that is easily understood. But the key factor here — and the message in this sermon — is the process of understanding rather than the distributor itself. Before you can say you understand something you should know it well enough to teach it to another person, well enough to use your knowledge to make critical decisions. A shallow depth of knowledge won't do — it isn't like craming for a test — you need to know your stuff.

If you are the Mechanic-in-Charge of your vehicle — and you should be if you own an antique Volkswagen — if you want a reliable, sweet running machine, you will have to work at it, to acquire a sound grounding in automotive engineering. That should begin with understanding the thermal, physical and mechanical principles on which the engine is based. Having a good grasp of the principles allows you to select the best distributor for your particular engine, or to tune your engine to make the most of the distributor you have. When you understand what's going on in your engine you are armed with the intellectual tools you'll need to recognize — and correct — a host of potentially damaging problems long before they cause trouble. Ski trip? Tweak for altitude, and drive on. Crossing the desert? Tune for high temps, and drive on. Poor quality fuel? Re-time that puppy and drive on.

But if you just want to jump in, turn the key and roar off to the beach so you can get skin cancer and swim in raw sewage and maybe... just maybe... get laid... buy a Toyota. :-)

Red Light On

I have "red light on" problems. I recently replaced the voltage regulator on the 1970 standard beetle. It had been clicking and the red light was coming on. After replacing the regulator, (although I didn't "polarize" the regulator) things went well for a few hundred miles. The red light came on again, and stayed on, didn't change while revving, etc. I went through St Muir's last night, testing with the timing light, etc. and based on the tests it appears the generator went south. I did the quick overhaul of the generator, which consisted of removing the brushes in the generator, and cleaned the commutator with the sandpaper. Upon replacement of brushes and starting the car, the light was off, I figured I'd solved the problem. Five miles down the road, I arrived home, switched it off and the red light stayed on. I restarted the car, revved it and the light went off. Upon trying to restart it again, the battery slowly died.

Does the collective wisdom think that my failing to polarize the regulator upon its replacement has/had an effect causing this problem? My next step is to pull the generator and have it tested at the FLAPS, or some other expensive (re: not do it yourself) solution....

A voltage regulator does not require polarization.

A generator requires polarization because the initial current is produced from the residual magnetism in the cores of the field windings. When a generator is overhauled it's common practice for the field windings to be replaced. (To remove a field winding the coil and its core are burnt by baking them in an oven at high temperatures. The high temperature destroys the special varnish used to insulate the winding and bond it to the core, allowing the copper wire to be recycled. The high temperature also demagnetizes the core, which is why it must be re-magnetized (or 'polarized') upon installation.)

Unfortunately, the typical 'overhauled' VW generator available from your FLAPS has not been completely overhauled in that the field windings have not been replaced. Nowadays an 'overhaul' appears to mean only that the commutator has been turned, the mica undercut and the bearings replaced.

The better FLAPS have provisions for checking your generator — and the ones they sell. It's interesting to note that the ones they pull off the shelves do not need 'motoring' or repolarization before testing, indicating that the field coils were not replaced. Raising such a point with a FLAPS clerk is an exercise in futility; they are clerks, not electricians nor mechanics. But their answers are often very amusing.

A used generator seldom requires re-polarization since some residual magnetism will remain in the core for several years.

Are you sure you've properly diagnosed the problem? A bad connection at some point in your charging circuit would give the symptoms you described. I think it would be wise for your to obtain a copy of the Haynes repair manual for your vehicle (their #159) and read Chapter 5 (Engine Electrical Systems), section 10 (Charging System - Check). The manual is well illustrated and has none of the errors contained in St. Muir.

The method of cleaning the commutator descirbed in St. Muir is an exercise in folly and usually does more harm than good. The commutator may appear to be clean but if the mica insulators are not cut back it's most likely that all you've done is short additional windings, reducing the output of the generator.

While this may sound extreme, replacing your generator and regulator with an alternator having a built-in regulator is often more cost effective than working your way through a series of junkyard generators, or generators that have been improperly overhauled.

The generator and regulator form a set, they wear at about the same rate. If one requires service or replacement it's good evidence the other does as well. If the generator is replaced, the regulator should be replaced at the same time.

The brushes in an alternator give about 8x the service of brushes in a generator and are more easily replaced.

Soldered Connections

Certified aircraft wiring is usually tin or silver (!) coated, not bare copper, except for certain battery and/or GPU circuits.

Aircraft wiring is usually provided with an abrasion shield over the insulator.

The crimping tool for aircraft crimp-on electrical fittings is about 18" long and generates several thousand pounds of pressure at the jaws, insuring a gas-tight joint. The typical pliers-type crimping tool used for automotive work generates a few hundreds pounds of force and does not insure a gas-tight joint. If the joint is not gas-tight, it will eventually corrode, especially if you spend much time flying very near the ground.

If you have access to aircraft quality wiring, fittings and tools you will no doubt have used them when making electrical repairs to your automobiles. But if you do not have these things your automotive electrical repairs will last longer and provide better service if you solder as well as hand-crimp all connections. This assumes you will use non-corrosive resin-cored solder suitable for electrical work and not corrosive solder as used in plumbing.

To provide vibration resistance at the connector, where the solder will indeed result in hardening of the copper conductor and promote early fatigue failure, use at least three layers of heat-shrink tubing, each layer being slightly longer than the other, so as to distribute any flexing stresses.

Aircraft and automotive wiring should be assembled in looms or bundles of wire, fastened in sleeves so the wires may contribute support to each other. All wiring should be fastened to the chassis/structure so as to prevent vibration.

If you perform aerobatics with your Volkswagen you should consider installation of a gel-cell battery, and make some provision for operating the engine in an inverted postion.

Solenoid Sermon Variations

This question keeps coming up, which means I failed to explain it when I did my billy-dew on installing a booster relay for the starter solenoid.

<< all the relays I can find are 3 prong. I would assume that the relay would need 4 prongs in it- an in from the starter, an out to the dash, an in from the dash, and an out back to the starter. >>

The quick answer is that the relay's coil is internally grounded. But sometimes the quick answer is horribly wrong.

WARNING! Read ALL of this article. It describes TWO types of relays (and I don't know which kind you have).

Let's back up to the starting line. The logic in the question stated above is correct — the coil inside the relay is its own electrical circuit, with an input and an output. The controlled circuit — the set of contacts actuated by the relay — are a separate circuit, again with an input and an output. That makes four terminals — two for the coil and two for the contacts.

So how come we only got THREE terminals?

To answer that, let me start with some background information.

You find relays everywhere. The themostat on your living room wall is a form of relay. So too is your door-bell.

In the real world a tiny relay — fed with 5vdc — is used to turn on huge electric motors — fed with polyphase 440vac.

The key point here and the reason for the examples above, is that in the real world the actuating voltage is usually different from the voltage being CONTROLLED by the relay. And in those cases it is vital to keep the coil leads seperate from the leads going to the contacts.

But automotive relays tend to be different for a very simple reason: You have only ONE voltage running around your car's wiring — whatever voltage your battery provides. The 3-terminal relay in question was designed for automotive use, meaning the contacts are going to be handling the same voltage as the coil in the relay... and that means we can use ONE CONTACT for TWO JOBS — the 12vdc going to the relay's coil can be wired — internally (inside the relay's package) from the SAME terminal as the 12vdc going to the hot side of the contacts.

—DON'T USE THIS ONE —

So what happens to the other lead from the relay's coil? That's the one we take to the switch. The switch is then wired to GROUND. When the switch is closed, the relay actuates.

Now — just to set your hair on fire — DO NOT USE this type of relay. Why? Because it means you have a hot lead running around your vehicle — if it grounds at any point and for any reason, it will actuate the relay.

Did that get your attention? Okay, lets go back and look at the relay again. Remember, it works because there is an electromagnet in there. Run juice thru the electromagnet, the contacts snap shut. The juice runs from the battery thru the relay's coil and back to the battery — through the grounding-lead, which often is the chassis of the vehicle.

(Using the chassis as one side of the electrical circuit is another aspect of automotive electrical systems that sets them apart from others.)

— USE THIS ONE —

A second, and more common form of automotive electrical relay is one in which the relay's coil is GROUNDED thru the frame of the relay. The thing will only work if the metal body (or canister) of the relay is electrically grounded to the chassis of the vehicle. This type of relay expects you to feed 12vdc, which should be fused, to the relay's coil via a suitable switch. The contacts have separate leads, electrically isolated from the relay's coil. This is the type of relay you want to use. The lead to the relay is only hot when you turn on the switch. If you get a short in the controlling lead all you'll do is blow the fuse — the relay will not actuate.

Ready for the biggie? Most American cars use the latter principle above, most european cars — including Volkswagens — use the former principle.... that's why the VW horn is such a pain in the ass. (If you're willing to stretch a point or two, horns are another form of 'relay' — they are based on the same electromagnetic principle.)

— SO WHICH IS WHICH? —

So how do you tell one from the other? It's pretty easy. Just hook up the thing using a couple of test leads, with your static timing light as the load. If the light turns on when you ground the relay's lead, you've got the wrong type.

Whatever relay you have, it probably has some markings on it. Be cool. The markings on horn and headlight relays have some wild variations. The most common appear to be ‘S’ for ‘Switch’, ‘B’ for ‘Battery’ and ‘L’ for ‘Load’ — but I’ve seen some the logic of which still has me baffled — ‘X’ for the switch-lead, in one case. And some have only numbers — 1,2,3 — not much help if you don’t know what they mean. But you can figure them out. Go on. Take a stab at it. I’ll be over there by the fire extinguisher :-)

-Bob

PS — Lately I’ve been using those little plastic cube-shaped relays that come with car alarms and the like. Most have four terminals — simply wire one side of the relay’s coil to ground. Their schematic is molded into the plastic housing. They are very nice little relays, with load ratings of 40 amps for intermittant service, 15 amps continuous. Cost about four bucks. Cheep. -rsh

Solenoid Trick

"Solenoid? We don' need no steeking solenoid!" or… St. Muir and the By–Pass Solenoid

This one really gets me hot under the collar, first because it ain't a by–pass–anything, and second because the usual method, using an old Ford starter solenoid a la St. Muir is dumber than hell, partly because it ain't a solenoid at all but a contactor, and finally because you just don't need a starter contactor for this particular job.

The problem is that Volkswagen feeds their starter solenoid 12vdc by way of China. They run the juice all the way up to the front of the vehicle, through the starter switch which isn't all that reliable to begin with, then all the way back to the solenoid — which is where the juice started its journey to begin with.

By the time those 12 volts have marched up front, squeezed through the switch terminals and hiked all the way back to the solenoid about of half of them are dead and the others have blisters. They jump inside the solenoid, put their electronic shoulders to the wheel but find they're played out by the trip. If the solenoid moves at all it does so sluggishly, often not enough to close the contactor terminals that provide juice to the starter motor.

The fix is to keep those 12 volts from wasting their time and energy on that useless hike by putting in a RELAY. That's what that Ford contactor is pretending to be. The joke is, the contactor takes almost as much juice as the VW solenoid! A wiser choice is a headlight or horn relay. Cheap, easy to find and easy to mount. Screw it to the fender well inside the engine compartment to help keep the terminals clean.

What the relay does is tell those 12 volts when to go to work on the solenoid. You wire your relay with the same wire originally used for the VW starter solenoid but you install new, heavier wires — with a shorter run to the battery and solenoid — from your relay. Since a headlight relay only needs an itty–bitty amount of power to pick or transfer, the original wiring provides more than enough energy despite its long run. And since your new, heavier wiring provides a shorter, neater, cleaner, prettier, healthier and politically more correct run between the battery and the VW starter solenoid, it fires right up every time.

I understand Gene Berg started selling Ford contactors because he got tired of trying to explain to St. Muir deciples that St. John didn't know very much about elektrissity. I know a whole bunch about elektrissity and I'm still alive, even though I use a headlight relay to pick my solenoid and a horn relay to turn on my back–up light and an itty–bitty microampere relay out of a short–wave radio to tell my external cooling fan when to turn on, although a Ford contactor would have done the job — sorta — in each and every case and would have, if St. Muir had thought of back–up lights and cooling fans. ("Back–up lights! We don' need no steeeking back–up lights!")

Sermonette

Cold weather brings home the problem of the voltage drop in the long wiring runs common to a Volkswagen bus. If you want reliable starts and brighter headlights you need to know more about heavier gauge main buss wiring and the use of relays. You are the mechanic–in–charge of your vehicle. Sometimes that calls for you to be an electrician as well.

Stock Ignition

Volkswagen Ignition System

This won't pass the '20 words or less' test, but since only one of the responses about the function of the condenser was correct, I think it's justified.

Early VW's used an ignition system based on the Kettering patents from the 1920's, in which the battery voltage was stepped up to several thousand volts through the use of a transformer, the thing we call the coil. But transformers only work when the voltage is changing. (Alternating current 'changes' 120 times a second (ie, 60 cycles) so transformers work just fine.) To use a step–up transformer in a car you'll need something to 'change' the voltage. Just turning it on and off will work, if you can do it fast enough. Henry Ford used a magnetic–reed oscillator, a kind of vibrating switch. Boss Kettering (he ended up with General Motors) had the genius to connect the ignition transformer through a mechanical switch driven by the engine. Opening and closing the switch provided the changing voltage needed to make the transformer work. The switch of course is the ignition points.

How the Coil Works

The reason a transformer works lies in the physical properties of electrical current. When a current flows through a conductor it generates a magnetic field around the conductor. Conversely, when a conductor is moved through a magnetic field, a voltage will be induced in the conductor. A transformer takes advantage of those principles of inductance by winding one coil over the top of another. At low frequencies you can focus or concentrate the magnetic field by winding the coils around an iron core. And since you can't move the coils relative to one another, the changing voltage in the primary winding serves as the 'movement' needed to induce a voltage in the secondary winding. And as you've probably guessed, the voltage in either winding is proportional to the number of coils in the inductor; if there are more turns in the secondary, its induced voltage will be higher than the voltage in the primary. But there's no such thing as a free lunch, the TOTAL energy remains the same. If you pump in 120 watts (that is, ten amps at twelve volts) to develop, say, 30,000 volts in the secondary (about what you need to jump the gap of a spark plug under worst–case conditions) the amperage can't be more than about three–thousandths of an amp (.003). Actually, things never work out that neatly in reality because there are losses in the coil's iron core, etc.

Why The Capacitor is Needed

Those same principles of inductance create a kind of paradox, because when you stop feeding juice to the coil, that is, when the points open and the magnetic field collapses, inducing the 30,000 volt current in the secondary, it also induces a current in the primary as well! It's not very much because there are only a few windings in the primary, but it's enough to jump a small air–gap, such as the one between the just–opening points in the distributor. That tiny spark is enough to erode metal away from the points and if there is any oily vapor inside the distributor, any oil on the points will become carburized; you'll 'burn' the points.

To keep your points from burning as they open and close, you'll need to provide something to absorb that spike of counter– current, something more attractive, electrically speaking, than the air–gap between the points. That's a job for a capacitor. To the counter–current, the capacitor looks like a black hole, an attractive one. The spike of current dives right in. And the points don't burn.

The points have a tough job, switching up to eight amps of current many times per second at highway speed. Indeed, as engine speed increases the efficiency of your ignition system decreases, thanks to heating problems and fundamental electrical laws. This declining efficiency has a serious effect on your spark voltage and results in poor high–speed performance, incomplete combustion and a host of other ills.

But us humans are tricky rascals. To see how tricky, read the message, Electronic Ignition [in the CDI section. —KH].

Timing Light

Engines are dynamic things. A static timing light is a smart way to set the base-line timing but once the engine is running you need a dynamic timing light to dial it in. In a high-time engine, the difference between cold static timing and hot dynamic timing can be as much as five degrees due to accumulated wear and other factors. Getting your timing correct within one or two percent is fine, if you can afford that amount of slop.   But one or two percent on the wrong end of the scale can cost you an engine. On the other end of the scale that one or two percent can reflect a ten percent reduction in fuel economy.

One reason I like CDI modules (and run them on everything I drive) is because the timing stays dead-on for up to ten thousand miles, changing only as the rubbing block and distributor components wear.

Modern ignition systems use a host of sensors and a microprocessor to provide the most correct timing under all conditions. The opposite end of that scale is static (or mechanical) timing, which itself is a hold-over from the age of steam (yes, you need to 'tune-up' a steam engine now and then) and is only suitable for engines designed to run at a single speed.

Observing a degree wheel with a timing light provides an excellent reference to the condition of the mechanicals in your distributor. That small amount of 'hunting' you see usually reflects wear in the distributor shaft bushings. If the thing is really jumping around, it would be wise to find out why.

Volt Meter

If you've only space/cash for one instrument, opt for the voltmeter. If your vehicle is air-cooled and you have a generator warning light, keep it. It is you quickest warning of a fan belt failure.

J. C. Whitney carries gauges of various quality & price for CHT. After-market suppliers who advertise in the VW-specific mags carry others, including VDO. I've found CHT to be of more use in aircraft than cars; on a long climb-out it's handy to be able to 'fly the gauge' since it responds much more quickly than oil temp. Because of the latency of oil it will always lag your cylinder head temp. gauge but in a car things happen more slowly. A bit of experience will tell you when to take your foot out of it.

An oil pressure gauge should be mandatory in all vehicles; it's the engine's basic Health-o-Meter. But keep the idiot light. If you blow a cooler line at highway speed you've got about fifteen seconds to make half a dozen correct decisions; you'll probably notice the light before the needle. (Racers use a light the size of your fist, plus a warning horn. At speed, they've only got about three seconds to do all the right things.)

Forget the idea of using two 6-volt batteries in series. Dodge tried it years ago and abandoned the idea as impractical. The problem is, no two batteries are identical, there will always be a slight current flow between them unless they are physically isolated (knife switch, etc) or you use expensive high-amperage, low-loss diodes. Parallel works fine, although it's best to jack up your alternator output to about 15.6vdc vs the normal 13.8 to overcome the voltage drop in the battery isolator/splitter. (Which you need because of the problem mentioned above.) You'll also find it convenient to wire certain accessories to one batt, keeping the other for engine-starting. A simple battery cut-off switch will allow you to switch from one to the other should you need the accessory battery for starting the engine.

While your alternator may have a rating of 50 amps or more, the number represents peak output. Buried somewhere in the fine print you'll discover a 'duty' rating. For automotive service it's usually around 20%, meaning you'll exceed the alternator's ability to get rid of excess heat if you draw 50 amps for more than about 1 minute in five (they're only about 50% efficient at converting torque into electricity). As a general rule, divide the stated rating by two in order to arrive at a constant output (ie 25 amps 100% of the time from a 50 amp alternator). These numbers are relative to the alternator's useful life; if you normally pull lots of ergs from the thing expect to replace it more often. Improving its cooling will help stave off the inevitable.

With that as prologue, and based on your electrical load, you'll find an 8 gauge wire is large enough to carry the load from front to rear in the typical VW bus; 10 gauge is fine if you're just going from the alternator to the batteries. If you're rewiring, bigger is better but make sure all terminals are soldered as well as crimped.

1776 Confusion

I get lots of mail. A good percentage of it comes from people who own bugs rather than buses. (I own a couple of each.)

Bug people tend to be youngsters. Their messages almost always ask how to make their bug go fast/make noise. Everybody seems to want a 300hp big-bore stroker for their bug.

I don't answer a lot of that mail — there isn't much I can say, the gulf is too wide. But now and then I get a well-reasoned letter from a bug owner who has done their homework and asks the right questions. Such a message lead to a lengthy response on the merits of 1776cc engine.

In the message I said this is a fine engine for a bus but for a sedan the wiser course would be to stick to the stock displacement.

That particular response ended up in the 'Sermon' file and has caused a lot of confusion since I'm clearly cautioning the person against building himself a 1776cc engine, while in similar messages to bus owners I said just the opposite. Apparently, a lot of bus owners failed to note the two included references that (I thought) made it clear I was speaking to the owner of a sedan. So let me say it again.

The 1776cc engine is a good choice for an early bus. It provides an increase in torque at an rpm that makes it especially useful in the Transporter. Properly balanced and assembled, installed with a dog-house oil cooler and — hopefully — a full-flow oil filtration system, you should be able to count on years of reliable service from a 1776cc engine in your bus.

My reasoning here is pretty simple. The lighter weight of the sedan has no special need for additional low-end torque in a daily driver — how fast you can accelerate is usually determined by traffic, not horsepower. On the open road, if you want your bug to go faster than the stock engine and tranny will allow, you're going to have to spin your engine faster, in which case you (bug owners) would do well to stick closer to stock — you can get plenty of upper-end punch out of the stock 1584cc displacement by improving what you have, shaving the flywheel a tad, going to a cam providing a different torque curve and paying attention to balance and cooling. The engine and tranny won't last as long — higher speeds mean higher rates of wear. But kids want to go fast and who am I to argue with Darwin.

But these mods simply don't make sense in a bus. In a bus, you have to deal with greater weight and greater aerodynamic drag than in a sedan. To make your bus more driveable you need more low-end torque rather than top-end horsepower. To achieve higher speeds in a bus, your horsepower requirements are going to go up according to an inverse-cube law — the few extra horses you get from the 1776 aren't going to make much difference in your top speed but they'll get you thru the hills a lot better and let you keep up with the traffic on the freeway — all at a price you can afford.

If you really need to cruise at 80mph — and own a bus — you will probably be happier with a different vehicle.

1776 or Stock?

I would like to up the displacement of my 1600 unit some, but am not sure of the possible repercussions on the smogablity of this car. I am in California, so this is a huge fear. Is it possible to go up a bit, to say a 1776 yet still be able to bolt on my stock carb and smog the thing? Is the difference even worth the effort?

If emissions are your only concern, you can relax. Fitted with a 34–PICT and a vacuum advance distributor (ie, stock in both cases), a properly assembled 1776 cc engine has no trouble passing the smog requirements for the 1600cc engine, which are quite broad. Emission samples are taken at only two engine speeds, idle and 2,500 rpm — within that range, the typical 1776 passes easily. But you may want to re–think the situation.

The 1776cc engine is normally assembled using 90.5mm barrels, retaining the stock crank, cam and valves. The crankcase and heads must be machined. and this requires you to machine any replacement heads needed for future repairs but generally, this is a very mild level of modification and may even be beneficial since the shop that machines the crankcase can tap the case for a full–flow oil filtration system when they do the other work.

With the stock cam and valves, the 1776 provides a bit more low–end torque making this engine ideally suited for the Type II. But at higher rpm the larger displacement quickly strangles the stock carb and valves — the engine is taking deeper breaths but unless something has been done to improve the flow–rate, such as bigger valves and better manifolding, the engine will lean–out at the top end, leading to overheating and potentially fatal detonation. This isn't much of a problem in the bus which is rarely able to use the maximum rpm the engine can provide. When fitted with proper instrumentation, the problem becomes apparent long before any damage is done.

With the sedan however, the situation is different. The lighter weight allows the vehicle to use the full potential of the engine, meaning you'll quickly find yourself in trouble if you step on it hard.

The problem here is a good example of the fact that engines are intergal designs — you can't mess around with one part of the envelope — the displacement, in this case — without running into problems along some other surface of that envelope.

———————————— As to the practicality of the 1776…

To install 90.5mm jugs you need to open up the crankcase and the cylinder heads. The instant you do so you have divorced yourself from stock sources of repair parts. If you need a replacement head, it will have to first be machined. When you take in your old head, it will not be acceptable as a core.

One thousand seven hundred and seventy–six cubic centimeters. Sounds pretty impressive when your stock engine was ‘only’ 1,584. In fact, it is only an 11% increase, which is why the 1776cc engine has no trouble passing the emissions test.

What do you get for your eleven percent increase? Basically, a bit more low–end torque. You can’t get much out of the high–end unless you improve the breathing and carburetion, and you really can’t do much about the breathing unless you’re willing to give up cabin heat — you can bolt–on any kind of exhaust you want but it won’t make much of a change unless you replace the heat–exchangers with J–tubes of larger diameter. Going to a different cam provides only marginal improvement. The real problem is the size of the valves and the manifolding. In effect, when you increase your displacement you need to redesign ALL of the engine’s components.

A whiff of Reality

A more realistic alternative to slapping on a big–bore kit, and one I hope you’ll explore, is to stay with the stock displacement, putting your money and time into improving what you have. In several of my articles I’ve mentioned methods of gaining ‘free’ horsepower by improving the mechanical efficiency of your engine. Improved balancing alone often results in more output than you’ll get from an unbalanced 1776.

A full–flow oil filtration system will more than double the service life of your main bearings and do nearly that well in extending the life of your cylinders & pistons. Two engines for the price of one. That’s hard to beat.

A CD ignition module will improve combustion at higher rpm and extend the life of your points to 50,000 miles or more. Swivel–foot adjusters increases the interval between valve adjustments — and hydraulic cam followers eliminates valve adjustment entirely.

These are hard–headed facts, based on sound engineering principles. These are things worthy of your attention. The magazines don’t stress the realities of automotive engineering, they stress buying their advertiser’s products.

Whose vehicle is this, anyway? Who pays the bills? Who are you trying to impress?

Impressing Yourself

I work very hard to impress myself — to solve life's puzzles. One of those puzzles is Personal Transportation — freedom of movement. To get about I need reliable transportation that doesn't cost an arm and a leg, wheels I can count on to take me where I want to go, be it the shore of the Arctic Ocean or some tropic sea — and I've done both.

Lately a lot of bug owners have contacted me about the pros and cons of big–bore kits. I'm going to make this a general post. Perhaps someone will cross–post it to the Vintage VW list.

Big Engine Reliability

Increasing the displacement of the Volkswagen engine is easily done through the use of larger diameter cylinders and a crank having a longer stroke. The larger engines produce more horsepower. They also produce more waste heat. Unfortunately, larger engines do not add additional cooling fins nor increase the flow of cooling air. Unless the increased heat load is dealt with, the service life of the larger engine is drastically reduced.

It's possible to produce large displacement VW engines that reliably deliver 80 to 100 hp for 100,000 miles or more, but only when careful attention is focused on the cooling system and the realities imposed by laws of physics. Such attention usually runs counter to the flow of conventional wisdom fueled by grossly misleading magazine articles and legions of self–appointed experts.

A good example has to do with external oil coolers. Given the size and placement of the early–stock oil cooler, an immediate improvement in service life is realized by removing the stock oil cooler and replacing it with a larger cooler of suitable design mounted over the air inlet to the blower housing. This has the effect of pre–heating the cooling air but it also serves to distribute the heat to all four cylinders, whereas the stock cooler placement concentrated its load on the #3 cylinder. This problem plagued all VW owners until introduction of the dog–house type cooler, which is of course an external oil cooler but one provided with a blast of cooling air independent of engine cooling, that is, a larger fan, separate inlet, and separate outlet.

But even this solution is flawed if the vehicle is subjected to a great deal of start & stop driving, since the air flow through the cooler is a function of engine speed. Given the heat latency of oil, a rather poor coolant by any measure, in stop & go driving the cooler must be provided with the largest possible air flow when the vehicle is at a stand–still. This can only be accomplished with a fan, which in turn dictates a remotely mounted cooler, the necessary plumbing, thermostatic controls and so forth. Such refinements fly in the face of conventional wisdom, which tends more toward lots of chrome, lowered front ends, five hundred watt sound systems and other symptoms of feeblemindedness.

The worst–case cooling scenario is the installation of a 2.2 liter engine in an early bus used to haul heavy loads in hilly terrain. Reliable long–term performance was achieved by remotely mounting a 10 x 14 inch steel oil cooler and using a 12" diameter thermostatically controlled fan. Air–scoops mounted over the engine compartment air–inlet louvers provide positive pressure to the engine compartment any time the vehicle is moving faster than 8 mph, forcing air through the cooler, which is mounted on a sheetmetal housing fastened to the floor of the engine compartment to the left of the engine, exiting downward through an 8 x 10" hole behind the left rear wheel well. In stop and go traffic, or when climbing long grades, the fan cycles on and off as required to keep the oil temp below 230 degrees Fahrenheit. (Normal temp is about 180.)

When building a large displacement engine you must address the cooling problems from the outset, starting with a late–model crankcase having larger oil passages. Particular attention must be paid to your cylinder heads, insuring none of the air passages are blocked by casting flash, especially in the area around the exhaust ports. The cylinders must be tightly shrouded; the stock deflector plates are not adequate to insure a laminar flow of air over the greatest possible surface of the cooling fins. You need the late–model 'Kool–tin' type shrouds, modified as necessary to insure a leak–free fit. The air–vanes in the blower housing should be re–worked, even to installing bronze bushings if the pivots are worn. When the blower housing is assembled you must insure the link rod causes both sets of vanes to open fully and at the same rate. The thermostat and actuating rod must be positioned so as to insure proper operation without any possibility of binding. You must do everything possible to insure maximum heat flow from the valve covers, crankcase and push–rod tubes. The fan pulley must never be smaller than stock.

And of course you must build a proper engine, insuring all rotating components are dynamically balanced as a unit, that you choose a rod length so as to reduce piston side–load, and that pistons and rods are balanced to better than factory spec. Hydraulic cam–followers should be fitted as a matter of course. Most importantly (and assumed throughout) is that the engine be fitted with a full–flow oil filtration system. Indeed, aside from its application and overall appearance, there is very little Volkswagen in a reliable 2180cc VW engine.

One of the most difficult tasks when assembling an engine is to insure proper volumetric balance. This applies to engines of any size but is especially important when building larger engines. Your deck heights should be identical. This is most easily accomplished through the use of shims, with the final adjustment made by shaving the head of the piston (but no more than a few thou, please. And always BEFORE balancing.) Chamber volume should match very closely and the chambers should be polished. For maximum longevity, compression ratio should be kept fairly low, typically between 7.3 to 7.5. Achieving volumetric balance is more important than nailing down a precise compression ratio.

Building an engine is a satisfying experience and the simplicity of the Volkswagen virtually insures success, even for first time builders. But that only applies to stock engines, and doesn't speak to long–term durability at all. The generally poor reliability of big–bore engines stems largely from ignorance of the problems involved. The stock 1600 VW engine is virtually maxed–out with regard to cooling capacity. Bigger engines are DIFFERENT ENGINES, demanding different solutions to their cooling problems.

Big Engines and Reliability II

Having written an article saying it's possible to build a reliable big–bore stroker I have repeatedly been taken to task for failing to provide the 'how–to' details. Three to five times a month I'm asked pretty much the same questions and in private posts I give pretty much the same answer: If you have to ask, you probably don't have the skills to successfully tackle the job.

I know how that must sound — old geezer Knowitall. The thing is, I thought everyone was pretty much up to speed on Volkswagens, overlooking the fact a lot of Volkswagens — perhaps a majority — are older than their owners.

As a matter of fact, I prepared a lengthy manuscript on building RELIABLE big–bore engines that may one day appear in print, assuming I can come up with suitable illustrations. But it will not be a popular article. The plain truth is that building a RELIABLE big–bore stroker is not a cookbook sort of project. Such engines are the tip of an iceberg of experience. And by the time I've included information on all of the needed experience factors the article would be the size of a New York city phone book.

Based on the questions I'm asked and those I see on the various VW–specific lists — and on the technical competence of the various VW–specific magazines — the general level of Volkswagen–related experience is falling. In that environment I think it's best to stick pretty close to basics.

In a message dated 97–02–18 15:49:04 EST, Scott wrote:

I was browsing your sermons and had a question. Is a stroked crank compatible with 85.5mm pistons and cylinders?

If you mean will a crank having a longer than stock stroke work with stock pistons, the answer is yes.

If so, is this a viable option in terms of HP and torque gain over a stock 85.5mmX69mm.

You'll have to define viable in mechanical terms. Increasing the stroke increases piston travel per revolution. Increased piston travel increases friction and increased friction accelerates wear and frictional loses in the form of heat. The longer stroke would increase displacement which will give a longer burn. Since you haven't increased the piston area the specific impulse would go up (ie, pressure vs area). With the stock cam you would end up pulling your torque curve DOWN the rpm scale — you'd end up with a rather doggy engine. If that's what you want then yes, the combination is 'viable'. But it probably isn't what you meant. And you probably don't have the money to devote to the research needed to arrive at an optimum cam for that particular combination.

Another problem in your question, and a common error, is that HP is always relative to RPM. Saying an engine produces more or less horsepower is meaningless unless the other half of the equation is filled in. A longer stroke with stock jugs moves max torque down the rpm curve. The engine might produce more than stock horsepower but at a speed too low to be useful in your vehicle.

It also works going the other direction. Maximum horsepower as used by most manufacturers and all of the VW–specific magazines is largely a dimensionless quantity. Being able to produce 165 hp @ 6.500 rpm — not all that difficult with a veedub — can mean you have a pretty useless engine… if it's bolted to a stock tranny.

A better approach is to re–think the problem. If you want to go fast you start at your anticipated max speed and work backwards, hoping to achieve that speed with the minimum rpm. What you need is a torque curve — maximum efficiency — that matches your gearing. But a lot of folks don't want to go fast, they simply want maximum acceleration. So you design for the optimum delta–vee. Others want to minimize fuel consumption — you do the numbers all over again. Others are after tons of cargo per pounds of fuel consumed — a different set of factors. Others need stone–reliability — different factors.

The point is, there is no one engine that will do it all.

Veedubs are optimized designs. You can improve on them a little by applying modern–day technology and close attention to detail, but you're limited in what you can do with regard to maximum output by the nature of their design. You can push the envelope a bit but only at considerable cost.

Also, what stroke cranks require no or minimum clearancing. I have hear that 74mm are drop in.

It's not the crank, it's the rods you have to worry about. With a set of Carrillo or Porsche rods, or others having a radiused cap, you can run a 74mm crank with only slight interference — if any — at the cam, which must be ground away. With longer strokes the cheeks of the journals are liable to touch the opposite side of the case and, in some castings, the top of the case near the parting line. And all will interfer with the cam.

The problem here has to do with rod–angularity and side–loading on the piston wall. If you run stock rods the maximum crank throw is something like 72.8mm. Anything longer and the frictional loses due to rod angularity go up faster than the increase in power. Sure, it will run. But not for long. 74mm cranks are a compromise, the longest throw using a stock rod that will last for a few thousand miles and doesn't call for too much clearancing.

Since a set of good rods runs about $800 you should begin to see the practical limits to the problem. Personally, I use Chevy rods, regrinding the crank's journals to match and re–bushing the little end accordingly. It's an old trick that works pretty well. Of course, by the time you get the rods modified, shaped and balanced you're liable to have invested a thousand dollars worth of time & money :–)

My 2180 recently passed the 80,000 mile mark — in a low–geared bus. You CAN build a reliable big–bored stroker — but the how–to has never appeared in any magazine — they cut too many corners, ignore too many critical details. The bigger the engine the more waste heat you have to manage — management of your waste heat starts with not creating so much of it to begin with, which means focusing on maximum mechanical efficiency, then optimizing the cooling system.

Bore and stroke are just numbers, a relatively minor factor in an equation having hundreds of factors, most with a wide range of variables. What you see in the magazines are cookbook solutions, virtually none of which apply to the realities of daily driving — or long–term reliability. Want to know what works? Hang out at the finish line.

The old saw about increasing displacement being the most reliable means of increasing output does not apply to the Volkswagen engine because increasing the displacement usually increases the width of the engine… which means the cooling system — the blower–housing and shrouding — must be modified to fit. And we're not just talking about sealing the gaps. The highest–volume output of the blower is aimed very specifically at the area around the exhaust stacks. Disturb the cooling shroud geometry by an eighth of an inch and you reduce this air–flow by half. Now look in the magazines. See those gaps? Most are 3/8ths to half an inch wide! The flow of cooling air to the hyper–critical 'corners' of the engine has been reduced by a whopping 90%. This 'minor' point has never been mentioned in any of the articles I've read — they simply stuff filler–blocks in the gaps. And of course, if the cooling system does not fit it can not work even as well as stock… but in this case it must work more efficiently than stock because it must deal with a greater quanty of waste heat. The inevitable result is a drastic reduction in the service–life of the engine.

The solution? You must modify the blower–housing and all related shrouding, plus you will have to fabricate tighter lower–cylinder shrouding. The reason for all of this is remarkably simple: If you cannot maintain at least a 12psi differential you will not have sufficient air–flow over the hottest portions of the cylinder heads.

The mods aren't especially tricky — you need to be a good weldor and willing to devote about 40 man–hours to the task, plus fitting the modified parts to the engine — including a modified thermostat bracket and locally fabricated thermostat actuating rod. Do a nice job, give it a good coat of paint, you can't even tell the engine — and tin–ware — is up to an inch wider than stock. It's one of those unimportant details, overlooked — or discounted — by the magazines as not being worth the trouble.

Wanna go fast, make noise? Stick to the stock displacement and focus your wits on improving what you have. The Japanese are pulling 1,200 hp out of 1,500cc engines… at 12,500 rpm. You needn't aim that high but it's a clear message there's a hell of a lot you can do.

I know this wasn't the answer you wanted to hear. But I think you've got enough problems in your life without having to contend with an unreliable vehicle. Stick close to stock. If you've an interest in automotive engineering you must surely realize it is not a subject easily mastered. But once mastered you can build any damn thing you want… so long as you don't break the fundamental rules. My big engines don't break any rules. And despite using some Volkswagen parts they are NOT 'Volkswagen' engines.

Corvair Engines

This is general information about the Corvair powerplant, provided at the request of a list member. I've made it a general post since it may be of interest to anyone considering a transplant for their Type IV engine.

If you want to see what a Corvair engine looks like, go find a Type IV. There are marked similarities — VW obviously picked off a few of the best points from the Corvair. But not all.

The six cylinder Corvair powerplant weighs about the same as the Type IV if you include the exhaust systems, which are much heavier on the Volkswagen. The Corvair engine displaced about 165 cubic inches, a bit shy of 2.7 liters. Bore and stroke was, I think, 87mm by 75mm and the engine was very conservatively rated at 95 hp @ 3,600 rpm, ideal for a stock-geared VW bus. It was fitted with dual carbs that mounted directly to the heads, the manifold being part of the head casting. With a different cam and rev'd to about four grand, the basic engine produced 110 hp. It also came in a four-carb model that was rated at 140 hp at something like 5,500 rpm, again with a different cam being fitted. Then there was the Spyder, a turbosupercharged version that would only make you feel bad if I told you how many horses it put out.

The Corvair mad a wizard little aircraft engine because max torque was down around 2,400 rpm, ideal for converting rotary motion to thrust using a propellor.

Best of all, the engine was smooth and reliable. Purists turned their noses up at the four-main bearing crankcase but the case was aluminum, not magnesium, and the bearings were sustained by thru-bolts rather than studs. The close proximity of the cam, nestled underneath the crankshaft, put a limit to how much stroking you could do, which was also limited by the small rod journals, only 45mm or so. But you could hang some really huge jugs on the thing. And because the cooling blower was belt-driven, you could cool a big-bore Corvair just by changing the fan (more vanes) or the drive-belt ratio (different pulleys) or both.

The Corvair engine consists of two crankcase shells, left & right, but differs from the Type IV in that the basic casting is machined on all sides. The bell housing bolts to the front, a sump to the bottom, a cover plate to the top — which mounted the blower on a central pivot — and an accessory case to the rear. The accessory case included the distributor, oil pump, oil filter and oil cooler. Design-wise, the closest thing to it today is one of Larry Pauter's racing engines.

The tin-ware of the Corvair is less complex than either the Type IV or the upright VW engine, nor are there as many pieces. But the shrouding was much better than on an upright VW engine and was copied almost directly onto the Volkswagen Type IV. And instead of one thermostat as on VW engines, Corvairs had two, one for each bank of three cylinders. The thermostats controlled the heated air outlets whereas VW controls the cooling air at the inlets. Different strokes.

The heads are perhaps the most similar part between Type IV's and Corvairs. Not in their rockers, which are far superior on the American engine, but in their pattern of cooling fins and method of inserting O-ringed pushrod tubes through the valve galleries. But the Corvair valve cover was bolted-on rather than held by a bail, largely because you never needed to visit the rockers unless you were doing a repair — no valve adjustment required with the Corvair, which was equipped with hydraulic cam followers.

Thanks to putting the distributor and oil pump in an accessory housing, basic repairs to a Corvair were relatively easy since the accessory housing was accessible without dropping the engine. But if you needed to do a Corvair engine, it wasn't much more difficult than doing a Bug. Different but not difficult. The trick was, you needed an overhead hoist. You used it to hike up the back of the car — just grab the bumper in slings, the unibodied chassis was very rigid — raise the vehicle, skivvie under and do the disconnects, put the jack in place and lower the car until the tranny was on the jack, skivvie back under and pull the bolts, then just lift the body up, lower the jack, and pull out the engine and tranny as a unit. The axles were fitted with old-fashioned U-bolts at the tranny side-plates and came away with loosening just four nuts, plus the anti-torque tube and a few other goodies. It wasn't very hard and you didn't need a very strong hoist — we used a children's swing-set to drop a Corvair engine without problems. As with most American vehicles, the fasteners were robust, considerably over-sized for the work.

But unless you were doing an engine swap, chances were you didn't need to drop the engine. The Corvair deck lid gave you complete access to the top of the powerplant and there was nothing buried beneath the tinware — the generator (early models) or alternator (later) was hanging right out there in the open, as was the distributor, carbs and dip stick. Of course, the four-carb engine an the turbo filled up the space but the basic Corvair was an easy machine to maintain — if you understood air-cooled engines.

An interesting note about the Corvair tranny was its use of a hollow output shaft. That is, the mainshaft from the engine ran through the center of the output shaft to the differential. This allowed the Corvair to be several inches lower than the VW powertrain yet could provide about the same ground clearance with tires of equal size.

I liked the Corvair engine. I owned three of the things and never had a problem I couldn't fix. They were fast yet economical, if you didn't have to run the gas heater too much. An the Spyder would flat EAT any Porsche alive. The fastest run I ever made — better than 200 miles averaging over 130 mph on public roads — was made in a Corvair Spyder. And no, it wasn't a Las Vegas cruz — the run started in San Francisco.

Installation of a Corvair engine in a bug was a bit much, and they didn't do all that well in the early bus — install a Corvair engine and the next thing you'd install would be tranny, to replace the one you'd cracked. But if you installed the entire powertrain — a Herculean task — you had a great-running machine because the Corvair tranny was one tough piece of goods. And if you installed a Corvair engine in a late bus having a rear engine mount, you had just about the best bus you could have.

Oddly enough, you still see Corvairs for sale, usually for less than a Volkswagen of similar vintage. The kicker is, it's hard to find parts for them. But a running Corvair for $500 usually means a rebuildable engine at a dirt-cheap price.

If you're interested in Corvairs, the same fellow that wrote 'How to Hotrod Volkswagens' did a similar book on Corvairs, although it is long out of print.

Blown Oil

Oil and Breathers

All piston engines experience some degree of ‘blow-by’, the common name for leakage of combustion gases past the piston rings. When you consider that the peak chamber pressure on a high-compression engine approaches 1200 psi, and match that with the fact your rings have gaps, it’s pretty easy to see where the blow-by comes from.

(Two points to douse incipient flamers: There are such things as piston rings without gaps, and the specific impulse pressure in a stock VW engine is more on the order of 600 psi.)

Pumping hot gases into the crankcase of an engine isn’t a good idea but it happens and it has to be dealt with. The solution is to vent the crankcase to the atmosphere in order for those gases to escape. Unfortunately, they’re liable to carry some of your lubricating oil along with them so the vent must be provided with some sort of oil trap. And since the gases will be loaded with hydrocarbons it would be nice if they weren’t spewed out to become smog, so we position the crankcase vent in a low-pressure area near the mouth of the carb, typically inside the air- cleaner, and hope the stuff gets sucked down the carb and all those nasty hydrocarbons get burned up. Sometimes it even works.

If we’re sucking/blowing air OUT of the crankcase it makes good sense to provide some place for air to come IN to the crankcase. Volkswagen engines have an annular inlet around the fan pulley. Park on a steep hill and you’ll discover it by the pool of oil that appears under your rear bumper. (Front is UP)

If you could climb inside your crankcase while the engine was running you’d discover surprisingly little liquid oil. The whirling spin of the crankshaft atomizes the oil escaping from the rod journals. The oil fog condenses on the walls of the crankcase and picks up considerable heat. The presence of this oily vapor is a necessity but it also explains why ventilating the crankcase often carries away a lot of oil.

The air inlet down behind the fan pulley is also a dirt inlet. And a water inlet. In fact, anything in the air will be drawn into your engine. The crap your engine sucks in becomes the determining factor on how long you can run between oil changes. Modern engines having shaft seals and filtered crankcase ventilation systems can run 7,500 miles and more between oil changes. On a stock bug it’s smart to change the oil at thousand mile interval, less if you're running in dusty conditions. If you've fitted a full-flow oil filter you can stretch that to 3,000 miles but less is definitely better if your engine doesn't have a shaft seal. (The lack of a shaft seal is the major reason why all the talk of synthetic oils is such a belly laugh when it comes to VW engines.)

Except VW-types call them 'sand seals.' (It's hard to explain reality when a tits & ass rag like DB&HVW sez otherwise.)

Of course, once you seal up the dirt/dust/water/air hole around the fan pulley you'll have to provide another air inlet for your crankcase ventilation. Failure to ventilate the crankcase will cause it to collect moisture which will emulsify the oil and lead to a host of lubrication-related problems. But make sure your new air inlet contains a good air filter; the dome-shaped jobbie from K&N is probably best. Don't waste your money on the ones that use a hunk of foam or chair padding (the white Dacron stuff). Get one that uses a real air filter.

The new inlets are usually provided on the valve galleries, as Volkswagen did with the Type IV engine. (Yes, Virginia. The Type IV not only has a 'sand' seal it also uses a full-flow oil filter, Kool-Tin and hydraulic valves. In fact the Type IV has all the things the T&A magazines insist aren't really necessary for a macho Veeduber machine.)

The best after-market crankcase ventilation systems incorporate an oil separator with provision for returning the condensed oil vapor to the crankcase. This is vital if the engine is installed in an airplane where it may be tasked with running for hours without any chance of adding oil, as in an over-water flight. It also makes good sense on land vehicles, assuming you plan to live on the same planet.

Why The Stock System Blows Oil

The hub of the fan pulley is grooved with a left-hand thread. The fan rotates to the right. The groves act as an air pump, actively sucking air (and anything it might contain) INTO the engine. The groves also act to keep the oil in the engine even when climbing a steep grade, pumping the stuff back where it belongs like a screw-type pump. Just behind the fan pulley there's a lovely dished washer that also serves to trap oil and keep it inside the engine. The dished washer is called an 'oil slinger' and that's exactly what it does, thanks to centrifugal force. Any oily vapor that gets near the slinger gets condensed and slung into the grove in which the oil slinger spins, where it runs down the walls and returns to the sump.

So how can the thing possibly leak? By overloading the system. Here's how to do it. Run your vehicle at some insane speed until it's hotter than a two-dollar pistol then, still going flat-out, lift your foot off the throttle. Bingo! When the throttle closes the crankcase is suddenly ‘way over atmospheric pressure and a gust of oily vapor escapes around the pulley hub. A lot of it is caught by the spinning fan pulley, condensed, and slung around the engine compartment. But a lot of vapor also comes from the inlet of the air cleaner because that’s where the crankcase ventilation exhaust is located. The overpressure inside the crankcase pushes oily vapor into the air cleaner but since the throttle is closed it has only one place to go, out into the engine compartment.

Do a lot of high-speed running and you’ll notice the walls of your engine compartment slowly growing a layer of grime. That’s your engine oil, folks. Courtesy of a sixty year old engine design. Of course, no one thought much of it back then; the factory oil consumption spec for the Model A (the Volkswagens original competitor) was one quart per 100 miles! A misty little dab of oil here and there was a quantum improvement, taken as a sign of superior Chermann engineering.

You say you never lift your foot off the throttle like that? Balls! We all do it, even if we think we don’t. Hitting a bump is enough defeat the stock crankcase ventilation system, which is why the emission control people get so het-up over older Volkswagens.

Sermonette

If you’re running a stock Volkswagen engine you are maintaining a museum piece. Fortunately, the design of the engine is flexible enough to allow the retrofit of all mod. cons. Yeah, it costs something, but the pay-back is more than the expense. No more valve adjustments. Change the oil twice a year. And the new engine will last twice as long as that greasy lump that’s in there now. It’s worth thinking about.

Blown Oil Seal

It sounds as if you've blown a seal. I can't tell if it's the tranny seal (10%) or the engine seal (90%) but the repair — which must be done as soon as possible — calls for you to drop the engine and replace the seal. Neither seal is expensive and they are available by mail order if you're out in the woods someplace.

If you've never dropped your engine before, come on over to the vanagon list vanagon@lenti.med.umn.edu, use the normal list-servor protocol for subscribing [ask if you need to]) where someone will be happy to lead you through it. If you've access to the web, pop up to http://www.sky.net/~rmk/hoover/ where you will find a list of 'sermons,' some of which cover removing an engine, replacing seals, why the sky is blue and if the Dodgers really think they have a chance against the Chargers.

Blowing a seal may or may not be a symptom of more serious problems. Right now, you need to replace the seal and the clutch disk — once the disk is contaminated with oil there's no effective cure. And removing the clutch disk is part of removing the flywheel, which is necessary to replace the engine seal. If it's the tranny seal the repair is a no-brainer, but you still need to replace the clutch disk. Oily is bad, in bell housings.

If it's the engine seal you will need some unusual tools. One is a piece of pipe about five feet long. Another is a piece of 2" angle iron the same length. A third is a bathroom scale. (I'll pull it all together in Chapter Three - trust me.) You will also need a 3/4" drive socket that fits the humungous nut holding on the Volkswagen flywheel. I know — modern cars use five or six small bolts for this job. The engine in your bus was designed in the early 1930's; they did things differently back then. So start checking around. You can usually rent such tools. If you plan on maintaining your bus yourself you may wish to buy them — a $50 will get a complete 3/4" drive socket set delivered to your door from Harbor Freight. If you want their phone #, ask. And no, I don't own the company. Whatever you do, don't walk into an auto-parts store and say "Gimme a breaker bar and a 36mm socket." You'll have to float a loan, they're so expensive.

The size of the socket you'll need is 1-7/16" for Earth-people, 36mm for all others. You'll need a breaker bar to turn the socket. Not a flex handle or a ratchet but an honest breaker bar. The mysterious piece of pipe must have an interior diameter large enough to fit over the handle of the breaker bar. You will need the additional leverage to loosen the nut — and to torque it to the proper value after replacing the seal. The five foot long piece of angle iron is euphamistically called an 'Anti-torque tool' in the Volkswagen manual covering 'Locally Fabricated Tools & Fixtures" You will need to drill two holes in it, spaced to match two of the bolts holding on your pressure plate, the thing the clutch-disk is hiding under, and large enough to accept the bolts. 5/16" is about right but check it out. With the anti-torquing tool bolted to the flywheel — and you standing on it, if you slide the pipe (appropriately called a 'cheater') over the handle of the breaker bar you'll have enough leverage to loosen the flywheel gland nut, which is torqued to over 200 ft/lbs. Siddle out a little farther if it doesn't come loose. If you use the whole five foot length you can flip the Titanic across the room.

Putting the thing back on is equally simple, except this time you stand on a bathroom scale and push down. If you grip the breaker-bar/cheater four feet from the end and press down until your weight is REDUCED by fifty pounds, you will have torqued the nut to precisely 204.361 ft/lbs, which is as God intended and all will be will, my son.

However, to further raise your brows I'm afraid there is another task for you to do before you can replace your engine seal. You must find out if your engine is playing too much. (It will be. 71's are notorious for it.) When the engine was assembled a stack of three thin metal washers called 'end play shims' was installed over the end of the crankshaft before the flywheel was bolted on. They press against the thrust-face of the #1 crankshaft bearing (which is sealed by the seal, now unsealed and dribbling and the reason we are here), and the thrust face of the flywheel. Each time you depress the clutch you push against the spinning engine with a force of over 500 ft/lbs. Imagine what you would do if someone weighing 500 pounds stepped on YOU? Your engine does exactly the same thing. In time, all of those pushes wears down the end-play shims, or the bearing, which is softer, or the flywheel, which is the hardest thing of all. Your job, as an honorable veedub owner, is to restore the engine's end-play to about three thousandths of an inch from the ridiculous gap it had worn to, and which may have cause your seal to pop. Don't do it and life will still go on, as will your engine. But not as long. And you'll probably blow another seal.

Okay, all of that sounds do-able. The catch is, you're dealing with THREE shims and a tolerance of only a couple thousandths of an inch. The proper tool is a dial indicator, a nifty machinist's gizmo (they call them 'clocks' — I'll let you figure out why) that will measure your engine's end-play to within a gnat's ass, or 1/1000ths of an inch, which ever comes first. A cheap clock costs about $15 bucks, a good one about $100. Cheap is okay for end-players. Knowing what the end play IS, and knowing what it SHOULD BE, you subtract the one from the other, hie yourself down to the Volkswagen dealer and say "Please sir, I would like an end-play shim stack that's xxx thousands of an inch high."

When he stops laughing, give him the greasy scrap of paper on which you've noted your end-play readings. After he tells all the guys and they all get a big laugh and look in the door to see if you're real, the parts guy will make you up the proper shim stack and charge you about three bucks. Cheep. He'll also sell you anything you want, except Alice.

There's a few minor points I may have dashed passed but we can save them for another time since you're eyes are already starting to roll and you're not too sure if this is a joke or a bad hair day or what.

It is an Or What. And you've GOT to replace a seal. I hope it's the tranny (smell the oil. Thick and sulphury? Sounds like tranny juice to me. Crawl under, take out the side-plug and give it the finger. Low? Probably the tranny seal. Lucky devil! Now you don't have to fool with adjusting your end-play. Mebbe next time.)

There are books that will tell you all this stuff. But the first one you should read — John Muir's "How to Keep Your Volkswagen Alive! - A Guide for the Compleate Idiot" contains some dangerous errors. And some dangerously good drawings. (Nude cars!) You can't afford the factory manual for you bus so don't ask. (Alright! Robert Benchley Publications. But you'll be sorry.) I don't know if Haynes Publications has a manual for your bus; ask the Vanagon list — they know everything. Don't waste your time on the Chilton manuals — one of their air-cooled VW books contains a long section on anti-freeze, forcrysakes! If you speak English or other foriegn languages, there are some books from England that are good. But you got to watch those Limeys. (They put bonnets on their cars.)

You need a book. A book always impresses your friends. Walk around with a book, smoke a pipe, you can pick up babes who take bathes and wear clean clothes. Get a book. But this is fun, too.

Bolt-On Filter Pump

Over the last few years a new VW engine accessory has gained considerable notice since it offers to double the life of your engine for about $50. The device is a full–flow oil filter, something the Volkswagen people didn't get around to until they designed the Type IV engine. The add–on accessory replaces the stock oil pump with one having an additional gallery cast in the space normally used for the pump's output. To gain enough space the add–on pump uses gears that are smaller in diameter than stock, picking up the lost area by increasing their length.

Instead of going directly to the engine's oil gallery (or to an external filter, as in the popular full–flow modification), the filter/pump's output goes to a cast aluminum pump cover that incorporates a pressure relief valve and the mounting boss for a small–diameter spin–on filter. The filtered oil is directed back to the new pump body, through the new gallery and then into the engine's own main oil gallery.

In theory, this is just about the neatest idea since pre–sliced bread but in practice there have been a few problems. The first is the restrictive path the oil must follow to reach, and return from, the filter. The passages are small and not especially smooth. There is no doubt your engine will be receiving cleaner oil than before, but it will also be receive less of it. This presents no problems with regard to lubrication, since the engine needs only a few ounces of the more than four gallons of oil the stock pump delivers at highway speed. But the oil is also your primary coolant. Delivering less volume of oil is not wise if you're running in a hot climate, habitually carry heavy loads or drive in hilly terrain. Those conditions demand maximum cooling; the add–on filter pump will reduce your engine's ability to cool itself.

The option here is equally clear, but dangerously so because it calls for the use of Common Sense, remarkably uncommon stuff where Volkswagen's are concerned: If you use a filter/pump, keep your foot out of it.

I've only dealt with four of these things, installed two, am still running one. So please understand I may have only felt the elephant's trunk.

The first big surprise was that the thing will not fit a standard bug (!). The recommended filter was too long; it struck the muffler. If you were running an after–market exhaust system, you'd never notice this. But if the idea is to simply bolt the thing on and drive off, you'll have to do a bit of thinking first. You can make it fit by going to a shorter filter. And that brought up another surprise.

The four filter/pumps I actually handled/inspected/installed were of three distinctly different designs. Two were copies — it was impossible to tell which came first, but the third was an absolutely beautiful thing that had larger oil passages and machining of NASA quality. It was from Taiwan. It was also .002" TOO SMALL! It fell into the oil–pump bore and rattled around; there was no way in the world to make it work. The VW oil pump is intended to be an interference–fit in the case; it's supposed to be a little too large, not too small. At normal operating temps the thing is supposed to provide a leak–free fit between the oil passages in the crankcase and the openings in the pump. If the pump's diameter is too small, there is nothing you can do to make it work.

My next filter/pump was a bubble–pak'd affair. Machining was horrible and there were obvious porosities in the casting. But it fit. And then it leaked. Not at any seam or seal, that sonofabitch leaked right through the metal! It SWEATED oil. Apparently the porosities were throughout the casting and not, as I'd assumed (!) surface–blow from the rough casting.

Number three was from J.C.Whitney; it had been ordered before I bought #2 and I was ready to send it back the day it arrived, but although it appeared identical to #2, the machining was of better quality, as was the surface appearance of the casting — a nice, densely–gray high–strength aluminum. This one worked! And leaked, but just a little; around the plug retaining the oil pressure control valve spring. Tightened it down, no leak.

Hoping to capitalize on my success, I ordered another from Whitney. The filter sealing surface looked like someone had attacked it with an ax. Back it went. I'm still glowering over that one.

One of the engines I keep around the shop is called the 'Utility' engine. Nothing special, just a stock engine assembled from spares. No external anything; with the proper flywheel, it will fit in every bug or bus that happens along. The idea is to keep an extra engine handy so the vehicle isn't out of action while its engine is being worked on. I'd hoped to use a filter/pump on the Utility engine. I'm still hoping (and may give J. C. Whitney another chance).

The little filter you want to use is the Fram PH–3614. (Or whatever cross–references to your favorite brand.) But here's another little pit–fall: The thread on one of the filter/pumps I tried was different! Diameter was 19mm (3/4") in all cases, but one of the filter/pumps was threaded SAE, all of the others were metric. You can get a filter that will match either but there ain't no way you're going to thread a metric filter to an SAE filter–base. That's the gotcha. The filters are the same size but I've forgotten the number that fit the SAE thread.

The real gotcha! on this one is that the filter recommended by J.C.Whitney is the long–style, same as for the Porsche. And it will not fit in a standard beetle without hitting the stock muffler. So when you order the filter/pump, pass up getting the filter. Take the filter/pump to your local auto parts place and find a filter that fits. A short one, if you're hoping to run it with a stock muffler. Then buy a bunch of them and have the number tattooed on arm, right below the type of spark plugs you use and the proper gap. (What? Oh. Gee, I thought EVERYONE did that.)

The filter/pump is a lot thicker than a standard pump & cover plate; your studs won't be long enough. The filter/pump should come with four bolts; 8mm for late engines, 6mm for early. Part of the installation is to pull your existing studs, clean up the threads, and use the longer bolts for installation. The studs pull easily enough using the two–nut trick.

When you take the filter/pump apart you'll immediately notice that you can't use a regular pump–puller — there's no outlet port for the pump–puller to fit into. I know; some of you still think a pair of screwdrivers is a pump–puller (and a lot of guys have never used anything else), but I've seen too many things go wrong; I like to use a puller. So I made up a new puller. I drilled & tapped the filter/pump body to accept two #10 machine screws; if you examine the pump body you'll see there are only two places where there's enough meat to do this, at about 10 and 4 o'clock. (What? Oh. Well, you see, clocks used to have these things called 'hands.') I made a drilled plate that could be fastened to the pump body via the newly tapped holes. In the middle of the plate I welded a longish 3/8" bolt; the regular pump–puller C–frame works just fine; tighten a nut onto the bolt projecting through the C–frame will draw the pump–body out of the crankcase. (I'm really a very lazy person; the screwdriver trick takes too much energy.)

Whatever filter/pump you end up with, make sure it fits before taking anything apart. Check it against a stock pump. Then take the oil pressure relief valve apart, clean the threads, prime them, and reassemble using high–strength loctite. Check the threaded fitting that goes into the filter cartridge. If loose, remove it, clean, prime and re–install with high–strength loctite. Allow to cure at least 24 hours before installation. If the thread is a sloppy fit, stake it down at four points; you don't want this thing coming out every time you change the filter.

Putting it in

Okay, that pretty much covers the filter/pump. Now lets go out to your bug or bus. Let's start as if it were a regular oil change. Warm the engine up, but not real hot, just enough to let it drain good. Put your pan under it and drain the oil. Put the sump bolt back in. (Did you remember to use a new copper gasket? Shame on ya!)

Clear out that mare's nest of hoses; we want to remove the rear breast tin; the thing the heater hoses go through. Take your time. Take off the fan belt. We're going to have to remove the pulley to get at the piece of tin behind it; your oil pump is hidden from view behind that piece of tin.

The fan pulley is held by a 30mm bolt. To prevent the engine from turning, insert a sturdy metal bar through one of the holes near the pulley hub. The bar must rest on the shelf cast into the crankcase beside the nose–boss. If the bar touches the body sheet metal, put something under it; it's liable to leave a dent.

When you pull the breast tin the next trick is getting the pulley off. Here again, a lot of you will start waving screwdrivers like D'Artagnion; I prefer a pulley–puller. The only trouble is, you've only got about four inches of working room; you need one of those flat, bar–type pullers made just for VW pulleys.

(Walking the pulley off with a pair of screwdrivers does work, but the first part of the trip is taken with steps too tiny to see, mebbe .001" per wiggle. Use long, fairly slender screwdrivers to take advantage of the spring in their shafts, then keep up a rhythmic left–right–left… and the thing will walk off the shaft, although it may take twenty minutes for it to move the first eighth of an inch.)

With the pulley out of the way, remove the sheet metal, put a pan under the engine and scrub everything down. Then scrub it again. You're about to perform abdominal surgery. It may be only an appendectomy but the risk of infection is high; you want the operating field as clean as possible.

Before removing the oil pump cover plate, examine the amount of room you'll have for the filter cartridge; hold the filter/pump in the approximate location with a cartridge attached. On some stock mufflers the pre–heater pipe will hit even a small–canister filter. You may be able to bend the pre–heater pipe up and out of the way; use your hydraulic jack and a narrow piece of wood.

When you're satisfied the thing will fit, remove the oil pump cover plate, then the gears, then — using a stock puller, remove the oil pump. Have the pan in place; you're about to do an oil change using a new draining technique.

While the thing dribbles, take a pair of nuts and begin pulling the studs. You'll need a pair of box–end wrenches. Once the studs are pulled, begin cleaning all sealing compound from around the oil pump bore; your goal is perfectly clean metal. As part of the cleaning, de–grease the upper stud holes. We will use loctite on the new bolts; it works best if the threads are oil– free.

To keep the lower stud holes clear of oil, jack up the rear of the vehicle an inch or two; the oil will flow toward the front, leaving the work area clear. Use Q–tips and coffee–pot brushes to get the stud holes perfectly clean.

Before installing the new filter/pump, lay a bead of blue RTV gasket compound on the flange of the pump housing, being careful to keep it clear of the inlet and outlet bores. You may use a paper gasket if you wish; put the gasket compound on both sides of the gasket.

Thread two studs (clean ones, please) back into the stud holes at opposite corners — you'll need them to guide the pump into position. (If you don't trust yourself, use all four of them; the alignment must be perfect.) Oil the pump bore, start the pump body into the bore, and seat it using the minimum amount of force (I used a block of wood, a lead–loaded pipe, and about a zillion tiny taps; puppy walked right in.) Start the bolts into all four stud holes to make sure they do not bind.

Install the pump/filter cover following the directions that came with it; some have an O–ring (best), others a gasket (good), one had neither (risky!). If yours has neither O–ring nor gasket, use the thinnest possible bead of the red jelly–type sealant (Loctite 518 Sealant); when you install the cover, do so without any wiping motion.

Prime the bolts and the threaded bores, apply low–strength loctite and run the bolts in finger–tight. Torque in steps, using an X–pattern.

Pre–fill the filter, oil the gasket, and tread it on, hand–tight but not a weak hand–tight; compress the gasket to insure a leak– free fit.

All Done

Take the opportunity to clean all of the tin and the fan pulley. You may wish to install new air or breather hoses and replace the grommet around the road–draft tube. Put everything back the way it was. If working alone, you many need help installing the little piece of tin under #4 cylinder; don't try to do without it as it has the nuts that hold the other two pieces of tin in position.

The tin–ware is extremely important to your engine cooling. The air on the bottom–side of the tin is hot, having just passed over the cylinders and heads. It is also under fairly high pressure when the vehicle is in motion. If the tin and engine compartment seal is not in perfect condition, the hot air will be forced into the engine compartment and recirculated; your engine will think it's crossing the Sahara (and won't make it as far as Timbuktu).

The fan pulley will slide right on if you'll take the trouble to make the bore

perfectly clean. Use whatever it takes to clean the nose of the crank. Shiny is good.
This is a good time to install a new fan belt. And lookit those spacer–washers! Jeez, whata mess! Get that rust offa there; give them a shot of silicon lubricant. No, not that much! Just a smidgeon. That's better.

Wrapping it up

Fill your sump with oil, using the regular amount. Double–check everything. EVERYTHING. Sit there and wipe down your tools while you think about it. Reach out and touch things, just to see if they're tight. Wipe the engine down with a clean rag; give it a shot of Armor–all here and there; use your toothbrush (handiest cleaning tool ever invented). If you're satisfied, so am I. Go start it up.

Let it run while you dash back and look for leaks. Ooze at the filter gasket? Shut it off and give it another torque with your hand; if still oozing, use a filter wrench (you'll need one of those little–filter jobbies). Just remember, if you put it on too tight, you'll have to tear it to hell to get it off; those canisters aren't as strong as they look.

Shut it off, let it settle a minute then check your oil level, topping up to the mark. Now give yourself a pat on the back; you've just flattened out your engine's wear–curve.

Sermonette

Ignore all of the above if you're not running a stock displacement engine. Bigger engines have greater cooling requirements; a filter/pump will reduce your cooling ability. How much? I honestly don't know. I'd like to run some quantitative tests but can't afford to do so. Instead, I'll preach the Gospel of Go–Easy.

The Fram PH3614 has about one quarter the filtering element surface of the PH8A. You should change the little filter at each oil change. If your engine has a sand seal you can probably go 3,000 between changes but I would treat this mod as an overhaul, changing the oil after only a few hundred miles, then again at about a thousand, the idea being to — hopefully — clean some of the accumulated crud out of it. After a thou or so it probably won't make any difference; the oil will have passed through the filter a zillion times; the crankcase is probably as clean as it's going to get.

Deep Sump II

Is it a good idea to put one of those larger oil–sump deals on your bus? It SOUNDS like a really good idea, but I suppose there could be some technical reasons that it would be harmful.

I've never seen a deep sump that didn't leak, apparently because the sump–plate studs — even when replaced with longer units — were never meant to carry such a load.

Reduced ground clearance, while never a problem on the drag strip, can cost you an engine in daily driving. I've seen several crankcases with chunks knocked out of them as a result of hitting something with the attached (and quickly detached) deep sump. I've also seen a couple of engines lost when the oil pick–up extension came adrift, started sucking air.

With a FILLED deep–sump the oil takes forever to warm–up. And of course you have to keep the thing filled if you want your dip–stick to work :–) Drag–racing, we ran the engine with the minimum of oil, pouring in fresh for each run. It never showed up on the dip–stick because the dip–stick does not extend into the deep sump.

We used to call these things the 'Poor Man's Dry Sump'. Getting the liquid oil out of the crankcase gave us extra rpm, always important when you're trying to catch a clock. For roundy–round, rallys and road courses, we had a lot better results — and less expense — using a windage tray and fabricating extenders for the push–rod tubes. Running at speed, we thought the deeper sump would keep the oil from pooling–up out in the head… and maybe it did, for a few seconds. Fact is, running at speed the extra capacity of the deep sump doesn't mean squat — we just ended up with an extra quart of oil in the outside head. Live and learn :–)

I thought the added surface area of the deeply finned (and properly fabricated sumps, such as the one Gene Berg made) would result in cooler oil temps. It didn't. The oil took longer to come up to normal operating temperature but once there, it was about as hot as before. Apparently the oil cooler is about twenty times as effective at cooling the oil as any form of sump —– you'd need about five times the surface area of the typical deep–sump before you saw an appreciable drop in your engine's oil temp. There's bound to be some variation here. I'm talking about using a deep–sump in California. Veedubers in Finland probably swear by the things :–)

All of the guys who claimed miraculously low oil temps after bolting on a deep–sump usually had chromed valve covers, chromed push–rod tubes, no thermostat and so on — they were already running near the red–line before they bolted the thing on — and most of their claims were based on only a few minutes of run–time — the extra oil hadn't even warmed up yet.

Deep sumps are suicide off–pavement… or on–pavement for that matter, if you have to negotiate the occasional rough alley or railroad track.

Deep sumps tend to get in the way when you need to drop your engine, forcing you to raise the vehicle higher (bugs) to clear the rear apron and to use a different scooter (buses).

Finally, most of the deep sumps I've seen were very poorly made, the exception being the ones Gene Berg used to sell (I've not seen his most recent offering but I understand it's aluminum. It used to be magnesium and beautifully made, too.) The deep sumps sold locally are bubble–packed crap, cast in Taiwan and have casting inclusions and lots of CASTING SAND RESIDUE. (Someone on the list… [Thom?] ran into this problem. It would be suicide to bolt such a thing on an engine.

The bottom line? Deep sumps first appeared on the drag strip. Kiddies bolt them on because they can and because they look kewl and because all the tits & ass VW magazines say it's the thing to do. I ran them on the strip but found them impractical on the road, sought other — more effective — solutions.

Want to increase your oil capacity? Add a full–flow oil filtration system. The big FRAM PH–8A canister holds nearly a quart of oil, the hoses about half a pint.

Drilling Oil Galleries

Ben,

I don't know about the English majors but the Engine majors call any long, corridor-like oil passage a gallery. (A galley can be anything from a place to burn your beans to stick of type, with pirate ships and pretty girls thrown in (although that's probably 'gally'). :-)

Is your 82 a Type IV engine? If so, Volkswagen may have done the work for you, at least in so far as adding a remote cooler. You can obtain an adaptor plate that bolts to your oil filter base. The adaptor is threaded for 3/8"NPT, allowing you to hang a cooler anywhere within reason. The adaptors may be had with or without a built-in thermostat; get the on with the thermostat so as to use the external cooler only when your own is having trouble keeping up with the heat load. Run 1/2" ID (AN8) Aeroquip high-pressure hose; it's cheap insurance.

But if I've missed the point, or if you're bound and determined to drill and tap something, you'll find enough How-To poop in Bill Fisher's "How to Hotrod VW Engines". The tap you want is 3/8" NPT (National Pipe Thread), the Never-Exceed depth (on late Type I & III cases) is 1-1/2", the drill size is 37/64" (9/16" will work) and you install the fitting with sealant (try Permatex) rather than tape. In bugs and buses you'll need an angled fitting, 45 or 90 degrees, depending on the installation, and it can only 'point' to a rather narrow arc in order to provide clearance for the hose. That means you'll have to hit the thread-in depth bang-on, you can't 'twist until tight' on this one. So use your fitting as a gauge, checking frequently as you tap the bore.

It's best to do the drilling on a drill press, and with the case-half well secured. Magnesium alloy is 'sticky' and will grap on you. Drills are ground at a different angle for magnesium alloy; you probably won't have that type so just be careful. And don't smoke. The magnesium swarf ignites easily; clean it all up after drilling to prevent future surprises in the shop. (Boy, is that stuff bright! No wonder they use it in flares.)

Extra Oil Sump

I was given (!!) a Gene Berg add on oil sump. Should I use this device on my '68 bus? Are there any precautions I need to take? Disadvantages, besides extra $$ for oil changes? Will it help me out in any way?

Deep sumps are a trick developed on the drag strip to get the oil out of the crankcase allowing the engine to accelerate more quickly. They provide no benefit to a daily driver, slowing engine warm-up and imposing mechanical strains the miniscule sump-plate studs were never designed to withstand. Claims they lower oil temperature are based on temperature sensors installed in the deep-sump — valve gallery temps stay the same and because the increased oil quantity introduces considerable lag, you can be running El Frito temps long before the gauge begins to move.

If you feel you need additional oil capacity, installation of a full-flow oil filter will increase your capacity by about a quart, an external oil cooler by at least a pint, plus the oil in the tubing runs.

You really don't want something like this dangling under your bus.

Filter Pumps

Regarding filter/pumps, I've a hunch they are one of those niffty ideas that doesn't quite work. I saw two that had porosities in the castings — oil oozing from bare metal, and one that was a whopping .006" UNDERSIZE. (The pump is supposed to be about .001" oversize to insure a tight fit at operating temp.) And before you install it you'd better figure out how you're going to pull it, because you can't use a regular puller. (And don't wave two screwdrivers at me, I've seen enough gouged–up cases to last a lifetime.) Then there's the problem of re–setting the studs, and where to find a filter that doesn't interfer with a stock muffler (Didn't they mention that? You have to use this teenie little filter. The Porsche filter is too long; it hits the pre–heater pipe beside the #4 exhaust manifold.) Okay, so you use an after–market exhaust system. Should work. If it fits. And doesn't leak. Of course, since you're tearing the thing down you could just go ahead and tap the case…

Full–Flow Oil I

Installing a Full Flow Oil Filter

The goal is to block the normal outlet from the oil pump, diverting the output through an oil filter, then plumbing it back into the main oil gallery.

Blocking the Pump Outlet

The pump outlet is most easily blocked by threading the passage and installing a suitable socket–head set screw. Since there are a number of different pumps, both stock and after–market, the diameter of the outlet varies. Simply select a suitable set screw and thread to match. Install the set screw with hi–temp lock–tite and allow to cure before assembly.

If you‘re a machinist you may prefer to weld the outlet shut. You‘ll have to clean it up on the lathe when you‘re done but this technique leaves the inner portion of the outlet port unobstructed, allowing you to use a regular oil pump puller for removal. Set screws, pipe plugs and the like prevent you from using a regular puller since the tang can not enter the port far enough to get a good grip on the pump body.

Modified oil pumps may be most easily pulled if the pump body is drilled & tapped 10–32 at about the 10 & 4 o‘clock position. A new puller is made to match the tapped holes and fastened to the pump body with 10–32 socket–head screws. The regular puller C– frame may be used.

Providing a New Outlet

The usual technique is to make or buy a pump cover that provides a tapped outlet. Aluminum pump covers should be avoided as they wear quite rapidly. The best pump cover available is from Gene Berg. It is made of high density cast iron. The finish of the Berg cover tends to be spotty. Dressing the cover dead flat on a surface plate with #600 wet&dry paper flooded with kerosene will get rid of the tool marks and provide a longer wearing cover. You may also wish to break the edges with a file and clean up the outlet to provide better flow. Be sure all abrasive residue is removed. After cleaning, the cover should be given a light coat of flat black paint. When cured, install a suitable adapter for the oil hose you‘ll be using. Aeroquip fittings are recommended since on a cold morning the pump pressure can exceed 200 psi.

Tapping the Main Oil Gallery

Oil from the filter (and external cooler, if fitted) is returned to the main oil gallery. The most common method is to remove the drilling plug at the fan–pulley end of the engine, drill out the hole, and tap 3/8–NPT.

Be extremely careful when drilling. If you drill too deeply you will interfere with the operation of the oil control valve. This is a common error and will prevent oil being diverted to the stock cooler when the engine warms up, giving rise to the widely held belief that installing an oil filter causes the engine to run hotter (!).

Take special care when tapping the newly drilled hole. Since National Pipe Thread is tapered, you can crack the relatively fragile magnesium crankcase. Proceed slowly, backing out and clearing the thread frequently, using the intended fitting as a gauge. The engine case must be thoroughly cleaned after the oil gallery is tapped, including removal of the oil control valve.

Mounting the Oil Filter

As a general rule, it‘s best to mount the oil filter within the engine compartment. It should be mounted vertically, open end up. In Transporters there‘s a handy strut to the left of the engine that makes a good mounting position. In sedans the filter is usually tucked into the upper left corner of the engine compartment.

A better solution is to emulate the Porsche, mounting the oil filter on the blower housing. The advantage here is that the engine may be removed from the vehicle without having to open the lubrication system to possible contamination.

The disadvantage is that you‘ll have to move the coil around to the back of the blower housing. The Porsche–type mounting works best on engines with dual carbs but if the bracket is positioned so the hoses attach from the left, it will work on single–carb installations.

Hoses and Fittings

Aeroquip. AN–8. There‘s really no alternative. The half–inch diameter, stainless steel braided hose has a bursting strength of 1200psi. It‘s expensive but it‘s a one–time cost. The aircraft grade fittings insure a leak–free system.

I‘ve used AN–6 stuff (ie, 3/8") for some stock displacement engines but it‘s really marginal. I would avoid the kit–hoses offered by Gene Berg, unless the life of my first–born was somehow involved. (And even then. . . Naw, kill the kid! Gene‘s hoses are too skinny and ‘way too short.)

If economics demands you use lesser stuff, such as barbed brass fittings and rubber hose, replace the hose at least every two years. Things happen in a hurry when you blow a hose at speed.

Oil Filter

Use the Fram PH–8A. House–brands (K–mart, etc) tend to leak (or burst!) If your relief valve is working properly you won‘t blow up the Fram, although for cold weather applications you may want to use the HP–8A (ie, High Pressure canister). If you do have problems with your filter it probably indicates your relief valve isn‘t working properly. One solution is to buy the Berg pump cover that has a 90psi relief valve built–in.

Always pre–fill the filter prior to installation to keep from running your bearings dry.

Replace the filter according to your driving conditions, but at least once a year. For normal highway driving the filter (and oil) should last between 2500 and 3000 miles, but you can cut that in half doing city driving, halve it again if you like to play in the dirt.

Oil

If you‘re running formulated oil (ie, 20–50W or some such) you‘re using 20 weight oil containing additives that increase its viscosity at higher temperatures. But those additives break down when the oil temperature approaches 300 degrees, leaving you with only the base 20W oil. This break–down occurs quite quickly in the VW since the valve gallery is typically running about 250 degrees. I‘ve used 20–50W without problems for more than 20 years but different patterns and locations of driving demand different lubricants. Friends in arctic climates (Finland, parts of Illinois, etc.) say they use 10# most of the year, adding a quart of 30# when spring arrives. I‘m not sure if they were joking or not. I‘ve used Aeroshell 50 weight when flying behind a VW, and lots of #30 when running round in Baja, where it seems to be the most commonly available grade.

Whatever you use, the cheapest insurance you can buy is to change your oil frequently.

Other Sources of Information

H.P.Books “How to Hotrod Volkswagen Engines” (available from J. C. Whitney for about $12) provides an illustration showing the basic mods needed to add a full–flow oil filter. (My copy sez `$5` on the cover.)

Cost vs Value

Installation of a full–flow oil filter will quite literally double the life of a newly assembled engine, making it the most cost–effective modification you can make; two engines for the price of one. And having plumbed the engine for a full–flow oil filter, adding an external oil cooler becomes a trivial task.

Full Flow Oil II

More on Full–Flow Oil Filters

Full–flow' oil filtration is generally accepted as meaning the total output of the oil pump is filtered. This provides the engine with a constantly clean supply of oil, at least in so far as particulate contaminates. This results in a dramatic reduction of engine wear.

But to achieve full–flow oil filtration on early VW engines we must violate some rules.

Your oil pump can produce up to 300 psi at the outlet. A fundamental rule of engineering is to put a pressure relief valve as near the oil pump as possible; typically, the relief valve is built–in to the pump. In the Volkswagen, the oil pressure relief valve is the first thing 'seen' by the pump's output. And that's the first rule we violate.

To plumb an oil filter into a lubrication system that didn't have one to begin with, we must resort to hoses and fittings. In doing so we make the external plumbing and the oil filter canister the first thing 'seen' by the pump's output. (Keep in mind that cold–morning starting pressure of up to 300 pounds per square inch.) We make the problem worse by putting an oil cooler downstream from the filter. (Filter HOT oil, cool FILTERED oil.)

The hoses, filter and cooler offer considerable restriction to the oil flow before it arrives at the pressure relieve valve, especially if small diameter hose is used and the cooler is one of the folded–tube type. On a cold morning an engine filled with 30W oil can easily develop enough hydraulic pressure to burst a filter canister, even when the oil pressure valve is working properly.

Gene Berg offers an eminently practical solution to this problem by putting a pressure relief valve in one model of his oil pump cover (GB 239x, where x = various model suffixes). Unfortunately, the solution reflects two minor compromises, the first being a reduction in maximum flow, the second being to allow some of the pump's output to NOT pass through the oil filter, but neither does it pass through the bearings so the point is truly minor. The flow reduction, however, is more critical, especially when running hydraulic cam followers.

My solution is to use Aeroquip high pressure hose and fittings with an ID of 1/2" (often called 'AN–8'). That is, both the hose and fittings are AN–8. (It's possible to install 1/2" fittings on smaller hose!) The safety of such hose and fittings has been proven by millions of hours of flight on commercial aircraft.

For an oil cooler you want one having a very low restriction. I've found the steel, 72–plate model offered by J.C.Whitney [38XX1483T] at about $50 to be the most cost effective.

Central to the configuration above was the need to insure maximum oil flow, not only for cooling in large displacement engines, but to insure proper operation of hydraulic cam followers, which normally operate best when provided with oil at about 50 psi, nearly twice the norm for stock VW's.

Oil Filters

The relief valve in an oil filter insures a clogged filter will not obstruct the flow the flow of oil to the engine. It has nothing to do with the oil PRESSURE relief valve. On Fram filters the 'A' suffix indicates an internal relief valve.

Full Flow Oil III

If you're using a Type I engine in a later model bus with the rear cross–member, and are using the adaptor plate that replaces the oil pump cover, the plate may be adapted to serve in a full–flow oil filtration system by welding a fitting in the appropriate place. The plate must be ground flat after welding.

I don't like this arrangement; the things seem to leak more than they should, but if you've no other engine case available it's a workable fix. Your engine will last a lot longer with a full–flow system installed.

More #@!! Filter Pumps

Screwed Again

For those of you who have followed my tribulations with the bolt-on filter/pumps, I got suckered in again. I've had my hands of five of these things now; four of them have been bad. To keep from beating a dead horse, take a look at my archived sermons on these things. I think you'll agree I've given them a fair trial.

For background, the oil pump mounts in a machined bore in the rear of the engine where a tang on the pump's driven-gear engages a slot in the middle of the cam shaft, allowing the pump to spin at one-half engine speed. The body of the pump has to be a tight fit in the bore since the inlet and outlet ports entire from the walls of the bore. A loose fit means the pump won't draw, and what little it sucks in will just get sprayed through the gap if the outlet isn't tighter than a newlywed's hug.

Here's some numbers that will make the situation a bit more clear. To make sure things are tight, Volkswagen machines the bore to about 2.7535" and the pump to 2.7570" . When you gently tap the pump-body into the bore the .0035" difference creates what's called an 'interference' fit, the thing is tighter than a bull's ass at fly time, which is why you need a puller to get it out. And why the thing works. (At operating temperature it's not quite so tight because the magnesium crankcase expands at a faster rate than the aluminum pump body, but you get the idea.)

The filter/pump I got from J. C. Whitney, the second one from that source, measures 2.7515" in diameter. It's so damn loose it rattles! Flops into the bore like a peach pit down a stove pipe.

Here I am, slinging an engine together, trying to do a half-way decent job of it and then I run into this piece of crap. But what really gets my dander up is the fact the last one I got from Whitney was a fine piece of goods.

Alright — I guess the joke's on me. Sitting here preaching about the evils of after-market parts and how any damn fool should have enough sense to clap a mike on anything that walks through the door, and then I get two pumps from Whitney, check one and ASSUME the other is okay. The Gotcha! done got me, and I can't even send it back — I got the thing several months ago, the papers probably went into the woodstove around Christmas. I'll throw it back of the bench with my collection of Rusties and Ohmygawds!

But maybe I can keep the Gotcha! from getting you.

More Blown Oil

When you have a shaft seal installed on an early VW crankcase you must thereafter use a fan pulley that has the hub turned down and polished to fit the ID of the shaft seal. The steel pulley is best all around but a lot of folks like aluminum jobbies and some full-trick, degreed aluminum pulleys are available with turned-down hubs. Unfortunately, when the cast aluminum hub encounters the shaft seal it begins to wear at a fast rate and has to be replaced fairly often, along with the seal, to keep the engine from bleeding oil all over.

Then there's the after-market suppliers who will sell you a degree wheel WITH a turned-down hub even if you don't have a shaft seal. If you're not running a shaft seal the polished, turned-down hub leaves a humungous hole instead of the narrow gap left by a stock pulley hub. Such engines may look trick (the degree wheel is usually polished or anodized or gold-plated or encased in tattooed human skin) but they gush oil, thanks to the huge hole and the 'trick' pulley that doen't fit. Wins lotsa prizes, of course. Trophies up to here. But you don't want to live in the same county with one due to the danger of an oil spill.

More Drain Plugs

Clean your bolt, as in super-shiny clean. MEK. Nuclear radiation. Grandma's lye soap. Get every bit of oil off the thing. Now gunk it up with #2 Permatex (the non-hardening stuff). Work it in with your fingers. (Uck! Now you'll never get it off your fingers.) Get it right down into the threads. NOW screw it into your aluminum crankcase, the one I thot was steel.

#2 Permatex is an excellent anti-galling compound. It will remain in the threads of the bolt long after the Pyramids have turned to dust. And keep your steel bolt from welding to your cast aluminum crankcase. The Permatex also acts as a sealant, and as an adhesive.

Steel into aluminum isn't a good idea for a drain plug. The aluminum is going to expand, not only diametrically but within the thread-pitch. This will force the aluminum into the microscopic serrations in the bolt's threads, which will lead to galling, which will lead to stripping out the thread in the crankcase. The Permatex will prevent this.

Removing the bolt when the aluminum was stony cold would have been better than doing it hot, but oil is drained when warm, not cold. The deck was stacked against you.

Brass would have been a better choice for the bolt, or a steel insert in the casting. You may wish to consider a bolt-within-a-bolt, the outer bolt acting as a sleeve, prevented from moving when you remove the smaller inner bolt which serves as the actual drain. Another idea would be some sort of valve — anything that would allow you to drain the sump without having to torque a steel bolt in & out of the aluminum casting.

With a steel bolt in an aluminum casting, it's only a matter of time before you'll be forced to renew the thread in the casting. Stripping the thing out wasn't your fault, it was a design flaw. A better method would have been a large diameter, coarse-threaded aluminum drain plug fitted with an O-ring, as seen on motorcycles and aircraft engines.

If you can drill the head of the bolt, it might be wise to safety-wire it. Use the fine gauge stuff (.028" or .032"). If the bolt has a large head, try drilling just a corner.

Oil Coolers

Everything You Ever Wanted to Know About After–market Oil Coolers

Fundamental Stuff

All reciprocating internal combustion engines used in automobiles are 'air–cooled' in that their waste heat is coupled to the atmosphere.

The main advantage of an air–cooled engine is its lighter weight. The lack of radiator, water pump and hoses translates into lower production costs. A lower parts count should mean less maintenance and greater reliability but this isn't true if the engine is required to operate near maximum output for long periods, as is the case with the Volkswagen.

The success of air–cooling depends on the physical properties of air, such as its density and temperature; thicker air, such as found at sea level, will absorb more heat than thinner, high altitude air such found at Denver, Mexico City, or Bogota. The engine's ability to transfer waste heat to the air mass depends on the velocity of the air flow over the engine's heat conducting surfaces, the surface area of those conducting surfaces and how well they conduct heat.

The success of a specific air–cooled engine, such as the Volkswagen, depends largely on the capacity of its blower, the shape of the air–containment shrouding, and the size & efficiency of its oil cooler. If the displacement of the engine is increased the factors above must be changed to insure the increased heat load can be coupled to the atmosphere.

Background Stuff

The Volkswagen engine design dates from the early 1930's and reflects remarkable innovation for that period. Using principles adopted from motorcycle and aircraft engines, the first VW prototypes were not fitted with any form of oil coolers, depending on their deeply finned crankcase. When this proved unsuitable, a variety of oil cooling methods were tried. A surviving photograph from 1932 shows an engine fitted with an external oil cooler but it was a plumber's nightmare. By making a minor modification to the magnesium crankcase casting, it was possible to fit an oil cooler within the blower housing. Hindsight has shown this to be a compromise but the engine was less expensive to manufacture than one having an external oil cooler and appeared capable of meeting the durability specification of 100,000 kilometers before needing major overhaul. The original Volkswagen was priced at 1,000 marks; in the mid–1930's a low–cost car capable of delivering 56,000 miles of service was unheard of.

The original Volkswagen engine was rated at 22 horsepower, its war–time version at 25. The original blower and oil cooler design proved adequate for the task except in Africa. Engine problems usually involved the failure of the #3 exhaust valve. The #3 cylinder received the majority of its cooling air from the exhaust of the oil cooler. Already heated by passage through the oil cooler, #3 cylinder typically ran hotter than the other three. The added heat stress caused the early failure of the #3 exhaust valve.

Modern Times

Post–war development of the Volkswagen saw a steady increase in engine displacement and thus waste heat. Engine failures followed the now familiar pattern of #3 cylinder swallowing its exhaust valve. But no significant changes were made in either air flow or oil cooler efficiency until 1971, when Volkswagen finally bit the bullet and redesigned the blower housing to accept a larger fan. At the same time they adopted an oil cooler having a higher heat transfer rate and moved it to a new location outside of the blower housing, thus making it an external oil cooler.

The redesigned oil cooler was housed in a 'dog–house' attached to the front of the blower housing. After passing through the oil cooler the heated air was ducted out of the engine compartment.

The new oil cooler is the same design used on the Porsche and Corvair. Volkswagen used it earlier on the pancake engines used to power Type III's.

The dog–house style oil coolers have enough excess capacity to handle engines with displacements of 2000cc.

Aftermarket Stuff

Within a few years of their introduction to the southwestern United States it was clear that the Volkswagen had a problem keeping a cool head. Driven at highway speeds when the temperature was above 90 degrees Fahrenheit insured your bug wouldn't last very long. Early bug owners quickly learned they had to keep their foot out of it or cross the desert at night. For bus owners it was even more of a problem. The deserts of the southwest were a lot farther from northern Europe than VW ever imagined.

Those of us adventurous enough to do our own repairs had good evidence that our engines would last longer if we could get the oil cooler out of the blower housing. The usual method was to make a hose adaptor that fit where the oil cooler normally mounted, allowing us to put the oil cooler somewhere else, usually in front of the air inlet to the blower housing so as to get the benefit of the air flow. This didn't work very well due to the small size of the stock oil cooler so a variety of alternatives were tried, including heater cores and refrigeration coils. A large heater core appeared to be the perfect solution since they were widely available (they had remote heaters that mounted under the rear seats) and most of them worked very well… until the first cold morning, when they would burst. Refrigeration coils also looked good, and even worked after a fashion, but the diameter of refrigeration tubing was rather small. By the time you had enough of it to do a good job of cooling, the flow of oil was so restricted that you were liable to suffer a bearing failure, rather than swallowing #3.

The interim solution was to use war surplus aircraft oil coolers. You could mount two of them across the air inlet behind the fan housing and no matter how large an engine you were running (some of us tried modified motorcycle cylinders; others used Corvair jugs) your engine would never overheat.

Mounting the oil cooler over the air inlet was of course a compromise since it pre–heated the cooling air. But it was a better solution since it distributed the heat stress to all four cylinders rather than roasting #3.

By the late 1960's tube–type aftermarket oil coolers were available specifically for Volkswagens. Unfortunately, tube–type coolers have a host of problems: Most offer too much restriction and many are made of copper and burst with depressing regularity. On the cheaper models the cooling fins are not brazed to the tube but simply pressed in place, presenting the heat flow with a high–resistance path. VW owners seriously interested in durability stuck with Corvair, Porsche and Harrison (aircraft– type) oil coolers.

Most recently, a steel plate–type cooler has become available. Intended to serve as a utility radiator for both lubricating oil and transmission fluid, it was never aimed at the Volkswagen market, although it was quickly adopted. The oil cooler (which is available from J. C. Whitney [s/n 38XX1483T, about $50] and others) may be mounted away from the engine when used with an auxiliary fan, or to the back of the blower housing. Its steel construction insures against leaks and while steel is not as good a conductor of heat as aluminum, the large size of the radiator makes it suitable for engines up to 2400cc.

General Conclusions

An external oil cooler is not required on dog–house engines up to 2000cc.

Do not use a tube–type oil cooler.

When installing an external oil cooler use AN8 (1/2") aircraft type fittings and high pressure oil hose with an internal diameter of 1/2". Racers and those serious about durability use Aeroquip fittings and hose, or their non–aircraft certified counterpart.

When mounted away from the air inlet, an auxiliary fan is required. The fan is normally wired in series with a thermostatically controlled switch.

Final Conclusions

When you install an external oil cooler you are doing something VW should have done in the first place, and which they got around to in 1971. This ‘Better Late Than Never’ brand of retro–fit engineering also applies to oil filters and hydraulic cam followers, which VW incorporated in its late Type IV engines.

The smartest move you can make when installing an external oil cooler is to install it in conjunction with a full–flow oil filtration system, in which case it is installed downstream of the filter, usually on the other side of a thermostatically controlled valve.

Depending on the plumbing runs, an external oil cooler and filter will increase your oil capacity by about 1.3 quarts. Aside from doubling the life of your engine the most significant change you’ll see is a slightly longer warm–up time. With a filter installed you can extend your oil change period to 3,000 miles (non–dusty conditions).

Oil Filters

In the mid to late 1960's I did two tours in Vietnam. During those years I missed a few things but my wife faithfully stacked up the many magazines and journals, saving them for my return. (Something called 'Star Trek' also came & went during my absence. Now it's back. I wonder if I'll have to go back…)

During my time in Vietnam a lot of basic research was being done on filters for both air and oil. New products came and went — I read about a few when I got home but figured, rightly so, that if anything was really outstanding I would see it adopted by the automotive industry. Among those products were various kinds of air filters made from foam, and a host of oil filters that used everything from centrifugal action to gravity pools.

Some of the new ideas were good; we see them in engines today. But most failed the test of practicality, or simply weren't good enough. I recall several articles comparing different forms of oil filtration and/or purification. The tests conducted by Pratt & Whitney, and by the oil filter manufacturers were very well done; the results were published in the Journal of the Society of Automotive Engineers and others. A few, mostly of the Gee Whiz variety, appeared in the popular press.

All around the world, every major automotive manufacturer continues to use the canister–type oil filter. There may be better filters out there but none do as good a job at so low a price. Honda adopted some centrifugal filtering methods — it makes good sense when you have parts rotating at the 5,000 rpm+ speeds that make centrifuging work. Fiat tried a 'permanent' porous bronze filter that failed, apparently due chemical contamination; it's tough to keep water out of your oil. Volkswagen tried several schemes for it's new engine–in– development but came back to the proven technology of the canister filter.

I've never used an Oberg filter. It could be the smartest idea since the breech–loading rifle, but I doubt it. If it could do a better job, extend an engine's life, or save a dime on the bottom line, you would see it coming out of Detroit by the millions, or hung on specialty–cars or aircraft engines. But you don't. Even in applications where money is no object, where the only goal is excellence, engine–builders and auto manufacturers keep going back to those 'old fashioned' canister–type filters. So do I.

I pay about two and a half bucks for a Fram filter; wait for the sales, buy a bunch of them. I maintain three cars, two trucks, a bus and a motorcycle; I use a lot of oil filters. The daily drivers (three of them) use four a year, on average — ten bucks. The other vehicles at least one a year. It adds up.

But slowly. I don't know the current cost of an Oberg filter; the last I heard, they were a fairly pricey item. And according to one of those SAE articles (or maybe it was Pratt–Whitney…) the only way to clean a porous bronze, labyrinth or screen–type filter was with ultra–sonics and something grim, like MEK.

So I guess I'll keep screwing on a Fram. I've been screwing on Fram's for more than forty years. Works for me.

Oil Galleries & Hydraulic Lifters

When doing an overhaul on a high-time engine it's a good idea to pull the soft aluminum plugs used to seal (hopefully!) the various oil galleries, replacing them with threaded set-screws, for galleries up to 1/2" (13mm), using socket-head aluminum pipe plugs for any of larger diameter. Set-screws come in a variety of lengths, diameter and thread.

It is extremely important the the engine be dismantled when the oil galleries are tapped, and that the crankcase be throughly cleaned after. To insure a leak-free seal, the threads should be primed and the set-screws treated with loctite. After insertion of the set-screws the case should be allowed to cure for 24 hours before further assembly.

For those of you running the 'drop-in' hydraulic cam follower (available from CB and others) in Type I engines, you will have noticed occasional clack and collapse of the lifters. The problem stems from the small diameter of the stock cam follower oil galleries. Under some conditions the 'corner' lifters will be starved for oil. You can cure this problem by opening up the cam-follower galleries with a long-reach 1/4" drill. The cam follower bores should be smoothed after drilling to remove any burrs. Enlarging the center cam bearing oil trough (ie, the space under the middle of the bearing) will also help, as this is the sole path for oil to the cam followers on the right-hand side of the case.

Oil Pressure Sender Removal

Also, would a sender from a '73 (whats that a 1700 cc engine) work in my '77?

The sender is a pressure sensitive switch. It is the same for all Type IV's…. and probably earlier engines as well, turning on (or off, depending on how you look at it :–) somewhere between 3 and 7 psi, depending on the engine's temperature.

The thread should be 1/8" NPT (ie, National Pipe Thread — a thread form having a taper of 3/4" to the foot). Get a new switch — either FLAPS, VW dealer or junkie — and determine the proper deep–socket needed for its installation. (This will also tell you what socket is needed for removing the failed sender.) Use a bit of masking tape to cause the sender to cling to the socket (for installation). Add a small amount of Permatex to the thread and very carefully thread the replacement into the hole BY HAND until it is fully seated. This hand–threading is very important since it's easy to cross–thread a tapered thead. Once it's seated, tighten it down. Being tapered, you won't need much force to produce an oil–tight seal — don't over–tighten the thing.

When finished, be sure to seal the access hole with a plug. If the original plug is missing, fabricate something. RTV and a bit of beer–can aluminum makes a good plug. Shape the aluminum to match the contour of the shroud, punch a hole in the middle for the wire. Be sure the wire is grommeted or bedded in RTV if you use a metal seal. Use a liberal coat of RTV, press the seal into place and leave the thing to cure. Glued–on metal is okay here since you normally don't need to replace the switch very often. Give it at least 24 hours to cure. Re–check your work — especially the grommeting of the wire — before driving.

Be sure to use Permatex or other liquid sealant on the threads. Do not use Teflon tape. The Teflon acts as an electrical insulator — the switch must have a good electrical ground thru the threads in order to function properly.

Hydraulic Lifters

I recently aquired a used hydraulic type 1 1641 engine. Its running great, but the oil pressure is much higher than I had with a type 1 stock engine.

I'm seeing over 60 at startup, and it settles to around 50 when hot and cruising, and low 20s when idling hot.

Does this sound normal? I'm afraid that I'm going to force oil out the seals.

I'm pretty sure this isn't normal for a stock 1600.

It's normal. And don't worry about the seals.

When running hydrualic cam-followers the stock oil-pressure relief spring, which provides 27 to 30 psi at the gallery with cold oil, is changed to one which provides a minimum of 45 psi. If the cam-follower oil-gallery on the right side of the engine were able to 'fill' faster (ie, had more than one connection to the main oil gallery) you could probably get by with the stock spring. The higher pressure insures adequate flow to the lifters on the 'corners' of the engine, especially those on the right-hand side.

Stories of 'blown seals' in an early air-cooled Volkswagen engine are mostly myth. The typical static seal, such as used on the oil cooler and adapter, is good for about 200 psi. The root cause of 'blown' oil-cooler seals is usually improper installation or a fastener that has come loose. The sealing ability between bolted, gasketed surfaces such as on the oil pump are as good as you care to make them. With only modest attention to detail it's possible to achieve a seal at the oil pump that will withstand 300 psi.

Rotating seals, such as those used on shafts, are not intended to be perfectly oil tight. To make such a seal oil-tight (or to handle high pressure) would cause accelerated wear on the shaft — that is, on the flywheel or pulley hub in the case of Volkswagens. Accordingly, rotating seals are rarely subjected to pressurized oil. In the Volkswagen, the flywheel seal bore is provided with a drain direct to the sump. The seal itself sees only the pressure of the atmosphere within the crankcase. The same is true of any seal installed on the pulley-hub.

Aside from improper installation, the most common reason for failure of the flywheel seal is due to accumulated wear usually in the form of excessive end- play. When the crankshaft can move fore & aft more than the width of the seal's sealing surface it will literally pump oil past the seal. Although it pumps only a tiny volume of oil with each ‘stroke’, at highway speeds it can drain the sump in as little as a fifty miles.

Another common cause of leaks from the flywheel seal, usually seen on freshly overhauled engines, is blockage of the drain-hole in the flywheel-seal seat, allowing pressure to build up behind the seal.

On engines fitted with shaft seals people often confuse leaks due to high internal crankcase pressure resulting from a blocked vent or excessive blow-by, to a ‘blown seal’ resulting from high oil pressure. When an engine experiences high pressure inside the crankcase you’re liable to see oil oozing from the sump plate, base of the cylinders, the distributor, valve covers or even the push-rod tubes — from every nook & cranny that was not not designed to contain oil under pressure.

While it is possible to make an oil-tight dynamic, rotating seal (hydraulic pumps & motors being a good example), in such cases the shaft is normally provided with replaceable wear-surface. The same thing is done even with unpressurized seals when they bear against a rotating aluminum part (ie, a soft metal that wears rapidly). RIMCO uses a pressed-on stainless steel collar on aluminum pulleys used with the sand seal they install on early crankcases.

Seals are of critical importance in aircraft engines since it isn’t always possible to stop and replinish your oil supply. Having a good basic understanding of gaskets and seals will allow you to accurately diagnose a failure. And the better you understand the problem the more likely you’ll be able to effect a repair, even a jury-rig, if that’s what it takes to get you home.

Keeping the oil — and gasoline — where it’s supposed to be is not an intuitive process. Good plumbing is based on knowledge best gained from professional texts on the subject.

Oil Seal

Kid comes in the shop wringing his hands, all upset. He's just paid a lot of money for someone to rebuild the engine in his bug and it's leaking oil from the front seal. The guy who screwed it up sez it's not his fault, it must be coming from the rear tranny seal, wants to sell the kid a rebuilt tranny. And besides, all VW's drip oil; no big deal. But the kid is sure it's leaking more than it did before it was overhauled and he's never had his tranny leak and the leaky stuff doesn't have that thick sulphury smell like tranny lube and his mom is all upset about the gunk on the driveway. (That last is the real reason he's here.)

So you drop the engine, pull the old seal, check the end-play ('way off), clean the oil drain drilling, put in a new shim stack and a new oil seal. To further the kid's education you show him how the seal has been ruined; whoever installed it used a hammer.

Hammer = Drips

At least half the drippy oil seals I see are caused by improper installation of the seal, or by improper engine assembly.

The #1 main bearing oil seal is neoprene or silicone rubber bonded to a metal ring with a circular coiled spring inside to maintain a leak-free sliding fit around the center boss of the flywheel. The oil seal fits into a recess cast into the crankcase; it's a tight fit. Properly installed, the oil seal ends up slightly below the level of the casting. Volkswagen shows the seal being pressed into place using a screw-type fixture, but a skilled mechanic can install one using repeated light taps from a plastic mallet. An unskilled mechanic will try to do it with a hammer and while it might look okay, about half the time the hammer blows cut the silicone rubber where it's molded over the invisible metal ring inside of the oil seal. Oil quickly discovers the cuts and you've got a leaker on your hands.

Too Much Sealant = Drips

The improper assembly problem is more subtle but when combined with an improperly installed oil seal the thing doesn't just leak, it gushes.

Like all of the main bearings, #1 is generously supplied with pressured oil form the main oil gallery. In normal operation the oil lubricates the journal and escapes from both sides of the bearing. On the flywheel-side of the bearing the oil collects between the bearing and oil seal, flowing back to the sump via a drilling in the left half of the crankcase. Want to guess what happens if that drilling gets blocked? (Be careful, it's a trick question.)

If the #1 main bearing oil return is blocked, oil pressure will build up behind the seal and the thing will eventually leak. That's the obvious answer. But a blocked oil return port also results in accelerated wear since the thrust face of the bearing and the associated shim stack is not being provided with a circulating supply of oil.

Most often, the oil return passage is blocked by an over zealous application of sealant when the crankcase halves are joined. Here's how it happens: The left half of the crankcase is in the fixture, parting line up, the guy swabs on about four times more sealant than needed and when he drops the right half of the crankcase into place it squeezes the sealant out, which flows downhill into the oil return passage from the #1 main bearing. And that's just on the inside. Outside, the sealant is oozing all over, including down into the recess for the oil seal. Being in the 'corner' of the recess, the oil return passage gets more than its share when it shouldn't have gotten any at all. (Hint: After closing the crankcase for the last time, check the oil return drilling to insure it is clear.)

In several cases I've seen engines with sealant deliberately painted into the oil seal seat, apparently hoping to stave off chronic leaks. In those cases the oil seal itself was always damaged by hammer blows. Think about that for a minute. The guy builds an engine, hammers in the oil seal and sure enough, the puppy leaks like a sieve. So the next time he globs on a lot of sealant, HAMMERS IN another oil seal and this time it leaks even worse, convincing him it's impossible to keep a VW engine from leaking. (And besides, everyone sez VW's leak. Conventional Wisdom wins again.)

So why do people install oil seals with a hammer? First, because they see a real mechanic do it successfully and never understand that it takes considerable skill to do it right. Secondly, they do it because most of the manuals say it's okay to hammer it in. (And besides, what could be more basic than a hammer. Everyone knows how to hammer, there's really no skill involved. Or is there?)

Push or Pull = No Drips

Oil seals are designed to be pressed or pulled into their seats. It's possible for a skilled mechanic to install them with a plastic mallet, or even a hammer in the case of some axle seals, but it's also possible for a skilled surgeon to do an appendectomy with a pocket-knife; the emphasis is on the skill, not the tool.

Oil seals aren't expensive and they don't look very sophisticated but there's more to them than meets the eye. If you toss an old one on the barby and wait for a while you'll be able to examine what's under the rubber. You'll see that most of them start out as a segmented ring of thin SHARP steel. Cover that with rubber, tap on it with a hammer and it cuts the rubber as neatly as a knife.

So press them in. Or pull them. You can make a dandy puller- pressor for your front brake drums (the seals you'll replace most often) using nothing more than a length of all-thread, some washers and three nuts. You can buy a screw-type pressor for the #1 main bearing seal.

Or drive them in, if the seal is small. By distributing the force of the hammer blows uniformly, a seal driver lets you pop the things into place with one or two well placed blows of a hammer. If you've a lathe, making oil seal drivers is a spare- time sorta thing; all are simple turnings, and aluminum or even hardwood works as well as steel.

But because of their tendency to cock in the bore, large-diameter seals are best installed with a press or fixture. Rear axle seals are especially troublesome due to their deeply recessed position in the seal cover. Because of their proximity to the brakes the wiser course is to always press-in rear axle seals.

Sermonette

With the exception of the Muir manual, books on maintaining your Volkswagen assume a certain level of competence. Learning to tap a seal into place with a plastic mallet isn't difficult; it's one of the many minor skills acquired during the apprenticeship all mechanics must endure. It is also one of the minor skills many self-taught mechanics never bother to master. (Hint: Start with an old seal. And an old engine case. When you can tap the thing in a dozen times in a row without damaging either the case or the seal you're probably ready to try it with a new seal on a good case. Along the way, you will have learned how to remove the thing as well.) But installing a seal with a hammer falls into the category of things a skilled mechanic can do when the proper tools are not available; pressing in the seal is not only safer, it's usually faster. And a pressed-into-place seal is cheap insurance against oil leaks.

Oil Temp Gauge

Easy Oil Temp For Upright Engines

Just to the right of the oil pump on the rear of every Type I engine you'll see a slotted plug. It is about half an inch in diameter and the slot is moon-shaped, rather like the cut-out for a Woodruff key, unsuited for removal with a regular screwdriver.

The plug closes off the drilled passage that supplies oil from the sump to the oil pump inlet. Inside the crankcase the oil pick-up tube is a press fit into the drilled passageway, the pick-up prevented from turning by being secured to one of the oil sump plate studs.

The inlet to the oil pump is one of the best places to measure your oil's temperature, since the oil has been drawn from the deepest part of the sump and gives an accurate indication of the average oil temp which can vary by more than a hundred degrees (F.) depending on where the temperature is measured.

J. C. Whitney provides an adapter that matches the threads of the slotted plug (13-xx-9267-A, $4). The adapter is internally threaded to accept the standard oil temperature sender (12-xx-6195-Y, $8) that matches their electric oil temperature gauge (12-xx-6193-T, $17).

For less than $30, plus shipping, you can add a durable, reasonably accurate oil temperature gauge to your engine and do so in an entirely professional manner. The wire is well protected and does not interfere with the sump plate or dipstick. The only 'gotcha' in the installation is removal of the threaded plug and this can be accomplished with vise-grip pliers once a suitably shaped blade has been made to accurately fit the curved slot in the plug, a task that takes only a few minutes if you have a vise and file. Once installed, the temperature pick-up does not obstruct the oil flow in any way.

For those of you with early-model buses, finding room to install additional instrumentation has always been a trial. One location is to use the cover plate on the overhead ventilator. Indeed, the cover plate is large enough to support four 2" diameter instruments and a 3" diameter tachometer, the wiring being concealed in the windshield corner post and carried back to the engine compartment through the driver's side frame member.

The only disadvantage of the overhead location is that it requires the driver to shift his/her eyes farther away from the windscreen than is usual and may induce some steering wander. Once accustomed to the location however you'll find scanning the overhead instruments more convenient than scanning those mounted below the dash or package tray and certainly less of an eye-sore and knee-gouger. The use of tapered wooden shims under the bezels of the instruments to cant them toward the driver makes them easier to read.

When pulling wire through the frame member you'll probably find it works best to use a fish-tape fed into the frame member from the middle. It would also be wise to pull as many wires as you might possibly need in the future, including at least one heavy gauge cable such as a #10 for auxiliary power.

The handiest way to get the new wiring harness into the cockpit is to drill a new hole near one of the existing wiring harness pass-thrus and install a rubber grommet. If you do a bit of planning you'll be able to come up with an installation that looks as if it were done at the factory and one that will cause no problems with existing wiring or plumbing.

If you can afford it, plan for the installation of an oil pressure gauge, oil temperature gauge, voltmeter and tachometer. If you order from J. C. Whitney ("Illuminated Preision Electric Gauges") all of the gauge faces will be of the same design. If you wish to have a symmetrical arrangement of two 2" instruments on either side of the 3" tachometer, you may consider an engine hour meter or even a clock to fill the fourth hole.

Oil Temp Sender

Installation of Engine Oil Temp. Sensors

In an earlier article now archived in the 'sermon' file, I described how to install an oil temperature gauge on an upright engine. The instant the article hit the web people rolled it up and commenced thumping me over the head.

"Bad dog! Bad, bad dog! The threaded fitting you describe only exists on the early-model magnesium crankcases."

Not entirely true. It is also present on early Type IV engines. But the point was well taken. I slunk off to the shop to ponder the error of my ways.

There were a number of engines in the shop at that time. I dragged a late-model crankcase under the workbench and began rubbing it on my belly. When I was done, it was fitted with a spiffy oil temperature sender.

Pulling the Plug

On late-model magnesium crankcases, and on the later Type IV's as well, the drilled passage for the oil pick-up tube is sealed with a pressed-in aluminum cup rather like a freeze plug but installed flanged-side inward. The use of aluminum plugs to seal the drilled oil passages in the crankcase is standard practice with Volkswagen.

Pulling the plug is crossing the Rubicon with regards to installing an oil temperature sender. Make sure you are prepared to deal with the hole or your engine-building career is over. To pull the plug I drilled a 1/8" hole in the center, threaded in a #8 sheet-metal screw and popped it out with a slap-hammer.

When you pull the plug you'll discover the passage behind it is 19mm in diameter, close enough to 3/4" so the difference is of no matter. The place where the plug seats is even larger, about .85" in diameter, which just happens to match the small-end of a 1/2"-NPT pipe-thread tap. Your first urge will be to hammer a pipe tap into the hole and start twisting. Resist.

Cracking the Crankcase

Pipe threads are tapered. Tightening a tapered plug into a tapered hole is an old-fashioned and eminently reliable means of insuring a leak-free fit. When you install a full-flow oil filtration system you thread the main oil gallery to accept a 3/8"-NPT fitting.

Frankly, tapered fittings are not the best thing to use on Volkswagen engines, they just happen to be the best thing that is commonly available. With magnesium castings there is some risk that the tapered, threaded fittings will be over-torqued, causing the wedge-effect to split the casting. When the hole you are trying to tap is a cylinder rather than a cone, you run into the same problem — too much muscle applied to the tapered tap can crack the case. To reduce this risk to an acceptable level, the hole to be threaded should be step-drilled or reamed to a taper. The common electrician's tapered reamer is a close match to the National Pipe Thread taper and the reamers are widely available in sizes suitable for fittings up to 1/2"-NPT.

I used a tapered reamer to shape the 19mm hole then tapped it to accept a 1/2"-NPT fitting. The oil temperature sensor I'm using happens to be threaded 1/8"-NPT and adapters for this combination are commonly available in both brass and aluminum, the latter from aircraft or racing equipment suppliers.

Where To Take the Engine's Temperture

Normal body temperature for humans is 98.6 degrees on the Fahrenheit scale but what you see on the thermometer depends on where you stick it.

With Volkswagen engines the oil pick-up gallery is the ideal spot to stick your oil temperature sensor because the oil is in constant motion, flowing past the sensor on its way to the oil pump. The temperature of this oil stream will closely reflect the temperature of the working oil in the sump.

VDO makes a very handy temperature sensor — for its own line of gauges — that is threaded 14mm x 1.50, the same thread as the sump's drain plug. In use, the drain plug is replaced by the VDO sensor, which comes with a bobbin-type electrical terminal allowing easy connection and disconnection of the wire. But the sump's drain-plug is not in the main stream of flowing oil, and the sump is cooled by the passage of air under the vehicle. The reading you obtain from such a sensor will always be lower than the temperature of the oil entering the pump. The difference is not large and is probably of little significance. If your only option is to use a sump-mounted sensor, then by all means do so.

Of course, you may thread a brass 1/2"-NPT adapter to accept the VDO sensor and install the VDO sensor in the oil pick-up gallery. Start with a half-inch to eighth-inch adapter, drill it out to 31/32", and tap 14mm x 1.50.

Other Ways to Stick It

Another option I explored was using a straight tap. The 19mm bore is close enough to 3/4" that it will accept a shallow thread from a 3/4"-16 tap but the resulting thread is so shallow it will not hold a bolt threaded 3/4-16. My solution to this was to turn a special adaptor on the lathe, making it large enough to fill the shallow threads I was able to cut in the oil pick-up gallery with a standard 3/4"-16 tap. There is enough metal in such an adapter to drill & tap it for any of the common oil temperature sensors, including the old Stewart-Warner 5/8-11 sensors.

Early Type IV engines use a threaded plug to seal the oil pick-up gallery, the same method used on the early-model magnesium crankcases. Standard adapters are available for this plug, allowing an oil temperature sensor to be mounted there. That works fine if the Type IV engine is in an airplane. In a bus, the rear engine mount blocks access to the threaded fitting.

Generally, any oil temperature sensor mounted in the sump will show a lower temperature than the main stream of 'working' lubricant. This is because the sump has some obvious stagnation points, such as the corners.

Since Universal Replacement crankcases were introduced it has been common practice to use the Type III oil-filler hole in the lower right rear corner of the sump as a handy place to mount an oil temperature sensor. Indeed, the cover plate supplied with most Universal Replacement crankcases often includes a threaded boss just for this purpose. But the oil in contact with the sensor is going to be quite a bit cooler than you'd expect. Having gone through all the trouble of instrumenting your engine it would seem foolish to settle for inaccurate data.

Using the Sump-plate Bump

Type IV engines, both early and late, have an ideal means of installing an oil temperature sensor. On the lower right 'corner' of the sump there is a mysterious round metal plate, 90mm (3 inches) in diameter. It is fastened with two cheese-head machine screws and sealed with an O-ring. The plate is not in the mainstream flow of oil but as a mounting for a temperature sensor its convenience is unsurpassed.

The sump plate has a small pimple in the middle, a narrow berm running between the screw holes. You may drill this out and braze in a pipe threaded adaptor to accept the common temperature sensors or you may drill and tap the adaptor to accept the VDO sensor.

Adapters You Should Avoid

For those unwilling to exert the modest effort needed to properly instrument their engine there is a special adaptor that screws into the oil pressure sensor port. The adapter will accept a VDO oil temperature sensor, with the oil pressure sensor left hanging off the side. This has to be the worst idea anyone has ever come up with for measuring oil temperature since there can be no oil flow at all in such a dead-ended adapter. Indeed, the thing is liable to capture a bubble of air and provide wildly inaccurate data for both pressure and temperature. In the latter case, the temperature shown on the gauge will in fact be the temperature of the crankcase, not the oil. But seeing how easy it is to install, I'm sure it will be wildly popular.

J.C.Whitney Gauges

The gauges I installed in the overhead console of my '65 bus were purchased from J. C. Whitney and include oil pressure, oil temperature, voltmeter, tachometer and an engine hour meter, the latter mostly to maintain the symmetry of the panel. The gauges are attractive and have identical facings. They are advertised as 'Illuminated Precision Electric Gauges' and they are. Illuminated. Reasonably accurate. Electrically powered. Gauges. The full set cost about $125 1995 dollars. The oil pressure sender is a canister about two inches across by an inch and a half high fitted with a 1/8"-NPT inlet. I used a brass 'street-el' fitting to install it and the oil pressure warning switch in the same hole. This might not work on a Type IV due to tin-ware interference. I've not yet completed the T4 engine I'm overhauling; I'll tell you how I did it after I figure out how I'm going to do it.

The oil temperature gauge is reasonable precise, based on testing it with boiling water. It also matches the readings of the Stewart-Warner gauge that was originally installed on that engine. Ditto for oil pressure, as compared to a mechanical gauge. Since the readings are relative, their precision is not vital, only their accuracy. After more than a year of use, they have shown no unusual behavior.

Sermonette

Idiot lights are bleeding wounds. By the time an idiot light comes on the situation is usually out of control. Proper engine management calls for more data than can be provided by a two- state signal.

Instruments showing oil temperature, oil pressure, revolutions per minute, and the functioning of the alternator represent about four percent of the cost of a properly built engine. And that is a one-time cost. People spend more for chrome tin-ware, fancy hub caps or sound systems that only disturb their neighbors and consider the money well spent.

Idiot lights indeed.

Rebuilt Oil Cooler

The purpose of replacing the oil cooler when you rebuild the engine is to get rid of the metal particles that have lodged in all those neat nooks & crannies in the cooler.

If you've got an up-right cooler you can pull the cans (ends) and boil it out, just like a radiatior, except it is assembled by brazing rather than soldering. VW usta sell you a rebuilt, exchange, for only a coupla bucks.

If you've got a pancake or dog-house, the thing can't be rebuilt, nor can it be cleaned. We've soaked/sloshed the things for as long as two weeks using MEK and worse, and could still identify metal particles in the drained solvent.

If you've got a Type IV you're okay; the cooler is down-stream from the full-flow oil filter. Fill it with solvent, seal it up (test tube corks work fine) allow it to sit several hours then drain the solvent into a glass container and examine the residue for metal particles. If none are found, you're reasonably safe in using it.

There's a vast difference between a flake of metal wiped off the cam and a gritty little particle that is actually pumped into the bearings. The flakes tend to settle around the oil screen in the sump and cause no problem; they're the wrong shape to get into the main, rod or cam bearings.. But pumping grit directly into a bearing shell is suicide.

If you do a proper rebuild you won't have to fool with your engine for twenty years, more if you've installed a full-flow oil filter and hydraulic lifters. A new or rebuilt oil cooler is cheap insurance.

If you've got the upright style you may as well consider changing over to the dog-house AND installing a full-flow oil filter. The dog-house cooler is about four times as efficient as the upright and with a full-flow oil filter, either the real thing or a bolt-on filter/pump adaptor, you've just doubled the life of your engine. Two engines for the price of one mades damn good sense to me.

Still More #@!! Filter Pumps

I wasted the afternoon visiting three VW parts places, where I examined a total of five bubble-packed filter/pumps. All were -.005 to -.0055 too small. At one place the owner took exception to my conclusions, boldly plugged the thing into a new engine case. It rattled. He insisted it would be fine with a bit of sealant. I offered him a stock pump I'd brought along for comparison but he'd lost interest by then.

One of the pumps I examined was from the back room, apparantly returned. I got the impression they were aware of the problem. The sight of a customer pulling out a micrometer drew a crowd at two of the places.

Does anyone know how we can bring this problem to the attention of the magazines without stuffing one of the pumps down the cleveage of a semi-nude girl and having her sprawl across the editors desk? I've reported similar problems (hydraulic lifters, distributors) to Dune Buggies & HOT VW magazine in the past without acknowledgement nor seeing anything of it in their 'technical' column.

I've now personally handled ten of these suckers. Nine of them were too small. That's a 90% failure rate. If it hadn't of said 'Taiwan' right there on the package I would have sworn it was from Detroit. So don't buy them. But if you absolutely positively gotta have one of these things, take your mike and check it first. And stop buying them from J. C. Whitney, period. By the time you check it and return it, you could have cast the metal and made one from scratch.

-Bob

PS — The five I checked were priced from $65 to $39.95. Same part, same bubble package. Whatever you buy, it pays to shop around.

Stripped Drain Plugs

Tight as You Can Get It… Plus One Turn

People have been stripping–out drain plugs since God invented the things. It comes from not using the proper washer. Normally, a drain plug is installed with a crushable washer, similar to those found on spark plugs except for being a perfect ring, capable of forming an oil tight seal when compressed. That's how tight they should be turned — just enough to compress the washer. But if you don't replace the washer you'll have to turn it a lot harder. You'll have to compress what's already compressed. If you're lucky, and if you didn't over–tighten it the first time, you can probably use it twice. After that, you're dealing with a flat washer. You may be able to flatten it some more but you're going to be making a mess of the threads. Eventually you'll strip it out.

Back in the Good Old Days, whenever that was, the local VW dealer would sell you five drain plug washers for a quarter, plus there was a new one in each oil–change gasket set. Change the oil, put on a new washer. But for some reason, a lot of people didn't change the washer until it started to leak. Or fell out. Or stripped out.

Stripping–out the drain plug hole or the bolt wasn't a big problem on early VW engines since you could replace the sump plate. Of course, if the thing fell out while driving you had to replace the engine, since your oil fell out along with the bolt. But you had the satisfaction of knowing you'd saved the cost of a five cent washer.

Expansion Plugs

The real message of this sermon is contained in the opening paragraph. People have been stripping–out sump plugs since the age of steam. And as you may have guessed, they've come up with a variety of fixes. The most common fix for a stripped sump plug is an expansion plug, a rubber jobbie that fits in the drain hole and expands when you tighten it down. That calls for two wrenches, one to keep the expansion plug from turning while you expand it, but High Tech expansion plugs have a short lever — you can hold it with your fingers. The quick–lube joints use the things in wholesale quantities.

Sermonette

Every real auto–parts store carries expansion plugs. And most mechanics keep a few of the common sizes in their tool kit for emergencies. But the real cure for stipped sump plugs is prevention. Use a new washer. Tighten to spec. Leave the guess–work for the amateurs. Or the quick–lube joints.

Sump Cover Plate

Sump Cover Plate Mods (Getting Rid of Those Annoying Leaks)

When running an external oil filter the stock oil screen is normally left in place. The sump is fitted with a cover plate having a drain.

The gaskets that come with a VW oil change kit are generally NOT made from resin impregnated paper which means they will weep oil after a time. Since the cover plate need never be removed when running an external oil filter you'll want to treat the standard gaskets with one of the new spray–on elastomeric gasket sealants, being sure to get a good coating on the inner edge of the gasket. Another alternative is to make up a pair of gaskets using better material but in either case you want to arrive at a gasket which will not harden over time. Because of the different expansion rates between the magnesium alloy crankcase, the aluminum screen carrier and the steel cover plate you must use conforming gaskets and insure the metal surfaces are oil–free prior to installation. Avoid gasket shellac as a sealant here. Gasket shellac not only becomes hard as a rock (and then cracks), it is very difficult to remove at overhaul time. Failure to use proper gaskets here is one of the root causes behind those annoying spots on the driveway.

Use a magnetic drain plug if you can find one, or fit an external magnet to the cover plate. If you locally remove the paint to insure a metal–to–metal contact, and use the very strong rare– earth magnets (available from American Scientific), a coat of paint is sufficient to keep the magnet in place. The rare–earth magnets I use are about 1/8" dia by 1/8" high yet have a couple of pounds of pull, very difficult to dislodge with fingers alone. They serve to attract and hold the wear–residue from the cam/cam– follower points of contact.

In addition to using different gaskets, at assembly time you'll want to use steel washers and nyloc–type nuts instead of the copper washers and acorn–type nuts. Be sure the washers are a good fit to the studs and apply sealant to the washers. Hand– tighten in a star pattern to insure even compression then torque to spec, also in a star pattern. Do not re–torque and do not over tighten. The integrity of the seal depends on the elastomeric property of the sealant rather than gasket compression.

Since you won't be removing the cover plate until the next overhaul, and since it lives within a foot of the road, you'll want to protect any exposed threads. I use D–5067 Corrosion Shield, a milspec'd stuff similar to cosmoline, normally used for protecting the journals of freshly polished crankshafts. It dries to a hard, waxy finish that resists oils and corrosive salts. A machinist's supply house should be able to provide you with something similar. (The Military Specification is C–16173.) You'll also want to use this on any exposed threads on your running gear.

2.0 Liter Rods

A great source of info on this is Tom Wilson's "How to Rebuild Your VW Air-Cooled Engine". Specifically page 46 on Type 4's says that all you need is 2L cylinders, crank, pistons, and rods. However, the book is confusing, at one point it says that "the swap won't work without cylinder spacers". I am not sure if he talking about 1800 —> 2000 or a big bore kit here. Can someone clarify?

You may have taken this out of context. But that applies to me too — I don't consider myself qualified on Type IV's, although I've built a few for use in light aircraft.

Tom Wilson's comment about the need for spacers is with regard to using 2.0 liter cylinders & pistons on a 1700 or 1800cc engine with the original crankshaft and connecting rods.

If you use 94mm (ie, 2.0 liter) jugs on a 1700 or 1800 engine (ie, original crank and rods) the longer rod will cause the piston to extend beyond the cylinder, hence the need for spacers and Mr. Wilson's comment to that effect. (Is pin-height the same? I can't recall. This could also be a factor in the need for spacers.)

Why someone would take this approach to achieve a relatively small increase in displacement has to do with the availability of the connecting rods that are unique to the 2.0 liter Type IV. I'm not sure if Mr. Wilson's book mentions it specifically but the key factor in converting an early Type IV to 2.0 liter displacement is not the case or heads or crank or jugs, it's the conncecting rods.

You can regrind the early crank to the later spec simply by off-set grinding of the rod journals, what we used to call a 'poor-boy stroker'. VW did this when they went to the 2.0 liter engine. But you can only do this sort of mod if you have a rod of suitable length and big-end diameter that will work with the reground crank, since it is impractical to re-size the big-end of a connecting rod to a radically smaller diameter. Being a manufacturer, VW simply made up a suitable rod... at the rate of four per engine plus a calculated quantity of spares. Those are pretty much used up by now . On paper, converting an early Type IV to 2.0 liters appears to be a bolt-up. The crankcase requires no machining, nor do the heads if you start with the 1800cc engine. Simply obtain the required parts and assemble them to produce the larger-displacement engine. The tricky part is finding the required parts, specifically a matched set of stock 2.0 liter connecting rods.

(There are other connecting rods that will work in big-bore Type IV strokers but their use — and such engines — are far beyond the scope of a bolt-up conversion using factory parts.)

So what happens when you can't find the rods? Why did Tom Wilson even mention the need the spacers?

One scenario goes something like this: Someone decides to convert their 1700cc engine to 2.0 liter. They buy the jugs, have the heads machined to accept the larger cylinders, go shopping for the crank and rods... find the crank, or have theirs reground, keep shopping for the rods... No rods. Or find none at a price they can afford. They crossed the Rubicon when they modified their heads to use 94mm jugs and spent all that money on those jugs. Now what are they going to do?

If they started with an 1800cc engine they're a little better off — there's no need to machine the heads — but if they've already bought the very pricey 2.0 liter pistons and cylinders their situation is much the same.

Unable to find suitable rods, having spent a lot of money and needing to get the bus back on the road, they often elect to re-assemble the engine using a stock 1700 or 1800 crank and matching rods, putting spacers under the 94mm jugs and — hopefully — making other adjustments to their valve-train geometry and tin-ware, since the engine is now a bit wider, thanks to the spacers.

Frankly, it's not the way to do it, which is probably why Mr. Wilson mentioned it only in passing, but when we set out in haste we often end up in places we never meant to go.

Painted Type IV?

I've read your articles on veedubes with great interest because I'm overhauling an '81 2000cc Vanagon engine and I want to do it correctly. Your articles are great! I noticed your article about engine paint and can't find a good medium temperature paint in dull black. An auto paint store has Vulux brand 2 part paint in gloss black that is good to about 300 to 350 F. What brand and type of paint do you use on the case and cylinders? Please give me a shout.

The Rustoleum Flat Black paint I use on Type I/III crankcases, which are of magnesium alloy, is not suitable for use on the Type IV crankcase, which is an aluminum alloy. To form a satisfactory, low 'resistance' bond between cast aluminum and paint, the aluminum must be etched. There are special aircraft primers for this purpose and I know racers running Type IV power-plants can afford to go the extra mile, but given the excellent cooling of the Type IV, and the higher resistance to corrosion of the aluminum crankcase, for a stock Type IV engine the wiser choice for someone rebuilding just a single engine would be to leave the aluminum crankcase UNPAINTED. If you used the wrong etchant you could precipitate future problems with corrosion and cracking, and if you use flat black paint without etching, it will come off in a couple of weeks.

The benefits of painting the cast-iron cylinders however is valid for all types of air-cooled VW engines. I've posted an article covering the procedure in the 'sermon' fine. I believe the article is titled 'Jugs'.

Type IV Overhaul

Aaron,

Regarding your questions:

First off, you may yet have an 1800cc engine. Your message didn't make it clear that you were reading the serial number from the engine rather than the blower housing. Bus gets bumped in the ass, they swap blower housings.

If the CB serial number you cited is on the right-hand half of the engine casing to the rear of the oil breather box, you only know it started life as a 1700... but the thing is old enough to vote. It could have been overhauled as an 1800, which involves nothing more than opening up the heads to accept the 93mm jugs and is a very common mod, with sets of 1700 jugs often very hard to find.

So that's a baseline you want to nail down: 'What engine am I working with?' Best bet is to clean one of the pistons, if they aren't too badly damaged. You should be able to read the size stamped in the top. But mebbe not.

The whole point here is that if you have 1800 cc heads and plan to reuse them, then you need 1800 cc jugs. Ditto for the 1700's but be damn sure the heads are reusable.

Split-case engines are a little tricker than mono-blocs, and air-cooled's have their own suite of tricks to play on you. But if you know a box-end from a crows-foot, you should do okay.

Your inventory of new parts sounds okay but I think you'd be wise to use swivel-foot adjusters rather than stock. They wear much, much slower, maintaining proper valve lash for thousands of additional miles between adjustments. Another money/engine saver is a CDI module. I've posted several 'sermons' on each of these subjects.

You didn't mention oil pumps. If yours is badly scored, replace it. A high-volume pump for the Type I will fit/work just fine. (Type IV pump is about $130, Type I about $30. Laws of economics apply.) Just make sure you get the type that mates with your cam gear.

Nor did you mention a clutch disk. It is part of the engine assembly you have to drop the engine to replace it. Best do it when you overhaul the engine.

Now let's do the quiz, one by one.

1. The cost of balancing varies by geographic area and by the quality of shops within a given area. I get my engines balanced at the same shop that does aircraft and racing engines. He charges $250 for a four-cylinder, three for a six and whatever the market will bear for a V8. He does the pistons & rods as well as the rotating components. Eleven miles away there is a balancer set up in the machine shop of a tractor & pump maintenance outfit (pumps are always balanced). He charges fifty bucks per engine, rotating components only, but can take up to a month to get around to the job.

Let your fingers do the walking. Balancers advertise, just like hookers and politicians :-) Call around, get their prices. Make a list. Then talk to speed shops, ask who they recommend and why. Best thing to do is find a real engine builder in your area, ask him. Hint: The older he is, the better. When it comes to Volkswagens there's always a lot of 'instant experts' around any college town. (You're about to join their ranks :-)

2. Stems of the valves, not shafts. Valve stems, rocker shafts. They are called poppet valves and their shape dictates the use of stem rather than shaft. I don't know why.

Yes, stem seals are the sign of a quality overhaul but for an odd reason. A freshly overhauled engine doesn't need them. Their benefit becomes obvious as the guides accumulate wear, when they serve to reduce the amount of oil sucked down the intake guides and blow-by via the exhaust valve guide. Of course, by the time the engine has that much wear no one wants to pull the springs to install the seals. So the good rebuilders install them as a matter of course at overhaul time.

Type IV engines are known to eat their young. And their valve guides. So use new guides. And install stem seals, although the engine will get you to California and many miles beyond without them.

3. You can use #518 sealant on the whole thing if you wish. Or Permatex #3 (the soupy black stuff). I tend to use #2 Permatex on steel and cast iron, the modern stuff on aluminum and magnesium, mostly because one cleans up better than the other. The truth is, If your parting-line surfaces are dead flat, no dings or nicks or puckers around the studs, any good thin-layer sealant will work, but you must avoid filled sealants, such as #1 Permatex, or any of the RTV compounds. They form too thick a layer.

But with the Type IV it isn't the parting line sealing that's a problem but the bolts, which are more numerous than on upright engines. Use #3 Permatex on your washers when you bolt-up and you'll usually have a leak-free engine, no matter what they tell you :-)

4. The Type IV is an aluminum casting. It doesn't use paper gaskets between the base of the cylinders and the crankcase. Type I engines are magnesium. The gasket was meant as much for corrosion control as for sealing. I use #2 Permatex on the spigot shelf. I've also used RTV compounds here when the spigot bore was a bit loose.

5. Go down to the local FLAPS and get yourself a tube of moly CV joint grease. Use it for your assembly lube. But don't overdo it. Nice, even coating on all bearing shells, brush it into your gear teeth, put some on a paper towel and roll your tappets in it until they are uniformly coated. Prelubing is more important than most people realize. Don't trust Vasoline or motor oil. The one is too thick, the other too thin. Reserve the use of motor oil for installing the pistons into the jugs, and even then, don't overdo it. Assembly should leave the part neat and clean. Also, clean. And don't forget to keep things clean. Work in a clean area. Wear clean clothes. Work alone. Do not permit distractions. Work with the parts layed out in a logical fashion so that a missed step is immediately obvious. And be sure to keep things clean, including your hands. Keep a pint of lacquer thinner near at hand, plus paper toweling. Clean up any mess immediately and don't feel shy about taking frequent breaks. A properly assembled engine will give twenty years of normal service, a few minutes here or there during assembly is time well spent if it insures a proper assembly.

It's vital that you work with clean hands and tools, for they are the vectors of contamination. Keep your tools neatly layed out but in two distinct areas, those you are using immediately to hand keeping others at a distance. Wipe your tools down frequently, ideally after each use. While this sounds excessive, forming the habit of wiping a tool beflore laying it down is one of those odd little insurance items. A clean tool can not contaminate the work. The act of wiping the tool and laying it down defines its location in your muscle memory, you hand will find it without hesitation when next it's needed.

This will sound odd but you really do more of the engine assembly in your head than on the bench. For that reason it's important to keep your head neat, uncluttered and clear. 6. Yes, you may check end play with feeler gauges. But such methods are only as accurate as your tools, which with feeler gauges isn't very accurate, which makes the point moot. Tom Wilson describes a handy feeler gauge method in his excellent "How To Rebuild Your Volkswagen Aircooled Engine," which you should have on hand when you begin assembly. The wiser course is to use a dial indicator for checking/setting end-play. As an ME student, you should have a clock to play with anyway :-) During pre-assembly you'll find a dial indicator valuable for checking cam lift and gear lash in your valve train and wear in your valve guides — a clock is a basic tool for engine assembly and a good-enough one costs less than twenty bucks. Cheep. I've mentioned their use and listed sources in several of my 'sermons.' I think you would be wise to save money in another area.

End of Quiz (How'd we do?)

Tips & Hints? Keep things clean. Take care of your tin-ware. Make sure the thermostat is working and properly installed. Tune your carb with the help of an oxygen sensor. Change your oil before it needs it. Make sure your tin-ware isn't leaking — good spark-plug seals, etc. Make sure your engine compartment is as air-tight as you can make it, good hatch seal, engine seal and good grommets on all cables entering the compartment. Be especially careful to seal the alternator and use a new boot on that tricky elbow fitting. It likes to break.

Chase all of your threads, clean the crud out of them. Use new hardware if you can find it. (Those little cheese-head screws are 6x1.00 mm, lotsa places carry them. Ditto for warpy washers.)

Proper washers, loctite, safety wire — are all cheap insurance. Get into the habit of using them.

Deal with the engine in a professional manner. Pay strict attention to details, especially cleanliness during assembly and a good fit/finish on your tin-ware. Use oven cleaner to remove the grease from the tin-ware, paint remover to strip the paint, elbow grease and sand paper to remove the rust. Straighten any parts that are bent, replace any nuts that are missing, weld any cracks and patch any holes. Then lay on a good coat of red primer and a couple of coat of gloss black. The results will look professional and that will give others the clue. Engines are managed chaos, things to be respected.

When rewiring, solder and crimp all of your terminals. Throw away those crappy plastic collers on crimp-on electrical fittings. Use graduated layers of heat-shrink tubing. And tear that computer connector outta there! It's a monument to bad engineering. Scrub down the engine compartment until it shines then give it a coat of wax. Keep it clean enough to eat off of. A clean engine compartment makes inspection, maintenance and repair much easier. Anyone can driver a booger... and most people do.

If your battery cables are corroded, replace them. Shave the new terminals to a perfect fit on the posts and put down acid getters before you install the terminals. A gas-tight connection not only handles more power, it is less likely to corrode. Neutralize any corrosion in the battery tray with baking soda but keep it to hell away from the battery. With the acid neutralized, use a phosphoric acid compound to convert the rust into ferric phosphate then seal it good with anti-rust primer. No sense painting; it's just going to do it again. But an acid-getter pad, either the milspec cloth stuff or the impreg-

nated paper you'll find at a FLAPS is a wise precaution under the battery. Use a bungee chord to keep the battery from moving around.
When the engine is out of the vehicle is your only chance to check your fuel tank straps and vents. On a 22 year old vehicle, such a check makes good sense. The firewall plate over the fuel tank has four concealed screws that you can only get at from the bottom, the middle two through holes in the tranny mount. Search them out, see if they'll come free — but think about how you're going to replace them before you do the deed — you need a Phillips screwdriver that will grip the screw, allowing you to insert it. The other screws are obvious. Check the rubber couplings of the vent hoses for signs of leakage and replce them if needed. The main filler neck and overflow vent are accessible through the large round pie-pan just forward of the battery. And if the pie-pan is missing, fabricate a replacement.

If you plan to install a booster relay for the starter solenoid, placing it just beside the alternator's voltage regulator would make for a neat lay-out.

When you put things back together be sure the aux heater fan is properly ducted to the engine. There are flapper valves in the fan housing that prevent your cooling air from escaping through the auxiliary fan via the ducts. No ducts, big leak, engine runs hotter than it should. You may not notice this during cold weather (although I wonder why anyone would not want a heater, if only for demisting), but it can be an engine-killer in the summer time.

Since you're starting with new jugs, you may wish to read my 'sermon' on cleaning & painting them.

If you don't have a test stand, promise yourself you'll drop the engine and retorque the heads after no more than 300 miles. This is perhaps the most important part of your break-in cycle, after the oil/flush/change routine.

Balancing is some of the smartest money you can spend. Besides running smoother, a balanced engine runs cooler. If you've never been in Yuma in July, you've not gotten acquainted with HOT. Your engine spends much of its life in 'Yuma'. It needs all the help it can get. 228: Good luck with it. Sounds like it's going to be a fun trip. Keep me posted on your progress, engine and otherwise. (It's not just an engine, its an adventure :-)

-Bob

PS — Re-reading this I seem to have mentioned tin-ware a few too many times. Or did I?

The average driver would not tolerate a leaky radiator; a puddle of coolant beneath a wasserboxer triggers an herioic response to seek out and destroy the salesman. Or the leak.

Yet when it comes to air-cooled Volkswagens I see almost daily examples of otherwise mechanically astute owners who shrug off huge holes in their tinware — in their engine's cooling system — as things of no importance, not worth their while to repair.

I've a hunch such people assume that since there is an unlimited supply of 'coolant' a few leaks don't matter. If that is the logic behind their thinking I hope you can see the flaw, and pray they never go down to the sea in ships :-) — rsh

PPS — A thought to keep in mind. As a student of Mechanical Engineering much of your educational task is rote-work, mental regurgitation. But if you keep notes of this engine overhaul, and if those notes clearly illustrate the proper formulation of questions, the search for answers and a concise description of the process involved, your overhauled engine will fulfill certain requirements of your education. To reap the benefit of having fulfilled those requirements you must petition your instructors in a clearly worded letter outlining the project and its goals. If they are educators instead of 9-to-5 drones they will respond with certain tasks for you to accomplish and report upon completion of the overhaul.

To make it work you need a 'hook' such as 'Comparison of Power Enhancements Resulting from Volumetric and Dynamic Balancing of a 1970's Era Powerplant.' Or... something else. (Ask the list. With nearly 600 minds at work there's no problem that can't be solved. Or confused :-)

The bottom line is, at the very least, a certain enhancement of your grade — assuming the damn thing doesn't throw a rod the first time you fire it up. But be careful. Doing a professional overhaul can mark you for life, as can writing a coherent account of it. Look what happened to Tom Wilson, Bill Fisher and all the others. Building race cars. Flying airplanes... Awful way to go through life, people giving you money for doing something you would have done for free if they'd asked you nice. Terrible fate in store for Aaron, the Air-cooled Engineer :-)

MOVING THE VEHICLE

Axles & Suspension

Towing & Winching

Transmission & Clutch

Wheels, Tires & Brakes

Alignment Tools

Could you list the necessary tools needed for a do it yourself alignment, please? (I'm primarily interested in a bus ball joint front end job). I seem to recall from my Bentley readings that a rather thin profile large wrench is needed for the camber adjustment. How many special tools are involved ($$Hazet$$Schley$$), and are there any good, cheap sources for these or make your own solutions?

Try the J. C. Whitney mag-mount caster/camber gauge 17-HY-9272X, about $65. You can use a pair of sticks to check toe-in (see St. Muir). Caster is set at the factory — it's built-in to the trailing arms and reset through the use of shims should the chassis suffer collision damage. Otherwise, it's not a field-maintenance item. The thin open-end wrenches needed to rotate the camber adjuster are (were?) carried by Sears and used to be available per each. Snap-on also carries them. Or you can MAKE one out of 3/16" mild steel plate and a plasma-cutter. The wrenches are in inch sizes but there's a pair that are a good match for the camber nut (ie, pivot-socket-thingee) for both bug and bus. Sorry I can't recall the sizes.

Maximum toe-in for both the bug and bus is about 3.3mm or 1/8". Minimum is zero (ie, straight ahead). Shoot for an eighth and be happy if it's a tag shy.

Camber is half a degree, give or take a third of a degree (30' +/- 20'). Since the typical camber gauge will read down to 10' of arc (and the good ones to 5') you will have no trouble matching spec. But be sure to start with a level axle and equally inflated tires.

Once you understand the geometry involved you can fabricate a single-purpose tool to measure camber using a plumb-bob but it will only work on that particular type & diameter of wheel.

Be sure your bearings are tight before doing any camber or toe-in adjustment — and remember to reset bearing-play when done. I've noticed that none of the 'experts' at the local alignment shops bother with this critical preliminary.

Ball Joints

VW ball joints are easy to replace if you have the right tools. You need a hydraulic press and a couple of tools that can be made from sections of pipe. If you've got the 3/4" socket set from Harbor Freight, two of the sockets are a perfect fit for pressing in ball joints and one of them will work to hold the trailing arm when pushing them out. The Bentley manual provides all the information you need to do the job properly.

Push out the old ball joints, press in the new ones. They are not expensive; write to Barrett Enterprises (and others) for their catalog. After they are replaced, check your wheel alignment to make sure it's safe to drive, then have your front–end professionally aligned.

The Basic Tool

The 12 ton hydraulic press from Harbor Freight is a bit anemic when faced with an old ball joint; the 20 ton press pops it out just like that. The frame of the 12 ton press is equal to the task but those cheap hydraulic presses use a bottle jack and the 12 ton model may have sloppy seals. A 20 ton jack in a 12 ton frame works fine. If you're a weldor, consider making your own press; a bench type is large enough for ball joints (but won't work for king pins or tranny gears).

The hydraulic 'On–the–car' ball joint removal tools ("Works for All Cars!") takes a special fixture to match VW ball joints. If a shop sez they can do your joints, ask to see the tool. If they don't have the VW–specific tool they can crush you new ball joints when inserting them. You won't find that out for about 3,000 miles. The works–on–all–cars tool available from J.C.Whitney does NOT work on VW ball joints. (sigh)

If you don't have/can't use a hydraulic press, talk to the folks at the nearest VW dealership, ask if you can bring in your torsion arms to have them put in the ball joints, or ask at the front–end alignment place. (VW is best; they've got the tools.)

Getting at the Ball Joints

Loosen the front wheel lug bolts, put the bug up on stands, pull the wheels and your stabilizer bar (you may want to replace the stock clamps with the stainless steel after–market jobbies [see J.C.Whitney; about $30] or even install a heavier stabilizer bar), dismantle the steering knuckle from the torsion arms, remove the torsion arms and ditty–bop down to the ball–joint shop.

The first Gotcha! is how to remove the steering knuckle from the torsion arms. VW uses a special tool to raise the upper torsion arm to free the steering knuckle. A weldor who knows bugs can make you up something similar or you can fasten the axle (on stands) to a concrete slab, use a jack to push the arm up. (You'll need to fasten a plate to the slab with expansion bolts, one on each side.) Be cautious about trying to do it with hammers/wedges/levers; things bend. I can usually do it by hand; I'm fairly strong but getting old; that VW tool is looking better every year.

With the torsion arms out, you'll want to check the torsion arm bearings. They are probably crap. If so, pull the torsion leaves, clean everything up and replace the bearings with hard urethane bushings; a little stiffer but longer lasting. The bearings are hard to find, expensive when you do; you can get the urethane bushings from J. C. Whitney.

VW uses a slap–hammer, special pullers to remove the bearings. You can pull the outer ones, drive out the inners. The inner bearings are a bit of trick but do–able. With the torsion leaves out, find a suitable drift (I've used one of the torsion leaves for this… in an emergency…), take your time (Tap a little, top & bottom, back & forth.)

The urethane bushings drive in, full depth, stop on the lip of the torsion tube. (J. C. Whitney sells Bug–Pak bushings.) You'll need a pickle–fork to pop the lower ball joint free of the steering knuckle. The upper one will come out when you wriggle the camber adjustment bushing. (Then you're liable to have trouble getting the camber adjusting bushing off the ball–joint bolt; they're a tapered fit, like to stick together. Back to the hydraulic press.)

When you pull the torsion leaves be prepared to deal with thirty years of grease. Get as much of it out of the torsion tubes as you can. Have a couple of extra tubes of chassis lube on hand before you do the job.

Other Front–end Stufff

Doing your ball joints provides the perfect opportunity to clean & inspect your torsion leaves, install new shocks, steering damper, rod–end bearings and adjust your steering box; a good time to do a general front end overhaul. If you've never done it, give yourself a day for disassembly, whatever it takes to scrounge any parts discovered bad/shop work/etc., and a long day putting it back together.

The steering knuckle is less trouble to deal with if you pull the front brake drums (and gives you a good excuse to do the front brakes.) Check your brake flex hoses; good time to do them as well. (Use the stainless steel jobbies for replacement; they seem to last forever.) If you aren't replacing the flex hoses, treat them gently; don't let the steering knuckle hang by the hose. (You should probably replace the hoses anyway.)

Possible Alternatives

Buy a full set of four new torsion arms with new ball joints installed (I've seen ads for such but don't remember who was offering them.) 2nd alternative: Buy a full set of arms from a junky, have the ball joints replaced. This is the best bet for those of you who have adopted the Forever Car Philosophy. Your ball joints will require replacement about every 60,000. If you have a spare set of arms, it's a long afternoon's chore.

Useful Hint

Some replacement ball–joints come without provision for lubrication. Send them back. Only use ball joints you can lube. The sealed ones are 'lubricated for a life–time of service', which works out to about 25,000 miles, assuming they are of recent manufacture. After laying on a shelf for ten years they don't last too long in a car. Keep them greasy, they'll give you at least 50,000 miles of service. (But check the boots. If the boots tear you'll get sand/crud in the ball joints; they'll wear out quick like a bunny).

Sermonette

When it comes to maintenance, we tend to focus on things that wear out fast, like the engine. But a bug or bus is an assemblage of inter–related systems, none of which can survive without the others. Because of our pre–occupation with engines, many VWs are junked for relatively minor — but totally mysterious — problems to one of the other systems, such as the tranny or steering. We need to get into the habit of looking at the total system, rather than part of it. Rapid engine wear can be dealt with through the use of a full–flow oil filter, hydraulic valve lifters and proper sealing. With a CDI module the engine will need little more than oil changes and the occasional fan belt to provide years of trouble–free service. The other sub–systems, such as steering, suspension and brakes are already sufficiently robust, but their useful life is a direct reflection of faithful adherence to regular maintenance.

Since the youngest bug with torsion arm front suspension is already old enough to vote, there's a good chance your bug could stand a bit of front–

end attention. Check it out. If it needs ball joints, go for it. Your bug will handle a lot better when you're done.

Boot Camp

No, we're not at war, but we've definitely got a fight on our hands when it comes to CV joints. And since you only need to do your boots every 30,000 miles you're not likely to become proficient at it. So here's a little refresher course. But before we start, I want to preach a little pre-sermonette at you.

When you do periodic maintenance on CV joints you must insure the parts are not thrown out of balance. Before taking anything apart, make orientation marks that will allow you to reassemble the parts in exactly the same relationship as they were originally installed. That includes not only the CV joints to the stub axles and tranny, and the CV joints to the axles, but even the balls within the CV joints; they should go back into their same races and the same opening in the cage. John Muir failed to make this point in his otherwise excellent discourse on CV joints and that failure had expensive consequences for lots of VW owners who reassembled them in a willy-nilly fashion and even used hose clamps and the like when installing their boots. The axles rotate at about a thousand rpm at freeway speed. The imbalance created by the screw-type clamps causes premature failure of the rear wheel and differential bearings. As with pounding on the wheel nuts with a hammer & chisel, this is another instance where the earnest efforts of St. Muir did far more harm than good.

Back to Boots

The boots are those rubber bellows around your axles. Swing-arm trannys have two of them, one on each side. Later model 4-joint trannys use four of them, one on each end of each axle. (Both early and late VW's have independent rear suspension systems. The term 'IRS' as applied to late-model trannys was invented by magazine editors [who seldom get things right anyway].)

On early swing-axle trannys there is no periodic maintenance requirement for the boots, you simply check them now and then, replacing them if they become torn (as they all will) or leak excessively. On swing-axle trannys the axle runs in a housing; the boot flexes with the rear suspension but does not rotate, permitting the use of split-type boots as replacements. Since the boots serve only as an oil seal they should be replaced if they are no longer doing their job.

On late model 4-joint trannys the boots act as grease seals for the Constant Velocity (CV) joints and rotate with the axles. In order to lubricate the CV joints you must remove the boots. Because of the unbalanced nature of

split-type boots they can not be used as replacements, you must dismantle the CV joint and press the axle out of the joint in order to slide the new boot onto the axle (and the old boot off). Read St. Muir
With the exception noted above, John Muir's 'Idiot' book provides the best available step-by-step procedure for the removal, lubrication, and replacement of your CV joints. If you don't hold a copy of 'How to Keep Your Volkswagen Alive...' go buy one. Now. (I'll wait until you get back.) But you should also have the Haynes VW manual (#159) which is superior to all others thanks to its lavish use of illustrations. They do an especially good job describing CV joint maintenance.

Proper Parts and Tools

About three weeks ago you should have ordered your boot kits from J. C. Whitney. The catalog number is 85 xx 9433-B. The 'xx' changes from catalog to catalog (as does the price, which was $8.69 in June, 1995). A 'boot kit' consists of a replacement boot, eight (or four, depending on model year) new bolts, a new splined washer (needed to provide the proper pre-loading during reassembly), a new circlip, 90 grams of CV joint lubricant, and a new boot clamp. J.C.Whitney's kits are from Meistersatz, the German company that supplies VW with your original boots.

[Editor's Note: Bob posted the following addendum next day:

"I screwed up. As Tim Maddox very kindly pointed out in a private post, the number I posted is the generic catalog number covering just about everything EXCEPT the late Transporters and Vanagons. J. C. Whitney offers only the boots for those vehicles (no kit). The catalog number is 85 xx 6958-A, $3.32. and is specific. (For generic numbers, you give the girl the make, model and year of your vehicle; the kit you receive may have a different number than the one under which it was ordered.)"]

If you've never done your boots, order four kits and do all of your CV's. It will provide you with a base-line for doing them in the future. You'll also need about twice as much lubricant than is supplied with the kits; pick it up locally. If some of your old books are still in good shape, clean them and hold them as emergency spares. You will need to carry a spare tube of CV lube but you can make a nicely balanced emergency boot-clamp using wire. (The trick is to make two wrappings, 180 degrees apart, having the same number of twists so as to maintain proper balance. Use stainless steel aircraft-type safety wire if you can get it, stainless steel MIG wire if you can't, bailing wire as a last resort.)

Over the years Volkswagen used different numbers of bolts on their CV joints, and different sizes, too. The bolts are socket- head types using EITHER

Allen-head sockets or the splined 12- point ‘3-squares’ pattern (ie, three squares superimposed, each rotated 30 degrees from the other). Volkswagen has used both 6mm and 8mm sizes.

Since the Allen-head type may be used as replacements for the splined type, and since the splined type came in two sizes, and since some prior owner may have serviced one of the CV’s but not the others, one of your first chores will be to determine what type of bolts are dealing with. Raise the vehicle, support on jack-stands, crawl under and scrub the heads of the CV joint bolts clean using a toothbrush and solvent. Be prepared to spend up to one hour on this job. You must clean the socket of every bolt and there are 24 of those puppies. If you fail to get the sockets clean the bit won’t seat properly and you’ll strip the socket, leaving you the lovely task of worrying the bolt loose using vise-grips. And don’t assume all of the bolts are the same! Scrub them all; you may find one of your CV’s wearing bolts different from the others.

Alas, Allen-head wrenches cannot be used on the 12-point splined bolts, nor visa-versa; you’ll only ruin the bolt if you try. The majority of Volkswagen CV joints use the 12-point splined socket head bolts of the 8mm (socket-head) size. J. C. Whitney sells a four-piece set of such bits in 6, 8, 10 and 12mm for about $10 (p/n 14 xx 1662-P). Unfortunately, the bits are American-made, their shanks are 5/16" for the two smaller sizes, 1/2" for the larger (that is, the bits will fit sockets of those sizes). The 1/2" isn’t a problem; you can use it in a 13mm socket, but the 5/16" size — including the 8mm bit, the one most of us will use, is something of a poser since it’s too large to fit an 8mm socket, too small for 9mm. I’m lucky to have a full set of metric and SAE sockets but if all of your tools are metric you will have to buy a cheap set of 3/8" drive SAE sockets in order to use the 8mm bit. The best solution is to find the bits already mounted in sockets (they come that way) but I don’t know of a mail-order source. Indeed, my frequent citing of J.C.Whitney parts and tools is not from any admiration of their quality, service or price, but only due to their global availability.

(One word of caution: ‘3-square’ pattern socket head bolts used on Volkswagens are not Torqx-bolts. Torqx is a 2-triangle pattern (ie, six points, rather than 12). The typical hardware store clerk doesn’t know the difference, apparently defeated by an number greater than five. 3-square pattern socket-head bolts are found mostly on European vehicles, Torqx on American and Japanese. Brazilian vehicles use a pattern that is perfectly round:>)

As a personal note, I’ve made most of the Allen-head and splined tools I use by cutting off the bit and brazing it into a suitable socket, usually something picked up at a swap meet. Such bits are made of hardened steel, they will dull a file and strip the teeth from a hacksaw. The proper way to cut them is to use an abrasive cut-off wheel or a diamond saw. Cut-off wheels work best; the harder the material, the faster they cut.

The final tool you must have is an accurate torque wrench, and this is one of those cases where a clicker is superior to the torsion beam type. Working overhead, under the vehicle, it is very difficult to position yourself so as to read a beam-type torque wrench without introducing parallax, whereas the clicker can be upside-down, behind your back and in the dark, if you wish.

Your Bentley manual fails to include the proper torque values for the two sizes of bolt used on the CV joints. Most of us have the 8mm bolt; they should be torqued to 25 ft/lbs, the 6mm to 31 ft/lbs. (That's right; 25 for the 8mm, 31 for the 6mm.) Run them up snug, then torque in a cross-pattern for the 6mm, a star for the 8mm (If you've got the 6mm bolts there should be only four of them.)

Hydraulics vs Hammers

The Bentley manual shows uniformed Volkswagen mechanics using the standard-issue Volkswagen hydraulic press to push the axle out of the CV joint (and pressing the CV back onto the axle when the job is done, no doubt marching in lock-step between times). St. Muir sez use hydraulics if you got'em but a hammer will work too. In this case, I agree with him.

The Haynes manual shows the mechanic pushing the axle out of the CV joint with his thumbs. This is the most likely case for disassembly since the axle is meant to be a tight sliding fit in the CV joint, rather than an interference-fit. If you encounter a sticky one, inspect the upper-most portion of the splines (above the groove for the locking ring). It's most likely that you will find some minor burrs on these splines. Stone them away and try again. If you must use hammers and drifts, use proper ones; lead or brass for the hammers, bronze or brass for the drifts. On reassembly the internally splined cup-washer must be compressed, a task most easily accomplished with a hydraulic press.

Failure to maintain the original spline/tooth orientation often causes the axles to bind in the CV joint hub during reassembly. Take it apart, verify the alignment and try again.

Sermonette

The Bentley manual neglects the CV joints, offering neither a nominal lubrication interval nor torque values. The Haynes manual sez to inspect them but to leave them alone unless the boots are torn or leaking. That is as invalid as the Bentley approach; by the time the things are torn or leaking you'll be faced with the expensive replacement of the CV joint rather than its messy but necessary lubrication. (The Haynes method is correct for the older swing-axle trannys and may well be a typographical blunder, albeit one of major proportions.) John Muir sez keep your CV's greasy and they'll last a long time. Despite his many errors and omissions, John Muir's approach is the most correct of all, at least when it comes to CV's.

Each of the manuals cited above claims a certain degree of expertise yet each contains many errors, some minor, some catastrophic. (The Chilton manuals are not worthy of mention.) Your wisest course is to gather as much information about your vehicle as you are able, and from as many diverse sources as possible — and then to think for yourself.

Boot Camp II

When you order a CV boot KIT (about $9) it comes with a new boot bonded and crimped to the metal shield, 90 grams of grease, the required boot clamp, a new snap ring and two internally splined washers. AND SIX NEW BOLTS.

I know; some model/year kits aren't available from J. C. Whitney (source of the above), the point here is the contents of the kit. Bolts used in critical areas are normally not reused. The threaded bore is made perfectly grease-free, treated with loc-tite primer, and new bolts installed with medium strength loc-tite.

In front of me I have a CV kit for a late model VW. The bolts are 8x1.25. If torqued to 25 ft/lbs the tension in the bolt will be about 7,000 psi at normal room temperatures, as much as twice that as the CVs heat up from normal use. With six such fasteners, properly installed, it is extremely unlikely they would come loose in normal service.

I think it would be wise to look beyond the bolts for the cause of the problem. It's possible the CV joint is imbalanced, or the cage and balls are mis-matched or perhaps the bolts were not torqued evenly in a criss-cross pattern.

The fact the bolts loosened and backed-out is a symptom of a problem, not the problem itself.

Dust Caps

They pry off. And drive on, using a piece of exhaust pipe tubing. No dents. You'll need a specially bent tool, like a brake adjusting tool or a beekeeper's hive tool (one of the must useful scrapers ever made). Whatever tool you use, use the cast bosses on the brake drum as fulcrums. The cap will pop right off, even when heavily rusted.

If you hammer on your dust caps you'll distort them, they'll no longer be round. They'll still 'fit' in that they won't fall out, but they will leak, water in one direction when fording streams, grease in the other when the hub heats up.

The same piece of exhaust pipe that serves to drive-on your dust caps will seat the front wheel seals on an early bus. It's wise to replace the seals with each brake job. They cost about two bucks each. Keep the driver with your brake tools, since that's about the only time you'll need it.

Front End Shimmy

A recent thread on Martha's Thinglist touched on front end shimmy that vanished when the wheels were balanced on the car.

Balancing the wheel on the car includes the brake drum or rotor in the rotating mass. When you have your wheels balanced on the car it is important that they be returned to the same orientation should they have to be removed. A witness-mark of paint is sufficient to keep things lined up.

Castings from Mexico and Brazil are often of poor dimension quality. It is not uncommon to find cylinders with mis-cast fins or brake drums that are not concentric to their bore. Imbalance — and the shimmy noted above — occurs when a brake drum casting is machined slightly off center. Although such drums can be balanced by removing metal from the heavy side, it is unwise to do. Indeed, it is not a good idea to use such drums in any case. Having been machined off-center the drum will usually warp when heated from braking action. You can have such drums turned repeatedly only to have the warp reappear.

Normally, a drum machined far enough off center to cause a serious imbalance can be detected by visual inspection. Examine the casting around the hub bore. If there is appreciably more metal on one side than the other, reject the part.

Front Wheel Stuff

I'm... guilty of failing to re-adjust the bearing on a periodic basis....

That's unfortunate because the simple chore of occasionally taking our front wheels in hand provides a wealth of information about the bearings, suspension and steering.

Attempting to lift the wheel up & down reveals any wear in the ball joints or king-pins, while pushing the wheel in & out (with the wheel-bearing tightened right down), reveals any wear in the ball joints or link-pins. With the wheel-bearing tightened down, or all of the slack pulled out, rocking the wheel from side to side will reveal any wear in the tie-rod ends.

The beauty of this simple test comes from the fact that our sensory equipment is not acute enough to perceive the small amount of play that the specs allow — if you detect ANY play at all, there is a high liklihood that repairs or adjustments are required.

To check the front wheel bearing lash, all you need do is jack up the wheel then give it a firm push-pull. If you detect ANY in-out play, the bearing probably needs to be adjusted.

In a similar vein, with the wheels back on the ground, simply reaching in thru the driver's window and moving the steering wheel with one finger will tell you the condition of the steering gear-box and drag-link, in that if the steering wheel moves freely for more than two inches or so, some form of repair or adjustment is required.

On buses, the last friction point that needs to be examined periodically is the pivot-arm. This test may be visual or tactile and involves having someone turn the steering wheel while you observe the pivot-arm. ANY vertical motion at the longer end of the arm is evidence the pivot-bushings are worn and need replacement.

The last item on your front-wheel-related periodic inspection list is toe-in. Accumulated wear in your tie-rod ends and wheel bearings causes the toe-in to change. This test is done by direct measurement, comparing the distance between the rear-most edges of your front wheel rims to the distance between their front-most edges. To eliminate any error due to a bent or mis-mounted rim, the normal procedure is to take the rear-most measurement and to then roll the vehicle BACKWARD until the point of measurement is at the front, which should be closer together by about .120" — call it a scant eighth of an inch (for 15" rims). Your measuring tools need be no more sophisticated than a pair of sticks. John Muir covers this procedure espe-

cially well in his book.
Toe-in measurement and adjustment is especially important when you have king- pins, since the periodic adjustment of the link-pins causes a change in toe- angle.

Most modern cars use ball-joints that simply bolt in place and may be replaced on the car, whereas Volkswagen ball-joints require the front suspension to be dismantled and the ball-joints pressed into the trailing arms using an hydrualic press and special fixtures to support the arms. Most alignment shops do NOT have these fixtures. Indeed, as several messages to this List have shown, even many Volkswagen dealers are unable to properly service the steering and front suspension of your Volkswagen bus.

Fortunately, rebuilt trailing-arms fitted with new ball-joints are available on an exchange basis, as is the reamer needed to properly fit a new pivot-arm bushing. And new tie-rod ends, or even the complete tie-rod, remain available from many sources. Given a long, greasy weekend, you can do a complete front-end rebuild yourself.

And finally... Shock absorbers and steering dampers are adjuncts to your steering and suspension system — they make those systems work better and last longer but are not intergal parts of those systems. Without shock absorbers your bus will still roll down the road, and you can even still steer the thing without any steering damper at all. You couldn't go very fast and the ride would not be very comfortable nor even very safe but wear, or even removal of these components does not render the vehicle undriveable. The fundamental geometry and structure of your steering and suspension remains unchanged, the only thing which changes are the dynamics of its operation. Conversely, the PRESENCE of those components has no effect on the static geometry or structure of those systems.

The point here is that replacement of your shocks and steering damper will NOT cure problems arising from worn-out ball-joints or tie-rod ends. Yet in an overwhelming majority of cases, that is what you will be told by shops that are incapable of effecting the required repairs. Having gotten you in the door, they seem determined to sell you SOMETHING, even if it's something you don't need.

In some cases, adding new shocks and a stiffer steering damper can mask some of the symptoms of worn steering or suspension, but within a few hundred miles you will be back exactly where you started, albeit somewhat poorer.

Lube Jobs, Needles and Looking Kewl

I shouldn't be writing this. I shouldn't HAVE to be writing this, since it covers a topic everyone already knows. Or should. But here goes.

Like most of my articles, this one began with a message from a youngster, the proud new owner of a old beetle. He'd found the 'sermon' files and sent me a message that, aside from the question it contained, told me he hadn't read any of the available manuals. I answered his question and, being the sweet sonofabitch I am, I pointed him toward the books and told him to get hot — I didn't have time to answer questions he could answer for himself.

Usually, that's all it takes to stub the tender ego of youth — I didn't expect to hear from him again. But I did.

Okay, he sez, he's got the manuals. And he's impressed. He has the Bentley, the Muir and the Haynes and he's reading as fast as he can and if I had the time, would I please tell him how much grease he should put in his fittings when he gives his '64 bug a lube job. It squeaks, he sez.

Instead of telling him, I pull out the manual, to point him toward the proper page and paragraph. But it wasn't there. Haynes says only to grease the thing — no mention of how much. Muir sez the same thing, except they screw things up by passing out bum dope on what to do about a bad Zerk fitting(*). The Bentley manual does a little better, saying "Continue with the greasing until fresh grease begins to emerge from the lubrication points." (Page 8–8 in the Bentley book for bugs.) So I tell him where to find it and get back to doing what I was doing, which has to do with propane and computers and all kinds of neat stuff.

Back comes another message, quick like a bunny. It's a Yeahbit message: "Yeah, I read that… but that takes something like twenty strokes and all of my friends say that's 'way too much."

Ah yes — peer pressure, and the deadly need to look kewl. This fellow's friends, one or two of whom might own a Volkswagen, were giving him the benefit of Conventional Wisdom. And then there's the Muir manual, which sez to stop greasing as soon as you see grease come out. Wrong.

I sent the kid a long, carefully worded message explaining that the purpose of a lube job is to CHANGE the chassis lube, offering him some tips on how to keep things greasy so they'll last a long time. The kid fires right back to say that after sending his second message he's checked with his dad and the local quickie–lube emporium (shudder) and EVERBODY AGREES… one or two squirts of grease is all you need. He also had some rather sharp things to say about lube needles. (see below) Faced with the possibility of looking un–kewl, the kid had taken the easy way out.

Goobye, kid. Good luck in the contest.

I go back to playing with vaproizers and trying to figure out how to fit a one hundred sixty liter propane tank in a bus and I'm laying out there under Grendel, looking at a patch of blue sky through her 'good condition' cargo bay when I begin to wonder…. doesn't everybody know the whole idea is to CHANGE the lube rather than just add a bit?

Lube Change vs Oil Change

A lube job is in fact the REPLACEMENT of the lubricating grease, not just its replenishment.

Lubricants — oils, greases and soaps — literally wear out. Their long–chain molecules are sheared by heat and pressure and over time they become contaminated with moisture, dust — and in the case of engine oil, with combustion products. We deal with worn–out, contaminated lubricants by replacing them.

Everyone knows they have to CHANGE their oil rather then just topping–up. And most of us know we have to CHANGE our tranny–lube every couple of years. And we scrub all the old grease out of our wheel bearings and the spindle bore and repack them with NEW grease…

So what's different when it comes to chassis lube? A lube–job is just another form of oil–change.

When doing a lube–job, too make sure you do a proper job of it, you keep pumping until you see the new grease coming from the part. Yeah, it's a mess — the old grease gets all over everything. You put down some newspaper or something else disposable to catch the globs of falling grease, and use paper toweling to wipe any any grease that clings to the part. When you're done, you should put a cap of some kind over the Zerk fitting. Cars used to come with neat little rubber caps for this job, and replacements were commonly available, although I haven't seen their like in recent years. Instead, I've taken to molding aluminum foil over the Zerks after every lube–job.

Lube jobs, like oil changes, are not carved in stone — you can't just go by miles traveled or a set period of service, you need to pay attention to the TYPE of miles traveled and the CONDITIONS encountered during a given period of service. Normally, your steering and front suspension needs its lube replaced about every six thousand miles — that's the spec. Then comes the fine print. Rough roads? (meaning lots of action from the suspension) – – replace the lube more often. Dusty roads? (meaning more contaminants, plus the wicking–effect of dust) — replace your lube more often. (Oddly enough, a vehicle that does NOT drive very much needs its lube replaced more often than one which does.) It's all there in the manuals (at least, in most of them :–). And has been, for about seventy years.

Keep it greasy, it lasts longer.

It is not just proper lubrication that prolongs the life of the vehicle, there is also the implied CLEANING that accompanies any lube–job. Dirty, dusty or harsh conditions, you need to clean your undercarriage more often. That's what you do before you change the lubricant, just as you clean off your engine when do an oil change.

Long, Boring (but real) Example

A fair example of the frequency at which you may need to change your lube was the run to Inuvik last year. Round trip, it was only eight thousand miles but there were so many miles of dusty, unpaved road I thought it best to double–up on my lube jobs, doing the greasy chore three times during the trip.

I've even got the photos to prove it :–)

(When we got to Inuvik someone snapped a picture of me doing the deadly deed to the old bus. If Ken can find a means of linking the snapshots to this article it will give you some idea of the joys of working on reasonably dry gravel. The other lube–jobs were done under much worse conditions.)

Following the trip to Inuvik I ran down to Cabo as a preliminary for our up–coming 12 July trip. I had the bad luck to run into the tail–end of a hurricane and had to ford a number of flooded vados. Soak your bus in water, you gotta change the engine oil, tranny lube and chassis grease. All tolled, the bus enjoyed five lube jobs for only fifteen thousand miles of service. (There was a three–thousand mile run to Kansas City in there somewhere.)

Doing the Deadly Deed

There are many different types of grease. For most chassis lubrication needs any good grease will work but see your manual for their recommended specifications. For CV's you want a different formualtion than the grease you use for your torsion bars— one more suitable for high pressures. But CV lube is great stuff for tie–rod ends and ball joints.

There are three basic types of manually–operated grease guns but all of them are in fact a form of hydraulic pump, designed to pump grease rather than oil. The lever–type gun can usually generate about 3000 psi, more than enough to force the thick grease into the finest fitting.

It is common practice to maintain a different grease gun for each type of grease your vehicle requires. I use a moly–based grease for CV's, tie–rods and ball–joints, a lithimum–based grease for the torsion–bar and steering knuckles.

Grease is sold in convenient cartridges, although you can bulk–load your gun if you wish. Wheel–bearing grease is normally sold in cans. The best wheel–bearing grease has very long molecules — it's called 'long–fiber' grease — and is unsuitable for use in manual grease–guns. Each cartridge holds about 400 grams of grease — about fourteen ounces. It takes about eight ounces of grease to do a proper job on an old bus. Later model buses have fewer fittings — more 'Lifetime–lubricated' parts waiting to fail — and so takes less grease per job. On the Inuvik run I used two tubes of grease and had to replace one Zerk, apparently kissed by a rock.

Zerks! Zounds! and Needles

A Zerk fitting is a nipple shaped to match the nozzle of a grease–gun. The grease passage through the nipple is closed with a check–valve, a tiny steel ball supported by an equally tiny spring. Left exposed, Zerk fittings go bad quite quickly which is why they should always be protected with a cap.

Being a lubricated joint, tie–rod ends were once fitted with Zerk fittings and many still are. The same is true of ball–joints. Unfortunately, it has become common for auto–makers to equip their products with ball–joints and tie–rod ends that are 'lubricated for life,' which is automotive double–speak meaning the things will only last about sixty thousand miles before they must be replaced due to lack of lubrication. They'll last longer if you stick to smooth, paved roads but the bottom line is that you can't lubricate them, meaning they'll wear–out faster than a fitting you CAN lubricate.

The solution to this 'Lifetime Lubrication' bullshit is pretty simple. Some VW ball–joints have a threaded hole for a Zerk fitting. Simply replace the nylon plug with a Zerk and pump away — your ball–joints will love you for it. Another, less effective method, is to inject grease directly into the fitting through the rubber boot, using a large hypodermic needle. I know it sounds crazy but it works. Indeed, it sounded so crazy that the kid mentioned above had never heard of it nor had any of his friends. Thanks to Conventional Wisdom the kid was convinced the suggestion — and all of my articles — had no value, that I was just another geezer blowing smoke up his ass. And besides, his dad told him it was illegal to own a hypodermic needle(!!!).

Ah well.

Wanna nice big hyperdermic needle? Go down to your FLAPS and buy one. It will be hanging on the wall in a blister pack, somewhere near the grease–gun stuff. Plews (brand name) makes one — their catalog number is 05–037. Cost about three bucks. Cheep! (This is also how you get those extra miles out of your CV joints.)

The 18 gauge hypodermic needle, which at least in California is perfectly leagal to own, is swaged to… you guessed it — a Zerk fitting! Plug it into the nozzle of your grease gun, stab the needle through the boot of your tie–rod end, CV or ball–joint, and pump away. Yeah, it makes a hole, and yeah, some of the grease will leak out. But the thing will last a lot longer, too.

—Bob Hoover

(*) So how did Muir screw–up on his lube–job instructions? First, he sez to pump until you see the grease come out — "…indicating that it is full." All that does is top–up the old grease. You want to CHANGE the grease, not just top it off. Keep pumping until you see NEW grease coming out.

Secondly, he sez that if you have a bad Zerk, run down to a service station and have the kid use the pneumatically–powered grease–gun to force grease through the fitting.

Bad, bad idea. What if the fitting is filled with dirt? What if the spring has failed and the ball is rusted in place? (Hint: You'll pump parts of the spring into the joint you're trying to lubricate.) And finally, what if even the powered grease–gun can't force grease through the nipple?

If you have a bad Zerk fitting, replace it. You can buy Zerk fittings at any auto–parts place that sells grease — they come with the territory. You should keep a couple spare Zerks of each type (they come in both straight and angled flavors) in your tool kit, just as you keep a few spare fuses and a few spare tire–valve cores. It's not anything special, it's what mechanics DO.

In all fairness, the Muir manual mentions replacing Zerk fittings… but only when they fail to make an adequate seal with the nozzle of the grease–gun. There's a bit more to it than that. — rsh

Rear Shock Removal

Hey folks, Anyone know of a good way to get the bottom bolt out in order to remove my shocks? Is there a good puller for this? The top ones came out easily enough, but the bottom ones will hardly budge with a socket. They are currently soaking in oil.

Your message is not clear. On some buses the front shock's lower 'bolt' is actually a stud.

However, if you're talking about the rear shock lower bolt... The bolt, which is a Grade 8 puppy, passes through the forged steel axle carrier. On installation of the shocks these bolts are supposed to be coated with grease or anti-sieze compound, with a generous layer under the washers. The object is to keep water from wicking into the space between bolt & forging. If moisture gets in there, the bolt will rust. And if the water contains any salt, the bolt will rust-weld to the forging making it very difficult to remove. (In the GODs — Good Old Daze — it was common practice to use sal amoniac, salt or even urine (!) to rust-weld nuts to bolts in critical applications, a primitive form of Loctite.)

In effect, the rust makes the bolt larger while making the bore smaller. The amount of force needed to break such a bond may exceed the strength of the forging. Best bet for non-destructive removal is to use penetrants and heat. It's also a good idea to locate replacement bolts BEFORE you start pounding on the old ones. Even if you get them out intact, if they are seriously rusted you will want to replace them. Don't count on your VW dealer to have them in stock — try an industrial hardware supplier or a truck dealer.

There is considerable risk involved in using a torch to heat the rear axle carrier (don't heat the bolt) so be careful. A chatter gun will usually pop the bolt free after an overnight soak with penetrant and a modest application of heat of concentrated heat — use a MAPP or acetylene torch; a propane torch is too cool.

After getting the bolt out, do what you can to clean the bore in the forging. If you have access to gun-stuff a .50 cal. bore-brush makes a fine de-rusting tool. Once the bore is clean, PAINT IT. (And stop laughing, I'm serious.) Use Rustoleum or similar 'Rusty Metal Primer' (ie, the red stuff). Swab the paint into the bore with a rag on a stick, really coat that puppy.

On installation of the new bolts & shocks, use anti-sieze on the shank of the bolt, keeping the threads clean. Install the nut with Loctite and torque to spec. It's okay if the paint is still wet at the time you install the bolt. (The paint will not bond to the bolt because of the anti-sieze.)

Tight Ball Joints

On June 26 I wrote you about ball joints on my '69 Bus. I have since taken everything apart, had new joints pressed in, and reassembled everything. I bought 4 new ball joints, new tie rods with ends, new drag link with ends and new dampner, all from Rocky Mtn Motorworks. The Bus has '71 (?) disc brakes and spindles.

I am having problems...the steering is excessively stiff...so stiff that the alignment shop wouldn't dial it in. (I wasn't going to pay them to tear it all apart and "diagnose" it). The new joints were very stiff on installation, but I figured this was acceptable given the load they handle and that they were brand new. The installation was moderately difficult, but not unreasonable for my first time. It drives, but there is little return on the steering. It feels sticky, but it will turn through the full range...with little return (gotta pull it back myself). This is with a total of about 10 miles on the new gear...in town.

I don't know what to do...I've sunk some big bucks into this already. Should I be patient and let it "break in"? Did I get screwed on the parts (Rocky Mountain is somewhat reputable). Did I F**K UP? Please respond for I am at a loss at this point. You have inspired me to tackle these jobs myself, and I have performed competently with (mostly) proper tools, referring to your sermons, John Muir, and Haynes frequently. I wasn't uncomfortable with any of the work, just the results.

I feel discouraged right now.

Stop feeling discouraged and start thinking about how to diagnose what in all probability is a very minor problem.

I hope you DON'T have a pickle fork. Pickle forks damage the boot on a tie-rod end. To diagnos the problem you've got to isolate it, and that calls for popping the rod-end loose. The best tool for rod-ends is one of the screw & lever typs. Pops them loose but doesn't touch the boot nor damage the thread..

Okay, what you want to shoot for is breaking the system into three sub-groups. The wheels together are one group. Pop loose the tire rods at the steering knuckle.

The steering box is a sub-group by itself. Pop loose the drag-link at the gear box.

Now start fooling around. The wheels should swivel freely on the steering spindle, and that means the new ball joints should swivel freely in the trailing arms. If they don't, the fellow who pressed them in screwed up and pinched the ball with too much pressure..

How tight is too tight? Go down to a front-end shop, explain the situation and ask to FEEL a new ball joint. It will have a firm, fluid movement with no tight spots. If you think you ball joints are the problem, pop one loose, clear the knuckle and compare the feel of the VW ball joint to what you just felt at the shop.

No shop? Then buy a ball joint from JCW, feel for yourself. Costs about ten bucks for a bug ball joint.

But lets say the ball joints aren't the problem. What's left is basically a pivot lever with two sticks attached, plus the hydraulic steering damper.

If you got a damper with a rusty rod it can take tons of pressure to move it. The damper should feel about like pumping up a truck tire with a hand-pump. And no play.

With the steering damper removed, the swing-lever and tie-rods should push back and forth very smoothly with only a moderate amount of drag. The swing-lever should have no vertical play at all. If it is worn, and you install all new parts, it will sometimes hike itself up and bind, presenting the symptoms you described.

Tie-rod ends are like ball-joints, they are a ball swaged into an hemispherically shaped socket and should rotate with firm fluidity and no play at all. To test them you stick a prick-punch or steel scriber thru the cotter-key hole, use it as a handle to turn the tie-rod end in its socket. They can have the same problem as described for the ball joints and for the same reason — shoddy workmanship.

Spinning the steering wheel should cause the Pitman arm to travel thru its arc as smoothly as snot sliding off a door knob. And there shouldn't more than a smidgen of motion at the steering wheel before the Pitman starts to swing. This is best checked with the steering assembled. But you can detect play and/or binding in the gear box best with the steering disconnected.

Your steering system is a very simple arrangement of push/pull rods and pivots. It is designed to be ultra-reliable. VW bus steering is better than what you'll find on a lot of American cars so don't settle for half a loaf.

Stiffness in the system indicates something is binding. Find it. Unbind it or replace it. Get the play out of the wheel bearings and steering gear. Install some stiff-walled Light Truck tires. Crawl under and adjust your tie-rods to give you about an eighth of an inch of toe-in. Then take it down and have the camber adjusted. After that you'll have a stable ride with precise, comfortable steering.

Don't feel so discouraged. You're not fixing a bus, you're only learning how. And learning — in the real world — is always a tough proposition.

-Bob

PS — I'm going to assume the problem is NOT related to the 69 vs 71 front axle swap. If it was steering properly before you did the rebuild, we are looking at a problem associated with the rebuild and NOT the basic design.

However, the burden of competence regarding the swap is on your shoulders. If there was some pre-existing problem — possibly with the disk brake caliper binding against a ball joint (?) — that precipitated a failure and thus dictated the rebuild, it should have been dealt with prior to doing the rebuild. Learn from the past or you're bound to repeat it. — rsh

Emergency Tow Bar

This article describes how to tow one VW bus with another but the technique of using a large tire lashed between the vehicles as a ‘tow-bar’ may be used to tow almost any vehicle.

1. Go to a busy tire shop that does trucks. Get a used truck tire. The tread can be worn out but the casing must be good — no blowouts, etc. If they want more than two bucks, go someplace else.

2. Go to a hardware store. Buy about a hundred feet of small diameter line. Also buy about eight feet of welded chain, a bolt to secure it to itself, washers & nuts as required and some bailing wire. (Folks don’t use wire for bailing hay any more but bailing wire will always be with us — it’s useful stuff. Look in the cement section. They call it ‘tie-wire’.) If they got good coir doormats at a low price, buy two.

3. Frap the two bumpers. (That means to pad their inner edges so they can’t cut through the rope.) Use a coir doormat or sections of rubber hose that you split with your knife. If you’ve nothing else, use a couple of pairs of Levis. Heavy canvas tool bags will also serve. Fasten the frapping securely so it can’t slide around.

4. Back the tow vehicle up to the vehicle to be towed. Lash the used truck tire in a ***horizontal*** position to the rear bumper of the tow vehicle. Each turn of the lashing should be drawn up snug using a half-hitch. Take as many turns as you can but keep the lashing as close to perpendicular to the bumper as you can.

5. Grab the front bumper of the towed vehicle, lift up the truck tire and pull the vehicle up snug so the truck tire is in firm contact with the middle of the front bumper. Lash them together as in #4.

6. Rig the chain between the two vehicles in a figure 8 passing around the bumpers and through the tire. Give it a little slack then fasten securely, wiring the fastener with bailing wire so it can’t come off. (That is, wind some bailing wire around the exposed threads so the nut can’t back off, use some more bailing wire to fasten the wrappings to the chain.)

7. Use a bungee cord to loosely fasten the steering wheel of the towed vehicle to the door or seat. The bungee is needed to provide a positive return to center when you go around corners and to act as a shimmy damper.

8. Rig your lights. Test them. Readjust your outside mirrors.

10. Test-drive. The thing will tow. ***Anything*** can be towed if its got enough air in the tires, the brakes don't drag and you remember to take it out of gear. What you need to find out is how well it ***stops***. Get the feel of it. You are now about thirty feet long, weigh nearly six thousand pounds and have a joint in the middle.

A Few Tips

If you encounter high winds, stop and wait them out or find a different route. The tow can get away from you very easily on steep descending turns if you get slapped with a cross-wind.

If you're traveling unfamiliar roads it's best to do so during the day but if you must travel in the desert you should take advantage of the cooler night-time temperatures.

Once you work your way up to speed it doesn't take much to keep you there, although you won't be able to cruise in fourth if you've got a stock engine. So run in third. It will get you home. Your mileage will go all to hell of course and you can't run too fast, mebbe 35 or so, but you're not going to break anything.

On pavement, you'll hardly know the tow is back there, assuming it tracks straight. But the weight of the tow will re-appear on every grade, forcing you into 2nd or even 1st. The weight is just as much bother coming down the other side. To keep from burning out your brakes, the old trucking rule is to come down a grade at the same speed you climb it. And if you've no experience with this sort of thing you'd better pay attention because burning out your brakes on a down-grade is the sort of mistake you only get to make once.

I don't know if this towing rig is legal, I kind of doubt it. Several years ago I used one Volkswagen bus to tow another from Winnemucca, Nevada to San Diego, California, about 700 miles and 2 long, hot days (more than 20 engine-hours) and never got stopped. I got looked-over pretty close by a cop at a truck-stop but later when he passed me on the road, he just waved.

Towing Bugs & Buses

Like all auto manufacturers, VW has a spec for towing things, carrying stuff on the roof, and so forth. It is a conservative figure.

As a general rule, if the tongue–weight does not exceed the amount allowed, and the max weight does not exceed the gross weight allowed, the tow is do–able.

The tongue–weight figure has to do with your ability to steer, the gross weight with your ability to come to a safe stop.

Towing a bug or bus on its wheels often gives a misleading impression of the bus' ability as a prime mover. With all four wheels on the ground, the tongue weight of the towed vehicle is virtually zero. Pump the tires up to 50psi and finger pressure is enough to make the thing roll. I've even known guys to use a bug as a trailer (!) because it was such an easy tow, they already had the bar, and so forth.

To me, the most imortant part of any tow is how the load handles and my ability to stop. It seems too obvious to justify repeating but if you've got a lot of weight behind you the wiser course is to keep the speed down. Fitted with a big, torquey engine and a suitable hitch, an early bus makes a fine tow vehicle. But it don't stop for spit when the combined weight goes above 4,000 pounds. Later buses with disk brakes should handle a bit more gross weight but all brakes will fade when overheated. And a heavy tow will push you places you may not want to go.

The ultimate trailer for use with a VW bus is probably a four–wheeled job with very low tongue weight and electric brakes.

Winches

When installing an electric winch on an early bug or bus the usual method is to fabricate a mount that utilizes the front torsion-tube mounting points. Unless you are working in the vertical (not recommended unless you have a good ramp to come down on... and a gimbal-mounted battery), the two-ton units can drag you out of most swamps.

But the problem with using a winch often involves where to attach the cable rather than the winch. Since the only real tree in Baja is busy shading the plaza at San Ignacio, finding someplace to fasten the cable can stretch your ingenuity to the snapping point.

Most of us just dig in. Bury one of the spares, with the cable latched to the tire-iron under it. Pile on the rocks. Sit on it.

Some guys carry two-foot square plywood panels. Handy for camping but not much good as an anchor, except in pure sand.

Rope is handy. A 100' hank of 5/8" trucker's rope can solve a world of problems, such as extending your cable to that big rock over there. Don't worry about the rope; it'll take about a ton of pull before it snaps. THEN you can worry about it, as in how fast you can duck. (If you're lucky it won't eat the windscreen.)

The truth is, if you've got a high-lift jack you'll be on your way long before you can figure out where to anchor your winch cable. But then, winches are buf. Macho to have a winch on the front of your rig. And big, BIG tires. Jacks are just... jacks. And you were really only running for the experience, right?

If your engine is still running, you're still in the race. Jack that puppy up, get some traction under it, and Drive ON! (You EVER see a winch on the typical Bajanese pickup? Rusty old '50 Ford, drum of gas in back, two cowboys in the cab along with a ton of gear. Wave them down. They'll pull your sorry ass out, point you toward the nearest La Quinta motel with a hot tub and cold beer, while they drive on. To them, it's not The Baja with capital letters, it's home. The most modern tool in their truck is a lot of common sense, rare stuff in modern-day Ami-Rica.)

But you say you've got trees? Ummm... maybe you COULD use a winch. But the ones I prefer are spelled differently.

Clutch Pressure Plate

If you'll examine the typical clutch pressure plate you'll see that it is not finished very well. The steel stamping that forms the shell often has turned ends and the holes for the mouting bolts need to be champhered for the same reason.

Spending a few minutes cleaning up the pressure plate with a file will not only make it safer to handle, since the edges are razor sharp, it will also make it fit better, since the turned edges prevent the clutch from laying perfectly flat when you bolt it down.

Since pressure plates may lay on a dealer's shelves for years, they are usually coated with grease or cosmoline as a rust preventative. If you will clean alway all of the grease with paint thinner you'll eliminate the possibility of getting grease on your pressure plate. The cosmoline is also a problem when it comes to balancing. If you leave the rock–hard cosmoline on the plate its mass will be included in the balancing process, but when installed and the plate heats up, the cosmoline will be thrown off.

After cleaning your pressure plate give the stamping a light coat of gloss enamel. It keeps it free from rust and sends a subtle message to the guy doing the balancing. The components of rofessionally built engines are either plated or painted, wherever possible. The cast iron pressure plate is not painted of course, since it is a friction surface. Protect it from rust by wiping it down with an oily rag. Scrub it clean with lacquer thinner or MEK before installation.

Clutch Return Spring

To replace the clutch return spring you must remove the clutch throw-out lever, the thing the clutch cable goes through. It is secured with a snap-ring. Scurb all of the crud off before you begin. The thow-out arm has serrations that matches grooves in the throw-out lever, it will only go together one way, but if there's a lot of crud it may not want to come off without a bit of work.

With the throw-out lever removed, clean things up and wriggle the shaft. Any play is bad and indicates the bushing is worn. Obtain a bushing kit and plan to replace the bushing the next time you do your clutch. I think the Bentley has illustrations covering this task which is relatively easy so long as everything is clean.

There are no mysteries to putting the lever and spring back together but you may have some difficulty getting the clutch cable through the lever and threading on the adjuster nut while holding tension on lever and preventing the cable from turning. My trick is to use bailing wire around the lever to the axel or other hard-point to hold the lever in position, allowing me to use both hands to insert/hold the cable while installing the adjuster nut.

Replace the spring as soon as you can. It is easier than replacing your clutch, which is what you'll have to replace if you run too long without proper return-spring tension. I'll make this a general post since it applies to buses as well as bugs.

Detached Mainshaft

That shaft that comes out the back of the trans and goes into the pilot bearing? I know two people (Joe and Marc) who have tried to pull the engine and ended up unintentionaly pulling that shaft out just this week. Marc tried to put his back together but now his bus doesn't move. Joe hasn't reassembled yet.

If you have time could you give the lowdown on what causes that, and whether it's a catastrophic sort of thing?

The mainshaft comes out when the circlip and coaxial stud has failed, which usually results — although not immediately — from a rear-end collision or colliding with something while backing up.

If the damage is isolated to the mainshaft, reversing gear, keeper and coaxial stud, the repair is relatively easy although the disassembly/reassembly is a pain in the ass.

I don't know if any of the manuals address this specific repair procedure. In most cases of main-shaft disengagement there are other, more serious problems to be dealt with. Repairing only the mainshaft could be the waste of a vast amount of effort, if after the job you discover you also have a shifter-fork or gear-cluster problem.

However, with the above as a precautionary prologue, the repair goes something like this:

Drop the engine and pull the transmission. On a bus, pull the outboard gear reduction units and strip everything down until you have bare axles. Unbolt the driver's-side cover plate from the tranny, seat the PASSENGER-SIDE axle fully into the differential side-gear and GENTLY drive the differential and driver's-side cover-plate out of the tranny using a lead or copper mallet.

Keep the shim stacks together. This is vital.

With the differential out of the way you will be able to diagnose the root problem, which is usually a sheared coaxial stud — it is a dinky 6mm stud, treaded on both ends, that screws into the center-line bore of the tranny's input shaft, and into the mainshaft.

The coaxial stud is only for alignment, not power transmission. Power from the engine to the transmission is transmitted via the reverse-gear coupling sleeve which slips over BOTH the mainshaft and input shaft. The reverse-gear coupling is held in place by a circlip on the mainshaft.

If the coaxial stud is sheared in the input shaft the repair may require dismantling the transmission (so far we've only been dealing with the differential). The typical bus owner is unlikely to have the tools or skills needed to tackle this level of tranny repair. But if the failure is limited to a problem with the mainshaft, reverse-gear coupling and circlip, the repair usually involves only the replacement of any damaged component.

Taken slowly, with constant reference to the manuals, this repair is within the capabilities of the novice but there is such a range of variables, any one of which can lead to more difficult tasks, that it would be wise to consider replacing the tranny as a unit, allowing you to repair the removed unit in a bench-top environment.

-Bob Hoover

PS — It should be obvious that any repair that requires removal of both the engine and transmission provides an opportunity to perform maintenance, repairs and replacments to related systems, such as the shifting linking, outboard gear reduction units, rear brakes, heater ducting and so forth. —rsh

Freeway Flyer

I've been *considering* the idea of making some kind of modification to my 60 Westy tranny to make a bit more compatible to current highway speeds

Could somebody explain to me exactly what a "freeway flyer" tranny is?

If you have the original engine in your 1960 Transporter it's displacement is 1192cc's — not much. Brand new, on a test stand, with the fan disconnected, it was rated at 40 hp. Measured in a real vehicle, at the rear wheels, it produced about 20 usable horsepower. Addition of the outboard gear-reduction units (which come in two flavors) was the only way you could move a vehicle as heavy as a Transporter with such a small engine and even then the top speed could never be very fast. (The higher-ratioed gear-boxes, called the 'mountain option' , where fitted to vehicles delivered to about a quarter of American dealers. Chances are you have the mountain-option gearboxes.)

To insure maximum torque at low speeds early bus engines were fitted with mechanical-advance distributors — the engine is running flat-out nearly all of its life. On flat ground with no wind the 40hp engine could push an early bus about 60mph — after spending about three minutes (!) to get there. If you had the high-ratioed gear boxes and ring-gear, your engine had to be turning about 5,000 rpm to do to do even that well. Adding a larger/later engine wouldn't change things all that much — you'd still need to run your red-line to travel at highway speeds. What the bigger engine provides is better acceleration — now it takes you only two minutes to get up to 60mph — but you're still spinning 4,500 rpm, a bit too fast for optimum engine life. Even so, you're living on the razor's edge. A bit of wind, a low tire — even a draggy wheel bearing — and you'd be lucky to do 50 mph. (I won't mention hills. Too cruel.)

I'm not sure when the bus powertrain was changed — '61 or thereabouts — but early trannys, axles and outboard gearboxes are different from later ones. I mention this because the so-called 'Freeway Flyer' option is not available for early split-case trannys.

Inside your tranny (actually, it's in the differential) you have a ring-gear that delivers power to the axles. The ring-gear is driven by the pinion gear, which is the output of the transmission. In Volkswagens the tranny and differential are mounted in the same housing, the power from the engine is carried through the differential housing by the main-shaft to the transmission, which occupies the forward two-thirds of the assemblage. The speed of the

mainshaft is reduced by the selectable gearing and returned via the pinion gear to the differential housing, where the ring&pinion gearing further reduces the speed.
The ring-gear & pinion form a set, the gears matched to each other at the factory. Ring & pinion sets came in several flavors, with ratios of about 4.4:1 down to something like 3.6:1 (don't hold me to these numbers — I'm not a tranny expert). Most American mechanics are not familiar with the full range of VW gearing but in Europe the Transporter was used for a wider variety of roles, from tow truck to fire engine and everything in between. In many cases these tasks called for different gearing than was used in the typical Micro Bus, Panel van and so forth exported to America.

Inside the tranny there were a couple of options for the intermediate gears as well. In the Transporter (up thru '67) the two options for the outboard gearboxes remained, although the ratios and the gears themselves were slightly different from the early models. As you can see, by combining the several available gear ratios for 4th, ring-gear and the outboard gear reduction units, you end up with a large number of possible combinations for the Transporter.

The reason for laying all this background on you is to make it clear there's no magic bullet to the gearing problem. It also puts the following into context: The so-called 'Freeway Flyer', be it for bus or bug, is nothing more than a power-train assembled with the lowest possible overall gear ratio. A number of tranny rebuilders offer this option.

Assuming your engine can provide enough torque to drive the higher gearing the difference in highway speed can be profound. For example: Where before you needed 3,750 rpm to travel 60 mph, with the higher gearing (ie, lower ratios) you find yourself cruising at 70 mph on only 3,500 rpm. But there's no such thing as a free lunch. In a Transporter you'll need an engine of about two-liter displacement to realize the advantage of the higher gearing. Sedans do quite well with less.

If you wish to consider this option you would have to go to the late-model tunnel-type tranny. This has to be carried through right out to the wheels — changing axles, gearboxes, backing-plates and so forth.

Since swing-type axles for buses are no longer being manufactured (sedan swing-axles are still being made in Mexico), most people wishing to improve the powertrain are looking toward the IRS conversion, allowing them to use the '68-71 bus tranny or any of the '69 and later sedan trannys. (There are no reduction boxes on '68-71 buses.)

I hope this gives you a better feel for the situation. Personally, I think your 1960 vehicle should be kept as stock and returned to As-New condition as your resources permit — the value of older vehicles is appreciating quite rapidly. For a daily driver your best option may be to shop for a 1971 bus. They remain fairly inexpensive and relatively rust-free here in southern California — prices range from under a thousand dollars to about $3,500, depending on condition. The 1971 model offers the advantages of disk brakes and IRS suspension but retains the early style up-right engine, the displacement of which can be increased rather simply to about 1800cc with no loss of reliability.

Gear Selector Position

I probably would not have done this if I had one of the older transmissions used in the air cooled Vanagon. They have adjustable forks that require a special fixture to work on.

While there is a special tool for setting the gear selectors, a perfectly suitable substitute may be fabricated from an old transmission.

When a transmission cracks across the differential housing, or pounds out the pinon bearing web, its life is over. Junkies an tranny rebuilders get rid of them cheep. Folks use them to build dynos or engine stands or send them to Martha as BBQ fuel.

Since the function of the special tool used to set the gear selector position is to hold the two gear shafts in the same relationship as when mounted in the transmission, you may use an old, damaged transmission to do exactly that. The only modification needed is to cut a window in the side of the tranny so you can see & adjust the gear selector forks. And since such a window is at the opposite end of the casting from the bell housing, you can use the same junked tranny as an engine test stand AND a transmission repair fixture.

Hard Shifting

Hard Shifting in the VW Bus

The Volkswagen shift linkage provides a crisp, positive feel. In the bus, positive engagement is achieved with no more than finger pressure. If your bus is difficult to shift it is good evidence there is a problem in the system.

The shift linkage used in the bus is slightly longer and more complex than that used in the sedan and has two additional friction points. The longer gear-shift lever provides the extra energy needed to overcome the additional friction.

There is a significant difference in the shift-linkage mechanism used on buses built before August, 1966 and those of later vintage. I've no direct experience with shift-linkage for buses younger than 1968; these comments may apply in a general sense but are specifically directed toward older buses.

The condition of the transmission mounts is the most critcal factor in how well your bus shifts. The three mounts, one front and two rear, support the transmission so as to align the shift rod in the nose of the transmission with the shifter-rod attached to the gear-shift lever in the cockpit. An elastomeric coupler is used to join the two rods at the transmission and any deterioration of the mounts or coupling will make shifting more difficult. Original equipment couplers are available from a number of suppliers. Use of after-market urethane couplers is not recommended due to poor quality and high noise transmission.

Running under the cargo bay, the shifter-rod is contained in a housing, supported by two nylon bushings attached to the shifter- rod. The 'lifetime' bushings wear out and must be replaced after about 100,000 miles of service. Replacement calls for removal of the transmission, disconnecting the shifter rod at the front and removal from the rear. The bushings are available from Wolfsburg West and are not expensive. (211 711 185A for buses up to mid-1962, -185B for buses built between 1962 and Aug, 1967. Cost is $2 and you need a pair of them). If your bus has accumulated over 100,000 miles it may be wise to plan for removing your tranny the next time you do the clutch and to pull the shifter rod and replace the bushings.

The bus shifter-rod is a two-piece affair with the shorter front piece extending from under the cockpit floor to just behind the front axle, bent so as to clear the steering gear and torsion tubes. The two pieces are connected with a rigid coupling and a locking screw that is safety-wired in position. This is where the coupling rod is disconnected prior to removal. The shorter front piece may then be removed to the rear once the gear shift lever is removed.

On early buses the front section of the shifter rod was very similar to the system used in the sedan, with the same Guide Plate and Bushing (P/N 111 701 259A — see my sermon on “That @#%* Bushing”). Fortunately, the bushing is very easy to replace on the bus.

On buses built after Aug, 1966 Volkswagen used a different bushing arrangement and Guide Plate, the latter having a pin on the Guide Plate on the same horizontal plane as the shifter-rod and engaging a nylon bushing installed in the end of the shifter- rod. The new bushing part number is 211-711-197 and costs a buck.

Visualizing the Linkage System

Your shift linkage is basically a straight rod extending from the bottom of the gear-shift lever to the nose of the tranny. Any deviation from that straight line will contribute to shifting problems. The shifter-rod is supported at each end and by two bushings along its length. Any wear in those supports will contribute to shifting problems.

The transmission is secured to the chassis independently of the shifter-rod. Any misalignment of the tranny will cause a kink in the shift linkage system at the shifter-rod coupler. And will contribute to shifting problems, etc. and so on.

Tracking Down the Problem

If your bus shifts with difficulty or does not have that clean, crisp feel that is one of the delights of driving a Volkswagen, you are probably experiencing the result of accumulated wear or deterioration in the linkage system. The various manuals explain how to check for deteriorated tranny mounts and couplings, and dismantling your gear shift lever and inspecting it will tell you if the shifter plate or lever is worn. Replacing any worn parts will restore the system to like-new operation, assuming the problem is not inside the transmission, something you can check by disconnecting the coupling and running it through the gears by hand.

If the transmission is properly lubricated, which means changing the lubricant every two years immediately dealing with a leaky boot, the tranny is capable of delivering 500,000 miles of service. (When was the last time you changed your tranny’s lube?)

If you've dealt with hard shifting by replacing the stock gear shift lever with an after-market shifter, you may have simply masked a problem in your linkage. Most after-market shifters alter the leverage ratio, allowing less shift motion at a cost of greater effort on the part of the driver. But that greater effort could also be scrubbing the life out of your bushings or bending your shifter rod. Before installing an after-market shifter it would be wise to do a complete overhaul of the linkage. And when you overhaul the linkage, the odds are you'll find you've no need for that expensive shifter :-)

Sermonette

It is the nature of parts that move to wear out but in a well designed system, one provided with a comprehensive schedule of periodic maintenace, the wear may progress at such a slow rate that we will tend to forget reality: If we use it, we are wearing it out.

When we begin to take reliable service for granted we are courting catastrophic failure. The only thing we should take for granted is periodic maintenance, and even them to question it closely. Volkswagen built their vehicles with many 'lifetime' parts, such as the grommets in the shift linkage, for which they provided no periodic maintenance nor recommended overhaul period. Having used up our vehicle's designed 'lifetime' we now have an obligation to repair what we have worn out.

IRS Retrofit

Swapping an Early Tranny

Roland Wilhelmy (see 'Stainless Steel Craftsman') is in the process of doing the Bus Boys IRS modification to his splittie. He's a dab hand at this sort of thing, having already done the conversion to his '56 beetle. I've been hanging around his shop handing him tools, taking pictures of the work in progress and making lots of notes with the idea of doing an article about IRS conversions.

To remove the tranny in a splittie you begin by removing the engine then the rear brakes, which can be a chore. But the stub- axles had been properly treated with anti-seize and slid off with only hand pressure once the axle-nuts were removed. Once you get everything disconnected it's a good idea to rustle-up a friend — an early tranny is an awkward package for one man to handle.

Roland did all that and I helped him pull the tranny out. It was clean. No drips or weeps, a recent re-build with the 'Freeway Flyer' gear-set.

I admired the workmanship, including the backing plates and brakes. When he did the original work Roland had taken the time to paint all of the components. Everything looked brand new. It was really a nice job and I praised him for it.

"That's a nice job," I said, pointing out the lack of rust on the brake shoes and the precisely lubricated friction points. Even the gear-boxes were neatly painted.

Roland gave me an odd look. We got the tranny off the jack, supporting it on blocks of wood so the boots wouldn't be stressed. I was really impressed with the condition of the parts. I was also trying to figure out how to get my hands on them. With the IRS installed and owning only one bus, Roland would not have any use for the swing-axle tranny. I have two early buses, one of which — Grendel — has no tranny at all.

I kept finding things to admire about the tranny and the backing plates. Roland laughed and gave me this really odd look. "Don't you remember doing them?"

In truth, I didn't. Not until he mentioned it. Then I recalled rebuilding his gearboxes and doing a brake job on his bus five or six — seven? — years ago, back before he built his shop. Roland does all his own work but back then he didn't have the space and I did.

I felt pretty silly, standing there admiring my own work.

“Where you going to store it?” I asked.

“Let’s throw it in your bus,” he said. So we did.

I went back over the next day and we jacked up Greenbus and put that pretty tranny in there and I drove home without even being able to hear what gear I was in.

Doing the Work

Pulling the tranny is a lot of work but it’s pretty easy if you have a floor jack and a place to do the job. Of course, if you’ve never done it before the idea alone can be intimidating, what with having to get the engine out of the way and needing to support the bus — pulling the tranny of an early bus means pulling the rear wheels too. Oddly enough, that’s where you have to start.

Before pulling the engine is the ideal time to loosen the rear axle nuts. If they were properly torqued it’s going to take some beef to bust them loose. You use a 3/4" drive 46mm socket — a six-pointer if you’ve got it — and a long cheater. Once the axle-nuts are loosened you back them off about one turn then get on with the rest of the work. Now is the best time to loosen your lug bolts too — it’s a little easier to deal with the drums if you remove the wheels. But for now, with the wheels on the ground and the engine still in the vehicle to provide maximum mass, just loosen things up.

I’ve already done an article on pulling an engine so I’ll just hit the high points, which are few. You start in the engine compartment, disconnecting first the battery then the electrical leads to the engine and finally the throttle wire. You might as well take off the air-cleaner too.

If you’re not familiar with your electrical leads you should mark them with tape or make a drawing.

I remove the bumper whenever I pull the engine. It makes things a little easier. After removing the bumper I remove the rear body panel. With the bumper removed, the vehicle doesn’t have to be raised to remove the engine.

The most important part of removing the engine is how you deal with the gas line. The easy method is to pinch the rubber fuel line with a clamp before disconnecting anything. VW used to sell a special clamp for this purpose but a small pair of vise-grips works about as well, assuming you adjust them

properly. You don't want them too tight — leave a little gap — otherwise you'll damage the gas line.
Once the gas line is pinched-off and disconnected you'll need to disconnect the heater-box wires. After that you simply unbolt the engine and pull it out.

Getting at the Tranny

With the engine out of the vehicle it's time to jack the thing up so you can pull the tranny. You'll want a pair of good jack- stands and some method of blocking the front wheels so the thing can't roll. Position the jack-stands under the torsion tube housing and raise the vehicle to a convenient height. But don't get under it just yet.

Go around back and remove your wheels. Lay them under the vehicle just forward of the jack-stands under the frame-rail. Put a couple of pieces of wood across each wheel. Shit happens. The wheels are your insurance policy. You're going to be removing some highly torqued bolts and if the vehicle comes off the jack-stands, it can kill you. The wheels provide a survivable amount of 'crush-space'. Do it. It only takes a minute.

With the vehicle properly positioned, pull the drums, protect the exposed stub-axle, dismantle the brakes and disconnect the emergency brake cable. If you plan to re-use any of these parts, take care of them. (If you've never pulled your E-brake cables, get a grip on the spring and pull it toward you. See that little split-clip? That's what's holding the thing to the backing plate. Remove the clip by twisting it, slide it off the cable.)

Skivvie under the vehicle and disconnect the hydraulic brake line atop the axle-tube. The smartest tool to use here is a real hex- type 11mm brake wrench, the one that looks like a box-end wrench with a slot cut into the box. Anything else is liable to bugger the brake-line fitting. The flexible brake hose wants a 17mm wrench to keep it from turning. Disconnect the hydraulic line and pull the spring-clips. Be careful, the thing may dribble some brake fluid.

When you disconnect the brake lines, also disconnect the lower end of the shocks. The proper tools are a pair of 17mm sockets. Be sure to fish the lock-washer out of the recess and keep it with the shock bolts. (Be sure to use lots of anti-sieze on the shock-bolts during re-assembly. They tend to rust into their bores.)

Now comes some hard work. Using a 17mm x 1/2" drive socket, remove the eight bolts (4 per side) securing the outboard gear- boxes to the spring-plates. Be careful of the brake line where it bends around the rear of the spring-plate and be sure to keep the washers with the bolts.

Slide forward and disconnect the shift-rod coupling, the grounding strap and the forward tranny mount. If you've got back-up lights, disconnect the wire from the switch.

Remove the starter or disconnect the wires. I think it's a little easier to pull the entire starter; with the engine out, the starter is secured with only one 17mm nut. Use some bailing wire to hold it up out of the way.

Using your 3/4" drive tools and a 27mm socket to loosen the two bolts in the transmission carrier. These puppies are torqued to about 170 ft/lbs and can be a bear to loosen. Be careful not to lift the body off the jack-stands.

Position the jack under the tranny's drain plug — use a block of wood — and support the weight of the tranny while you remove the 27mm bolts from the carrier. The tranny can now be removed from the vehicle.

Handling the Tranny

The tranny from an early bus has to be one of the most awkward loads in history. With the gearboxes on the ends of the swing- axles to add mass, the thing flops about all over the place. Volkswagen used a special cradle when dealing with a swing-axle tranny. You can strap a length of 2x4 or pipe across the top of the tranny, lashing it securely to the axle tubes, and gain some measure of control but it's really a very awkward load to deal with by yourself.

Working alone, the most effective method of moving and positioning the tranny is to take it a step at a time, positioning first one axle then the other, mincing your way about until you have it properly positioned. Being a lazy sort I welded up a cradle very similar to the VW tool but that only works with a really husky floor jack.

While the Tranny is Out

Skip this part only if someone is shooting at you.

When your engine and tranny are out of the vehicle you have the perfect opportunity to clean things up. In a real deader like Grendel I had to start with a putty-knife, scraping away thirty years of neglect. Under that was a nice layer of rust, still working hard. Get rid of it. Now start painting.

See all that hardware you took off? Clean it up. Start with solvent to get rid of the grease then use a powered scratch-wheel to get rid of the rust. Now start painting.

If you had any trouble getting the spring-plate bolts out of the gearboxes you may want to replace the bolts. This is also true for the shock bolts. And if the spring-plate bolts had flattened threads you'll want to get your hands on the proper tap (12x1.75mm) and chase the threads, otherwise your new bolts will be ruined.

When the tranny is out is the time to replace the tranny mounts - - the two mounts in the tranny-cradle and the one at the nose. You may also wish to consider replacing the nose cone and hockey stick or at least replacing the bushings in the nose cone. And since the drums are already off, it's the perfect time to do a brake job. Ditto for replacing the shocks. Ditto for... You get the idea. Dirty, rusty, damaged or worn, now's the time to tackle the job. Indeed, when the engine and tranny are removed is the ONLY time you can do certain things.

Being rubber, replacing the mounts and shift-rod coupler whenever you have the chance is good insurance — if they're more than five years old they probably need to be replaced anyway. And of course, you can't get at the bolts of the rear mounts unless you pull the engine... Now's your chance.

Putting it back in

"To assemble, reverse the procedure."

Don't you hate it when you see something like that? The truth is, it's never that simple. On average, it takes about three times as long to put something together than to take it apart. The reasons for this are many but a good example is the shift-rod coupling: To dismantle, you simply loosen the positioning bolt and pull the thing apart. But to reassemble you must first ALIGN the shift-rod to the hockey-stick.

A word of caution here. At least half the shift-rod couplers I see are LOOSE, the shifting sloppy as hell because of it. The thing is loose because someone installed the safety-wire wrong. The safety wire has to be installed so as to put a constant TIGHTENING pressure on the positioning bolt(s). That is, since it tightens when turned clock-wise, you want to make sure your safety wire comes out of the hole and then goes around the coupling in the direction that will keep the proper pull on the bolt.

The rear tranny mounts are another good example of why things take longer to assemble than disassemble. Simply '...reverse(ing) the procedure...' won't help a bit. The rear tranny mount comes apart any way you want but only goes back together in a certain way. What you have to do is assemble it real loose, taking only one or two threads on each nut — if you screw ANY of the fittings down flush the thing simply won't go together without bending something. By assembling everything loosely you provide the room needed for the mounting pads to line-up with the holes in both the tranny and the cradle. Once everything is assembled LOOSELY you start drawing it up, working from the lower/middle bolts, ending with the upper/outer bolts. (Confusing? It'll make more sense when you see the configuration of the parts.)

Another difficulty when installing an early tranny is getting those pesky bolts back thru the spring-plates and into the gear boxes. The spring-plate is exactly that — a flat plate of spring steel oriented straight up & down. But being on the ends of the swing-axles — which swing thru an arc — the spring- plates must be twisted into alignment. The secret? There really isn't any secret. You start with the lowest bolt then use your floor jack to position the outboard gearbox. You'll have to run the TWO lower bolts in nearly snug before you can get the remaining two bolt-holes to align. Just be patient, use your jack and never clap a wrench onto the bolts until you've hand-threaded them into their bores at least half a dozen threads. (What if it doesn't want to go? Then you may be dealing with buggered threads.)

How Long Does it Take?

There's too many factors involved in this type of job to come up with a labor estimate that will apply to all cases. What with one thing and another, Roland and I spent about fifteen man-hours doing the swap. Working alone, doing a lot of cleaning & painting, I've spent forty hours on the same job. If you have to swap your axles and gearboxes over to a new tranny you'll have to allow yourself another six or eight man-hours. New shocks? Add some time. New brakes? Add some time. New anything? Add some time... :-)

Sermonette

It is April, 1997. The youngest splittie is thirty years old. Even with the best maintenance and only modest use the tranny and gearboxes of your early Transporter are in well-worn condition, if they haven't already been replaced.

This article isn't meant to be a cook-book 'how-to' for tranny replacement — the manuals have already covered that — but it should give you a good idea of what's in store. Replacing the tranny of an early bus isn't an easy task but it's the kind of thing you can't ignore — rebuilding or replacing the tranny and gearboxes is something that's going to have to happen sooner or later. The wiser course is to plan for it.

Pulling the tranny lays your entire aft undercarriage open for inspection, repair and painting. It also forces you to open your brake system. When the tranny is removed is the most logical time to perform a host of other maintenance and repair tasks as well.

What this article is meant to do is to give you some idea of the inevitable — if you haven't already replaced your tranny, you will. You are the Mechanic-in-Charge. By planning ahead you're able to budget your resources; you remain master of the situation. But the most subtle point of this article is to make you aware of the many tasks that should be planned in conjunction with a tranny-swap.

More Detached Mainshaft

Ken (and the List),

The instructions I offered-up would work fine... if you have a bug or late-model bus. In an early bus (ie, one having out-board gear reduction units) the differential is on the PASSENGER side of the housing... and must be driven out from the DRIVER'S side (because there is a thing called a pinion-shaft in the way).

It might help if I read these things BEFORE hitting the big red button....

That #@!!@ Shift–Rod Grommet!

I recently made a few disparaging remarks about VW and their use of a 'life–time' plastic grommet to locate the shift–rod. As usual, another list subscriber disagreed, saying he/she/it had replaced three grommets in four hours, or four grommets in three hours, or something equally silly.

Here's how you replace your shift–rod grommet.

Start by removing your back seat. Open the cover plate over the shift–rod coupler and de–couple it. Now go take off your front bumper. (You say the bolts don't want to come out? Gee, whatta surprise. Soak 'em. If they're really bad, consider removing the bumper brackets, sliding the thing off as an assembly. You may not need to take it completely off; all you need is to raise the bumper high enough for the shift rod to slide under.) When the bumper is off, open the hood, remove the spare and take off the cover plate on the vehicle's center–line, down behind the spare tire. (It's that round, black plate, just beside the data plate.) Now jack up the front of the vehicle, place jack–stands, crawl under the vehicle and using a short screw driver, remove the cover plate in the middle of the chassis–head. (I know; mine wouldn't come off either. Use WD–40, Liquid Wrench and any Loosening Incantations you know.)

Inside the vehicle, take up the floor mats. Remove the knob from the gear shift lever. Work the floor mat over the lever and fold it out of the way. (You should vacuum first, and keep it handy; there will be a lot of crap around the pedal cluster.)

Make a distinct alignment mark on the gear shift lever housing and the tunnel. Remove the two bolts holding the gear shift lever housing to the center tunnel and remove the shift lever and housing.

Using a pair of pliers, reach down through the opening and start walking the shift rod toward the front of the vehicle. Now keep walking. (Hey! This is fun! And those nice sharp edges around the opening add a bloody–adventure aspect to the job.) Okay, put on a pair of gloves, find a better a pair of pliers and keep walking.

When the shift rod is out, the new grommet can go in, assuming the hole is still round. Use an inspection mirror and a flashlight; go spelunking. Chances are, no human has even been inside your tunnel before. See all those pipes? Check their brackets too. You may want to determine their location; if one of them breaks, you'll have to cut into the tunnel to repair it and it would be nice to know where to cut. Make a little map, keep it with your manuals.

If the hole has been worn to an oval, you're going to have to replace the support bracket. I've seen the top of the tunnel cut off to do this; the job took an hour or so. Someone said you can drill the spot–welds, slip a new bracket into place and re–weld. It looks do–able. Use whatever method works best for you. (I kinda like chopping the top off the thing.) In either case, be sure to install the grommet before you re–weld (assuming your welding won't melt the new grommet!)

If the bracket is okay, just pop the new grommet into place. Okay, sorry, just kidding. If you're left handed, put the ring on the grommet and work it into the hole. If you're right handed, you'll probably have to remove the passenger seat to gain working room.

The trick to getting the grommet into the hole is to deform it at the split, work one edge into the hole then twist the thing while pushing on it, while keeping it partially deformed. Since you have to do this one–handed using only your three longest fingers, it can be a chore, especially if your hands are big. (I kinda like chopping the top off the thing!)

You'll probably drop it; that's okay. Fish it out with a piece of welding rod; bend a hook on the end; stick a trouble–light in the chassis–head opening; do a few ghenjus to Kali; light some candles; sacrifice a live chicken if that's what it takes, just get that #@!! grommet in the flipping hole! (I kinda like chopping the top off the thing!)

Okay, the grommet is in but your bug looks like it exploded. The back seat is on the lawn, the driver seat by the hood, which is up, spare tire on the sidewalk, bumper leaning against the fence, passenger seat back by the rear wheel, upside down. You've taken the whole damn car apart just to replace that #@!! grommet! And some yo–yo is going to say "Gee, I did tree of dem in uh, like, four hours." Sure he did.

Now put everything back together and call your helper. Oops! Didn't I mention that? You see, when you start sliding the shift lever back into the nose of the bug, your chances of hitting the grommet dead–on are about the same as finding an honest politician; you can spend the best years of your life prodding your bug with the shift rod and never get it in the hole. Have your helper do the pushing while you get inside and guide the thing into the grommet. And then it's back to the walking! (Hint: Squirt some oil on that puppy.) When the thing is almost fully inserted, dob some chassis lube on the rod where it will be carried into the 'life–time' bushing. Plan on lubing it every year or so; I'll leave you to figure out how to do it.

Okay, The shift rod is back in. Reassemble the coupler, using all–new parts (you figure it out). Safety wire the coupler bolt. Put the panel back on. Put the rear seat back in.

If you've thought about installing a speed–shifter, now's your chance, but in either case, dismantle the gear shift lever and clean it; check for wear. Lube it good, put it back together and re–install it. Don't put the floor mat back until you've checked the shifter; you may need to adjust it.

Button up the front of the vehicle, re–install the bumper, put the spare back in, close things up. (Hint: Use a socket–head screws on the chassis–head cover plate. Dob some grease on them so the next guy won't have so much trouble. And flip Volkswagen the bird for using a part that never needs replacement or lubrication.)

If you marked the gear shift lever housing before removing it, realign the thing and bolt it down. Put the driver's seat back in, get in, start the engine and check it out. To adjust it, loosen the bolts and tap the housing fore or aft. I've found reverse makes a good check; it's usually less worn than the two other selector rods and gives a more positive feel. When you're happy with it, tighten it down, replace the floor mats and the other seat. (You forgot the spring. That's better.) Take it for a test drive. (I don't want to hear about it, just deal with it.)

And you wonder why I call it that #@!! grommet?

Stuck Coupler Bolt

I am in a quandry about what to do about my stuck rear coupler screw. Is the metal of the input shaft softer than that of the screw of vise-versa? I really dont know how to get it out. I dont think I can use an easy out cause it relies on there being threads to come out on. I can turn the bolt, (it is the sqaure headed bolt that holds the rear coupler on the tranny input shaft) just fine, it just won't c go anywhere. Please help......

If the screw turns but neither advances nor tightens then the threads are stripped. You'll have to drill it out. But you won't be able to do much drilling if the thing keeps turning.

The options here aren't very handy. I would probably weld the bolt to the collar, grind it flat, center-punch the bolt, drill it out and re-thread the hole. If you don't have welding equipment you might try cleaning the bolt & collar they building up a fillet of filled epoxy such as JB Weld or similar. The object here is to hold the thing in place so you can drill it out.

IF the set-screw is the same as on older buses it is threaded 8x1.25mm, the same as many other fasteners on your vehicle. Obtain the necessary tap before doing any work.To drill out an 8mm bolt you want to start with 3/16" then open it up to about 13/64 when you have a well-centered hole the length of the bolt.

Of course, given the location of the thing there's a good chance you won't have the angle-head drill-motors and such that you'll need to do the work.

That leaves you with the Brute Force Option, something we always have but don't like to fall back on.

Brute Force means just that. Grab the bolt with vise-grips. Pry the vise-grips away from the fitting while turning it anti-clockwise. A set-screw is generally softer than the collar into which it is threaded. You should be able to force-feed the thing back through the threads and thus remove it.

It won't be a happy camper when you get done — no matter how you get it out you're going to need a new set-screw and possibly a new coupler, or at least chase the threads of the coupler.

If you can't find a 'real' VW-type shifter-rod set-screw, make one. You'll need to grind an accurate cone to the end of whatever bolt you use — it is the cone that indexes the shifter-rod to the coupler, insuring proper alignment. The cone-shaped end of the set-screw takes more strain than it should during shifting so try for the nicest possible fit. With the coupler out of the way you'll be able to trial-fit the new bolt as you grind the cone.

Add a nut to the bolt before doing any grinding. After you get a nice cone-shape, the nut will chase the threads when you back it off. But you'll also want to add a nut to the bolt before installing the coupler. After the bolt is torqued down, tighten down the nut, locking the bolt against the coupler. A twist of safety wire in the threads of the bolt just above the nut then securely wrapped around the barrel of the couple would be a smart thing to do, as would using high-strength loc-tite during installation. (A little concentrated heat on the head of the bolt will break the grip of the loc-tite, should you need to remove it.)

66 MC into 67

Looks like this is next weekend's project. Anyone who's done this, please feel free to share your experience with me. I'm interested in reliable brakes that I don't have to pump up. However, I don't have the $200 for the '67 dual curcuit master cylinder.

On the other hand, if I have to run a bunch of new tubing and resign myself to never go back to the dual circuit MC, I may reconsider.

Do I have to run new lines? Will the existing lines plug right in?

Joe, the existing lines will NOT plug right in, despite some guys doing it that way. But economics make this a very practical retro-fit.

I'm going to make this a general post since every owner of a '67 bus is going to run into the problem eventually.

Up through the 1966 model year the master cylinder on the bus and sedan were basically the same — the typical master-cylinder shape with a cast flange around the piston rod threaded to accept a pair of mounting bolts, the opposite end of the casting drilled axially for the brake-light switch and radially for THREE M10 - ISO-bubble-flare fittings. Three, because the front wheels each had their own port and supply line.

The 1967 model went to a double-piston master cylinder with two supply-line inlets... and only TWO pressure-ports, one for the front wheels, one for the rear, each supplied by one of the coaxial pistons in the master cylinder. The layout of the master cylinder was changed with regard to the ports, and each section was given its own brake-light switch, wired in parallel to the other. The ports moved to the SIDE of the casting, one near the end, the other about mid-way along. Opposite the port, on the other side of the casting, is the threaded boss for the switch for that particular section.   The mounting flange was not changed.

That means the plumbing runs on the '67 are considerably different from the earlier models. The pipe to the rear breakes approaches from that direction and will mate to an early model cylinder without modification — the classic bolt-up. But the single line to the front brakes approaches along the driver's-side frame member, curving down to intersect the SIDE of the master cylinder about half-way along its length about three inches too short to reach the outlet-ports of the early-style master cylinder... and there-in lies the problem.

The QuickenDirty Fix is to take the shortest standard length of ISO-bubble-flare tubing — and a suitable coupling-nut — and simply extend the front line to reach the outlet ports of the early model master cylinder, coiling the excess tubing as needed. You then put a plug in the un-used third port.

A different method — and the one I recommend you use — is to form two completely new sections of brake line, complete with securing clips which you will have to fabricate and install.

My method is to open the existing front brake pipe at the “T”, fabricate two new lines and run them from that point to the early-model master cylinder. In effect, I convert the 1967 brake system into the 1966 & earlier system. If the piece of pipe aft of the ‘T’ is in good condition you should be able to use it for one of your new plumbing runs. In either case, you’ll need two couplings and at least one new section of tubing.

The double-flare (ie ‘bubble’ flare) is easily fabricated but you must have the proper tools.

Bubble-flare coupling nuts can prove hard to find. There are several ways to work around their lack, including the use of SAE single-flare fittings and couplings, which are in better supply.

If there’s any trick to this mod it is in the planning. Use heavy wire to emulate the new tubing, allowing for fasteners and fittings, then measure the actual length of the wire, which becomes your model for creating the necessary bends. This allows you to do most of the critical work at the bench. When you finally go to the vehcile the work should be little more than bolt-up and bleed. The brakes, not you :-)

Don’t overlook the clips. Make sure the new brake lines are perfectly secure, can not vibrate and do not touch each other at any point. Brake lines are one area where casual craftsmanship won’t hack it.

Spend some time getting the new lines perfectly aligned to their threaded bores. You want the fittings so neatly aligned that you can run them up full-depth with just finger pressure. A stripped, canted or cross-threaded fitting is the last thing you want to happen. You can prevent it by insuring perfect alignment and full-depth thread engagement before you reach for a wrench. This really isn’t very hard to achieve so long as you begin the work with that goal in mind.

Some will see this modification as step backwards. In one sense, they’re correct — two pistons form two independent braking systems. Unfortunately, Volkswagen chose to divide the braking fore & aft instead of diagonally, the standard on modern vehicles. I’ve heard a couple of stores as to why they did it this way, some having to do with the advent of disk brakes, available as an option on Transporters from 1966 on, although not introduced as standard equipment until 1971. Other versions are less generous but the fact remains, the ’67 and later models had a dual braking system, ’66 and earlier is a single-pump system — failure of any part means failure of the whole. However, the early system is robustly designed and not known for failures when properly maintained.

One thing you may wish to consider when installing your new master cylinder is putting the reservoir in some other location, such as under the dash on the passenger-side of the vehicle... or even behind the driver’s seat as with the later ‘loafs. This can be accomplished using components from later-model bug or bus master cylinders and any bit of suitable neoprene hose, since the supply line and reservoir is not under any pressure other than gravity. If you undertake this mod, give the supply line the same consideration in fastening as the hydraulic lines.

Wiring

Since the late-model switches are wired in parallel, you may plug either of them to the single switch on the early-model master cylinder. So long as the unused terminals are not allowed to short together, your brake lights will work as before. But you’ll have a much neater installation if you take the time to replace the late-model wiring with a newly prepared loom.

Adjusting Toe-In

Alignment Basics

Your front wheels incorporate caster, camber and toe-in. Caster is when the wheel touches the ground a little bit behind (or ahead of) the axis on which the wheel pivots during a turn. Caster-angle is usually built-in to your front suspension. On a torsion-tube VW front end, caster is adjusted by shimming the top torsion tube a little farther forward than the lower torsion tube but that would only be necessary in extreme cases. Normal caster is built-in to your spindles. If your trailing arms and ball-joints (or kingpins) have not been damaged through wear or collision, then your caster is probably correct.

Camber is how much your wheel leans in or out at the top. On your Volkswagen, you want them to lean OUT. Your wheels don't stand perfectly vertical. The angle is small, about half a degree, and is checked with a protractor. You can make a camber gauge using a plumb-bob and a couple of shelf brackets. On ball-joint front-ends camber is adjusted by turning an eccentric sleeve that holds the upper ball-joint shaft. On king-pin front ends camber is adjusted by the link-pin shims.

Toe-in is how much your wheels... toe in. Just as your front wheels do not stand perfectly vertical, neither are they perfectly parallel in the horizontal plane. The front of the wheels is a little closer together than the back of the wheels. Toe-in is adjusted by extending or shortening the length of the tie-rods, which are fitted with threaded ends and clamps just for that purpose.

The Do-It-Yourself GOTCHA!

Doing your own maintenance is smart, but when you work on your front end you may discover that replacing your ball-joints or tie rods renders your vehicle unsafe to drive because the new parts have thrown your wheels out of alignment.

Being built-in to the design of your spindles, you can't do very much to effect your caster but doing your ball-joints or king-pins will throw your camber out of alignment, while doing your steering box or tie-rod ends will throw your toe-in out of alignment.

So re-align them.

You can buy alignment protractors that will allow you to do an acceptable alignment. The results won't be as accurate as a job done with the newest laser-alignment equipment but you should have no trouble returning the front end to spec — there's a pretty wide tolerance in the VW front suspension. The real GOTCHA! on adjusting the camber of a ball-joint front end is the need for a special wrench to get at the eccentric sleeve. With king-pins you simply add or remove shims to achieve the proper angle.

Toe-in

Toe-in changes as the front suspension wears. As wear accumulates the steering will feel loose and your toe-in will vanish, becoming toe-out and eating up your tires quick like a bunny.

Adjusting toe-in is very easy. With the vehicle on a level surface, crawl under and loosen the clamps on the rod-ends of the driver's-side tie rod.

Using two sticks or two pieces of stiff wire or two of just about anything that will accurately touch the edge of the wheel's rim, measure the distance between the wheels, right up near the body at the REAR of the rim. That is, you put a notched stick against the edge of the wheel's rim at about the 3 o'clock position, do the same for the other wheel (9 o'clock) and MAKE A MARK where you two sticks overlap.

Put a chalk-mark on the tire to mark where you took the measurement. (Spit works too, if you work fast. And if you're an accurate spitter.)

Roll the vehicle backwards until the chalk-mark is about 180 degrees from its original position and measure the distance between the wheels again, this time at the FRONT. Use the same pair of sticks, oriented so the original mark is visible, although your second measurement will probably cover up the original mark.

Measure the distance between the marks. If it's between an eighth and a sixteenth of an inch, it's safe enough to drive.

To adjust the toe-in, lengthen (or shorten) the tie-rod by turning it, using a pair of Vise-grips. Turning the tie-rod toward the front of the car will lengthen it, increasing the toe in. Turning it toward the rear will shorten it, decreasing the toe-in.

Be cautious when making adjustments. It takes only a very small change in tie-rod length to cause a large change in the toe-in. After changing the tie-rod length you must repeat the toe-in measurement. Shoot for a toe-in of about 1/8" (.125")

When satisfied with the toe-in, tighten the tie-rod end clamping nuts. Have the front-end professionally aligned as soon as possible.

Any time you alter the tie-rod length or adjust the play in your steering gear box, check that the steering wheel spoke is horizontal when the wheels are straight ahead. This is important since it effects the self-canceling feature of your turn signals.

If the spoke is not horizontal, make it so by adjusting the length of BOTH tie rods. Lengthening the one while shortening the other will cause the steering wheel spoke to move up, reversing the procedure causes it to move down. By lengthening/shortening the rods in small, equal increments, when you have the steering wheel spoke horizontal the necessary toe-in adjustment should be quite small and should not disturb the steering wheel alignment.

When you have your front end professionally aligned, make a point of mentioning the steering wheel spoke orientation. A lot of shops don't bother to do the job right unless they know the customer is aware of what needs to be done.

Sermonette

Like all other parts on your early Volkswagen, the steering and alignment are inherently quite simple, far less complex than on front-wheel drive cars. The Bentley manual does a good job of explaining the front end geometry, and it's difficult to get things so out of whack as to make the vehicle unsafe to drive. Once you understand the principles involved, maintaining your front end is no more difficult than maintaining any other part of your vehicle.

Warning

My youngest Volkswagen is a 1970 Karmann Ghia. The instructions above work perfectly well for 1970-and-older vehicles but may not apply to younger machines. If you have a Super Beetle these instructions will not apply at all.

Balancing Wide Fives

I'm poking through the Type2 archives trying to turn up the trick to get the local Firestone place to balance tires on the old style wheels...

Anyone happen to recollect the date or thread name or even the trick..?

Seemed like it was something like their mounting the star hub on the balancer but I can't remember it clearly.

There is a fixture available for balancing the older style Porsche and Volkswagen wheels. Call around, make sure the shop has experience with veedubs.

However... if you plan to keep your speed down to 130 or so you can do a perfectly adequate balance-job yourself using an old-fashioned bubble-type balancer. But there's a trick to it. (Ain't there always? :-)

The trick is to go buy a pair of those kewl adapters, the ones that allow you to install four- or five-lug wheels on an early veedub. J. C. Whitney carries them. J. C. Whitney also carries bubble-type wheel balancers. And wheel weights. And wheel-weight pliers. (Do you detect a trend here?)

Take your kewl adapters — or just one of them — to an automotive machine shop that does engine balancing. Have the thing balanced to a gnat's ass or .1 gm, whichever comes first.

Back at your shop, set up the bubble-type balancer and zero it. Now put your balanced adapter onto the bubble-type balancer and move it around until the balancer returns to zero. Mark the relationship between the balancer's cone and the kewl (but balanced to a gnat's-ass) adapter.

Got some lug bolts? You need five of them. And they need to be balanced too. You can do this with a triple-beam balance or a sensitive postage scale. Find the lightest lug-bolt then take a file to the others until they all equal the weight of the lightest.

The rest of the Program should be obvious: Pry all the old balance-weights off your wheel then bolt your kewl adapter to the wheel and plok the thing onto your bubble-type balancer, observing the proper orientation of adapter-to-balancer. Now wait a bit....

Okay, now look at the bubble. Using a selection of balance weights positioned on the wheel's rim, cause the bubble to be PERFECTLY centered in the bulls-eye. Attach the wheel weights and the result is a wheel assembly balanced well enough for all practical purposes.

So why does everyone use dynamic balancers? Because no brains are required. Just throw the tire on there and watch the blinking lights. It takes much less time to achieve a perfect balance and even an ex-burger-flipper can usually get it right the first time.

But what happens if the kid doesn't have the proper adapter? Or if he attaches the wheel to the adapter with only three lug-bolts (instead of five?) or if...

Some Notes...

A 6-6.00 aircraft tire is about sixteen inches in diameter and spins at some incredible speed when you touch-down at 80mph. Good balance is important and you'd think dynamic balancing would be the only way to go. But experience has shown that bubble-balancing, if properly done, does perfectly well.

One thing you NEVER want to do is follow St. Muir's recommendation for Do-It- Yourself Wheel Balancing, where he puts the wheel to be balanced on one of the front spindles then spins it. All that does is tell you how much drag you have in your oil seal and wheel bearings.

Another point, and one often overlooked, is that balancing is NOT a forever kind of thing. The balance of your wheels changes as the tread of the tire wears away. The change isn't very much for tires with smooth, symmetrical tread, such as used in aircraft, but it can be an enormous amount in tires having aggressive, knobby tread such as are commonly found on light truck tires (the type you should be using on a VW Transporter). The point here is that you should re-check your tire's balance as the tread wears away.

The last versions of bubble-type balancers used an electric lamp to project the image of the bubble onto a screen. This eliminated any possible paralax when viewing the bubble. On the really sexy systems they projected this image onto the wall or ceiling of the shop. Projected in this manner, you could see an obvious change in balance from masses as light as a cigaret paper laid on the rim of the tire.

This sort of precision was only possible with top-of-the-line balancers having a hardened pivot with virtually zero friction. But the example serves to show that the 'old-fashioned' method of balancing is capable of achieving.

Brake Cylinders

Rebuilding Brake Cylinders

Can a person do an acceptable (safe) job by hand, just sanding with a high-grit sandpaper? Can you use your eyes as a good judge of the smoothness?

No. Buy a brake hone. They aren't very expensive. Get one set of coarse stones and two sets of fine. You'll do most of your work with the fine stones. Use the coarse stones on really cruddy bores. If they don't clean up, give up on them. Seriously pitted bores need to be turned on the lathe.

To hone a brake cylinder you must hold it in a fixture. Never clamp it in a vise, as that will result in an oval bore — a common problem with Brazilian brake parts. The fixture can be anything that does put pressure on the bore or cause distortion. For some VW wheel cylinders you can grab them in a vise by their mounting tab, for the others I use an aluminum plate clamped in the vise. The brake cylinders are bolted to the plate. The plate is drilled to hold several different types of cylinders. I have a different plate for master cylinders.

The hone is chucked into a drill press or drill motor. I usually use a 1/4" drill motor but if doing more than a few, set-up the drill press for the job. The honing is accomplished by moving the hone back and forth in the bore as the hone is spun by the drill. On the drill press, the hone is fitted in the chuck, the speed set to about 800 rpm. You move the cylinder up and down on the spinning hone. I use kerosene as a lubricant and coolant, spraying it into the bore from a pump-type oiler. The kerosene prevents the stones from becoming clogged and washes the debris out of the bore as the honing progresses.

While most are statisfied with a well-honed bore, I've found that polishing the bore gives longer service.

A polishing hob is a copper or brass bar or pipe meant to be mounted in the lathe or drill press. It is a sliding fit at the size you wish to polish. You may make it expandable by slitting it and using wedges or screws to force it slightly larger — we're talking tenths here (ie, .0001"). I use tin oxide or cerium oxide, mixed in a paste with water, painted on the hob with a brush. Keep the polishing compound, brush and container perfectly clean. If you get a bit of grit in it you'll scratch the bore and have to go back to the honing stage. Your best source of information on polishing cast iron is to locate a live steam enthusiast in your area and inquire about model steam engines. Making the cylinder of a model steam engine calls for the same skills and procedures as for making the bore of a wheel cylinder. Such amateur machinists are usually well versed in boring, honing and polishing small diameter bores in cast iron.

All cylinder bores look pretty good to the untrained eye because of their ability to catch the light. Machinists use visual comparison to standard surface-finish samples to keep from being mislead. An experienced machinist can tell you the surface finish by examining it with a loupe for the finer finishes or by scraping it with his fingernail for the coarser.

If you are not familiar with cylinder honing, buy a new cylinder of German manufacture and use its finish as your comparison gauge. When your honed & polished cylinders match the German cylinder in a side-by-side comparison, you will have done well enough... although you can do better with more polishing.

Since the kerosene and polishing compound will contaminate brake fluid, you must use MEK or laquer thinner to make the part perfectly clean before rebuilding the cylinders. When rebuilding, lubricate the bore and the new seals with brake fluid. If you are using two sets of parts and plan to hold the rebuilt cylinders as spares, wrap them carefully in plastic then in several layers of aluminum foil, molding the foil to their shape. The object here is to exclude as much air as possible from the package. A wrapping of masking tape will serve as a lable. The stored parts should be dismantled, inspected and reassembled about every two years.

Honing isn't always necessary. If the cylinders are in good shape I often just polish them.

The most cost-effective brake system maintenance is to flush the system about every two years.

Brake Light Switch

The brake lights on my 65 panel stopped working. Turn signals and tail lights work. Bulbs are fine. I just adjusted the brakes. Could the pedal not be making the connection anymore?

Forget the pedal. It has nothing to do with the problem in the sense you mean.

The electrical switch that turns your brake lights on & off is actuated by the hydraulic pressure in your brake system.

The brake-light switch is similar to the one used for the oil-pressure warning light circuit except for having two spade-lugs instead of one. But don’t get them confused. They are entirely different forms of switch and are not interchangeable.

The brake-light switch is located on the rear of your master cylinder. If it is bad, it must be replaced. Replacement of the brake-light switch means opening the brake system at the master-cylinder (that is, when you unscrew the old switch the brake system is then open to the atmosphere), which means a full, four-wheel brake-bleed must be done after replacing the switch.

So let’s make sure it’s broke before we fix it.

Power for the brake lights comes through your ignition switch (it must be on) then thru a fuse (I think #8 on your model year — check the end fuses) then to the brake-light switch.

To insure all that is happening, start by disconnecting the negative lead of the coil from the distributor. That will prevent you from frying your points (you’re going to do some tests with the ignition switch on — if your points are closed, they’ll be carrying ten amps of current. It takes only a few minutes of constant ‘on’ time to cause the points to overheat and weld themselves shut).

With the ignition disabled, turn on the key and crawl under the vehicle with your static timing light — you’re going to use it as a volt-meter :-) (Make sure it’s working first — test it using the positive lead at your coil.)

Find a good ground for one lead of your timing light. This can be hard to do under the vehicle — most are rusty as hell. (If you bus is rusty, sand a bright spot for the ground lead... and plan to deal with the other rust as soon as you can.) When you have a good ground connection, use the other connection of the timing light to determine which of the two leads to the brake-light switch is the hot side. Your timing light will go on when you find the hot lead.

Okay so far? We've just determined that the circuit from the ignition switch, to the fuse, through the fuse and to the brake-light switch is functional.

If your test-light did NOT come on, find out why — your lack of brake lights may be due to a lack of power to the brake-light circuit. (The most common cause of the 'no brake light' complaint is a blown fuse.)

Okay, you got power to the brake-light switch. Unplug the OTHER lead on the brake-light switch and touch it to the first lead — the one on the other terminal —where you know you have power. This should cause your brake-lights to come on.

If you're working alone, affix the leads together. The alligator clips on your timing light make a handy clamp. Ditto for a jumper-lead. (a couple of which should be in your tool kit)

If your brake lights do NOT come on, the problem is in the wiring between the brake-light switch and the brake-lights.

Okay, they came on. Turn them off by disconnecting the lead.

At this point we've finally arrived at testing the brake-light switch itself.

About half the complaints of 'no brake lights' involve a failure among the items we've just tested, another twenty-five percent or so involve grounding problems in the tail-light fixtures, bad bulbs and so on — I've removed those from the diagnostic because you've said the turn signals are working normally.

When someone complains of no brake lights, the brake-light switch is at fault only one time in four, or thereabouits. Yet for some reason it is the FIRST thing people replace, often to no avail. Because of the need to bleed the brakes after replacement of the switch, the wiser course is to eliminate all other possible causes of failure. (Did I mention that a blown fuse is the most common cause of failure?)

Now let's see if the switch works. To do that, connect the hot lead of your timing light (that is, the lead which is not grounded) to the other terminal of the brake-light switch. Now pump the brakes.

If the light does NOT turn on, the switch is bad. Replace the switch, bleed the brakes and re-check the system.

If the light DOES turn on, your vehicle is cursed. Go buy four black chickens and meet me at the nearest VW dealer at midnight next Friday. (I know, I know... you've seen a procedure in DB&HVW that uses a blond virgin instead of four black chickens. Well, if you can FIND a virgin of legal age, bring her along and I'll show you how it's done... but I'll tell you right now NOS virgins are virtually NLA in southern California, which is why all of the mechanics I know have replaced the original Nordic Ritual with the Brazilian routine.)

Bleeding your brakes is not just getting the air out, it's a standard maintenance procedure done every other year in order to REPLACE your brake fluid. You simply keep puming until you see clean fluid coming from the bleeder. Provide yourself wit the proper tools and at least two pints of whatever brake fluid you are using. You shouldn't need that much and you should already have a pint in your on-board spares — the extra pint is in case you need it, since the vehicle can not be driven down to the store to fetch more until the job is done.

-Bob Hoover

PS — Don't forget to reconnnect your coil.
PPS — Did you check your fuses?

Brake Lines

When you put your foot on the brakes you generate up to twelve hundred pounds of pressure in the brake lines. Brake fluid is a mixture of oil and alcohol capable of finding the smallest leak even when not under pressure. To insure against leaks, your brake system uses metal-to-metal fittings torqued to some fairly high numbers. The hydraulic lines are typically made of steel tubing. The steel tubing is flared; different forms of flare are used.

The brake lines on early VW's use what is called a 'bubble-flare' fitting. American cars use what is called a 'double-flare'. Some Japanese cars use double-flare fittings idential to American SAE fittings except for their metric thread. I don't know what late-model VW's use.

Replacement steel brake lines are stock repair items. They come in American, Japanese, and European style. The 'metric-bubble-flare' is the stuff you want for an early VW. The replacement lines come in a variety of lengths from about one foot up to six feet. To make longer runs, you splice two pieces together using fittings that have female threads on each end, usually called connectors, barrel-nuts or sleeves. When buying connectors make sure they not only match the thread of the fitting but have the correct angle to accept the type of flare your line uses. Check everything for fit before you leave the store. A careless counterman can kill you.

The tool needed to make the bubble flare is expensive and difficult to find; some FLAPS and even some brake shops will tell you bubble-flares are a factory-made sort of thing, that no such tool is available. If they try that one on you it might be wise to take your business elsewhere since they obviously don't know theirs.

American-style double-flare tools are fairly common and not too expensive if you get them from J.C.Whitney or a dealer who specializes in automotive tools. I paid $48 for such a tool at a FLAPS in the Puget Sound area. The going rate is about half that when bought at a real tool store.

The availability of the double-flare tool, and of adaptors that allow double-flare fittings to mate with bubble-flare fittings, is the key point of this posting and one I apparently didn't make clear in my report on repairing a damaged brake line in a 1967 bus. One subscriber, a well qualified mechanic, pointed out that I could have accomplished the job using stock SAE replacement line with just an adaptor on the end to mate with the Volkswagen master cylinder. While that would probably work with a wheel cylinder or perhaps a bug master cylinder, it won't work with the '67 bus. In 1967 Volkswagen introduced a dual-system master cylinder for the bus, with the front section providing juice to the rear wheels. Due to the master cylinder being right alongside a frame member there isn't enough room to use an adaptor and still make the required bend in the tubing, although it might work for the front brake circuit.

But his point is valid; there are probably a dozen other ways to accomplish the same end. The method I used, and the one described here, is a reflection of my experience and the parts that were available. If I were a little smarter or if I had a bigger selection of parts, I might have done the job another way. In this case, the damage was at the bend, just beside the master cylinder, where the brake line had been deliberately crimped, apparently in an unsuccessful attempt to shut off the rear braking system. (There is a 'blind' fitting that will do this. Most off-road racers carry one for emergencies.)

The effect the repair the procedure I used was to cut away the damaged portion of the existing system and splice in a section of new, undamaged tubing. Since there was no bubble-flare tool available, I used a double-flare tool to install a standard SAE fitting onto the existing brake line, converting that to metric-bubble through the use of an adaptor, attaching the replacement brake line to the adaptor. It's a bit Heath Robinson — there are more elegant ways to do it — but it works and isn't too clumsy.

Stock replacement steel brake lines are straight, you must bend them to match whatever section you're replacing. In the case above, the line needed a sharp ninety-degree bend just behind the fitting (the end going into the master cylinder) then a slow curve to carry the line over the arch of the frame above the front torsion tubes. Given the nature of steel tubing, it's best to use a tubing bender. Be sure it will accept 3/16" tubing; don't trust a 'one-size-fits-all' sort of bender. I didn't have a bender but was able to do the job using a box-end wrench as a bending tool. (You slide the tubing through the box-end, make your bends a little at a time as you 'walk' the tubing through the box-end. Practice on old tubing first, give your hands a chance to learn how to do it. If you crimp the line, throw it away and start over.)

Determining the needed length of the replacement line can be a problem since you must include the length of the new fittings, adaptor and barrel nut. Under the vehicle, I traced the line back until I came to a relatively open area where I thought there would be enough room for me to use the tubing cutter and flaring tool. I estimated the tubing run at two and a half feet and kept that figure in mind when I went to the auto-parts store. They had stock metric bubble-to-bubble line 30 inches long and I bought it as the first step in making up the replacement. The next step was to find the needed fittings. With those in hand, I screwed them all together and screwed the replacement tubing into them and measured the total length: 32-1/2" This told me where to cut the existing brake line.

Back under the vehicle, I used a piece of string to measure the curving path of the existing line. Since you can't stretch steel tubing, give yourself a little insurance by making the cut a bit closer to the fitting. I measured 32-1/2", made the cut at 32", came within an eighth of an inch of a perfect match despite all the curves.

To form a good flare the tubing must be cut square. A tubing cutter is the best way but if you're working in cramped quarters you'll probably need the small style of cutter, the kind thats about one inch cubed. Other methods of cutting steel tubing are to score it all around with a Swiss file having a sharp edge, break it on the score and file it square. Flushing the finished line to get rid of metal partiles is a standard procedure.

If you've never used a double-flare tool, laying on your back under the vehicle isn't the place to start. Make a practice flare on the good end of the tubing you've just cut away. A key step is getting the chamfer on the inner diameter of the tubing just right, rather tricky given the small diameter of brake lines. I used a drill bit ground for drilling aluminum (ie, a steeper angle than for steel). A regular drill or chamfer tool will work but will take more effort when forming the second flare.

The procedure for making a double-flare is the same as for making a single flare except you use a special fixture in the flaring tool to first fold the edge of the tubing inwards. The object is to produce a flare having a thickness of metal equal to the wall of the tubing. A single flare produces a tapered thickness and usually causes steel tubing to crack, if not during fabrication, when the fitting is tightened down.

After fabricating your new line and closing the system, open the first fitting downstream from the new fitting and pump about a cup of fluid through the system to flush out any debris. On the repair I made, the first downstream fitting was the T-fitting to the rear wheels.

With all parts on hand, the repair took about three hours under adverse condtions with a tired mechanic. If someone is shooting at you it should take only a few minutes :-)

Sermonette

Being able to stop is more important than being able to go. Knowing how to adjust your brakes is more important than knowing how to adjust your points. Being able to overhaul your brake system is far more important than knowing how to overhaul your engine.

Shiny paint and clean upholstery is nice but it's a skin-deep sort of thing. If you spend all your time thinking of paint and polish one day your pretty car will try to kill you.

All of my cars are ugly but they'll stop on a dime and give you six cents change.

Bulletproof Tires

Odd thread for a VW list…

The term 'bulletproof' was applied to tires during the First World War, when Dunlop developed a 'Semi–Pneumatic' tire for military vehicles. It was a solid rubber tire with a beaded rim, designed to be fitted to wheels intended for pneumatic tires. 'Real' trucks still used flat steel wheels with solid rubber 'tires'.

The bulletproof tires worked reasonably well on the European front, where most tires failed not from bullet wounds but from being cut by the many pieces of shrapnel in the muddy roadways. In the Middle East, the bullet-proof tires proved impractical, although their greater weight–handling ability saw them used on the rear wheels of many vehicles.

During the Spanish Civil War a truck tire stuffed with straw was the standard 'bulletproof' tire.

Nowadays there are a variety of ways of making a tire 'bulletproof' but most use the same principle as the early Dunlops: A solid mass of rubber or something else, unlikely to be damaged by a rifle bullet or disabled by a shrapnel cut. Some designs use a urethane foam filler that provides both a fair ride and reasonable life. Plys are almost always steel. Such tires are enormously heavy, upsetting a stock suspension. They are also very expensive.

Humvee tires use a pneumatic jacket around a 'fail–safe' core–tire. The jacket may be inflated or deflated while the vehicle is in motion, allowing it to adjust its traction to the terrain. Should the pneumatic jacket be damaged, the fail–safe core will usually provide enough support for the vehicle to withdraw under its own power.

As for Volkswagen content, the bulletproof design is spelled T–U–B–E. If you plan to go off pavement, run tubes in your tires. You can patch a tube, drive on. Tubeless tires can kill you. Try pumping up a tubeless tire down in Baja — or the Yukon — with your 12v air–compressor.

Master Cylinder Seals

A hint on hydraulic seals: If you'll shop around you'll find a kit with seals to fit virtually every cylinder diameter ever made. Indeed, they appear to run in families. While the master cylinder may have special valves that must be replaced with identical parts, the slave or wheel cylinders may often be overhauled with parts that fit but which were never intended for that specific vehicle.

When a dealer says "They don't make it any more," it usually means: a. I don't carry it any more, or b. My supplier doesn't stock it any more, or c. I'd really rather $ell you the whole cylinder.

I've successfully rebuilt some very early hydraulic brake systems by comparing specifications for bore diameter, pressure and so forth. In each case I was told the parts were no longer available (d. From that manufacturer :-)

The generic nature of hydraulic seals also applies to O-rings, filters, fasteners and every type of bearing and bushing. If you'll take the old part to the right counter it can usually be cross-referenced to a current part number and source. The trick is finding the right counter. In most large cities a good place to start is at the oldest independent auto-parts house; they can usually direct you to specialists (such as Wynn's All-Bearing here in southern California); the yellow pages are another good source of Who-To-Call.

Locating a generic source for certain VW bearings and seals would be of enormous value to subscribers of this list. Please keep us posted.

TOOLS

12 Volt Power in the Shop

An old car battery makes a fine 'power supply' for those incidental 12vdc needs around the shop, such as checking a headlamp. As lead/acid batteries age the surface of their plates becomes contaminated with lead sulphate, reducing their effective discharge surface. Such a battery may not be able to conjure up enough amps to start your engine but it does perfectly well when the task calls for a low-amperage discharge, such as seeing if that rusty horn still works.

Keeping it Clean

Batteries aren't what you'd call user-friendly. Old ones are usually dirty and all of them have the habit of spitting acid on you if you tip them over or, heaven forbid, drop one of the things. But dirty batteries can be cleaned, and a wooden box well sealed with urethane enamel or varnish shrugs off a bit of acid.

The best way to clean a battery is to start by wiping it down. And then keep wiping. You may want to spritz a little 409 or other detergent after you get most of the gunk off, but modern battery cases are polypropylene and nothing sticks to them very well.

If the terminals are corroded use a fiber-bristled brush to scrub off the worst of it. The corrosion products will eat up a steel brush. When you get down to metal, use one of those patent battery terminal cleaners, the kind you twist down onto the terminal, to scour off the last of the corrosion. Wiping down the terminals with a stiff solution of baking soda and water will neutralize any acid remaining on or near the terminals, followed by rinsing with fresh water. But don't over-do it, with either the soda or water. Batteries usually corrode because the seal between the battery case and the terminal has failed, allowing electrolyte to be drawn out of the battery by evaporation and capillary action. If you flood the top of the battery with baking soda solution it's liable to get into the battery and ruin it.

It's always wise to assume that the terminals of an old battery have failed seals. One solution is to put acid neutralizing pads about the base of the terminals.

Giving it a Home

Batteries like dark places. I don't know why, they just do. If you want a happy battery, make it a box to live in. Use solid wood or plywood. Don't use particle board or fried rice. My idea of a good battery box is one having a base made of 3/4" plywood with walls of 1/2" ply and a tightly fitted lid with an inner lip. The box should be sealed with at least two coats of high-gloss urethane varnish or enamel. If you're poor, try asphaltic emulsion, let it sit in the sun for a week, put on another coat.

To get power from the battery you'll need to put connectors on the terminals, big connectors and cables if you're going to test starters, little cables for lighter loads. A weak battery will still actuate the solenoid and spin a starter, assuming it's out of the car and you've supported the shaft; VW starters have to be in a fixture or bell housing to be tested since one end of the shaft is supported by the bushing in the bell housing.

One trick for getting small amounts of power out of your battery box is to use a pair of brass bolts through the case as external connectors. Dry wood is a good insulator if the potential is only 12 volts so the bolts can go right in the wood, although it's wise to soak the holes with varnish — 'dry' wood contains about 12% water by weight. The farther apart you put the bolts, the better. Inside the battery box, the brass bolts are connected to the battery terminals with wire. If you don't have regular battery connectors, just drill & tap the terminals to accept a coarse-thread bolt. I use 1/4-20 copper bolts (see how to protect them below).

If you plan to store the battery outside and run the wires through the wall, make your lid so it overlaps the box, sliding down over the sides to act as a rain shield. Won't don't run uphill unless you push it.

Before you varnish the box, but after fitting the lid, use screws and glue to attach a couple of husky 2x2 blocks across the ends of the box as handles. Batteries are heavy suckers. It helps if you can get a good grip on them.

Keeping it Charged

You can have a lot of fun here. Some years ago I made up a voltage sensing controller to turn a charger on or off according to the battery voltage. Cheap. One IC, a couple of pots, a transistor and a relay. You can buy such things nowadays for about what it costs to make one but if you like the smell of solder let me know and I'll try and get the schematic up on the web. And of course, such a controller also works for solar panels and the like. Or for telling you to turn off the TV and go to bed, if you're running the TV off the car's battery.

You can make a better battery charger than you can buy but it's handiest to buy one. Keep it near your shop battery. Let the controller do the on-off chores or just click it on when you notice the battery getting low.

It takes at least 14 volts to push a charge into a 12 volt battery. Some chargers run as high as 18 volts, a bit too much. It's good to check to see exactly what your charger is putting out.

Enjoying It

You've got a battery in a neat box, and some means of keeping it charged. So add a radio to your shop. Whatever radio you happen to have is usually good enough if you add a larger speaker but you can use any sound system you can run in a car, which today means some very sexy equipment. Or a 12 volt TV set. The battery is already there, you may as well get some use out of it between testing horns. Or testing radios.

In fact, any 12 volt device you can run in your car can be run in your shop, if you've got a reliable source of power.

Twelve volt direct current is pretty much a universal standard today but lots of us have older, six volt vehicles. Everything I've said above still applies. And you can even use a 12 volt battery!

A twelve volt battery has six cells, six volt has three. The cells are strapped together in series with lead-alloy straps across the tops of the cells. If your battery has a polypropylene case, you can make out the straps if you position a bright light against the battery case. Once you know where they are you can drill into them, tap them for a 1/4-20 bolt, and pick-off 6 volt power from a 12 volt battery. The bolt you want to use is lead-plated steel or solder-covered copper. You can get 1/4-20 copper bolts in the electrical section of a good hardware store (ask for grounding bolts). Heat one gently while keeping it slathered with soldering flux and flow solder all over it. Heat it a little more and shake off the excess solder then chase the thread with a die once it cools. You now have a bolt that will shrug off acid, at least for a while.

Discharging half your battery will confuse the hell out of your battery charger and cause the un-used cells to become over- charged. If you started with an old battery, this is probably an acceptable compromise. You can usually pick up a pretty good battery used for about ten bucks. Kept fully charged, reasonably cool and not subjected to the vibration of a car, an old battery can last five years or more.

Cheap 12 Volt Power

If you've ever tried to run something like a sound system using a battery charger as a power supply you quickly discovered that a battery charger is not a REGULATED supply. They hum. Loudly. But if you go shopping for a regulated 12 volt power supply you'll find they run about $8/amp, more for little power supplies, less for big ones. Most automotive sound systems need at least five or six amps, say fifty bucks. Which is why the battery-plus-charger makes good sense. But howzabout this: A regulated seven amp regulated power supply for twenty-five bucks. Cheeep!

Alas, there are a couple of gotchas. The power supply is a switching power supply out of a computer; it may have a high- frequency whine. Computers don't mind the whine but sound systems amplify it. The other gotcha is that the output is 12 volts. I mean, EXACTLY 12 volts. Your automotive system is only called a 12 volt system to be polite, it's actually a 13.6 volt system or thereabouts. The computer 12 volt supply may cause your cassette to run a tad slow.

But I like the things. They are light-weight, come with their own fan, are very dependable and cost a lot less than their transformer-based cousins. American Science & Surplus (ASS Co., (708) 982-0870) is offering such power supplies. And if you don't need it in the shop, it makes a handy spare for your computer (Item #24082, $25.00) They work fine with mobile ham radio gear, which is designed to run on anything from about 11 to 15 volts.

Sermonette

Whenever the world has a bad-hair day, the lights go out. Earthquake, flood, hurricane or what-have-you, utility power is one of the first things to go. Most of us have a portable radio around the house, maybe a few candles, and the power is never out for very long... we hope. What if it's out for days?

A fully charged car battery in the shop is a useful everyday tool that can be a real comfort at times, possibly even a life-saver.

12 Volt Shore Power

For those wishing to operate their 12vdc equipment from shore power, the required twelve volt power supply need not be bulky. Modern switching power supplies do not use a heavy transformer, unlike their bulkier ancestors.

I use a 20 amp power supply that weighs about five pounds and measures 6" x 5" x 4", a compact cube of a thing that contains its own cooling fan. Because of its small size and light weight it may be mounted just about anywhere, so long as it receives adequate air flow. By comparison, the transformer power supply it replaced weighed about twenty pounds, was about 12" x 6" x 8" and was rated at only ten amps.

The model number of the power supply is RSP-2012. The nominal 12vdc output is adjustable from about 11.8 to 14 volts and is set to deliver 13.6vdc. Regulation is very good. It was manufactured in Taiwan but the sticker showing the American distributor is defaced. I bought the unit used at a ham radio swap meet about six years ago. The price was $20.

The system, which is installed in a small home-made camper, is designed to use 12vdc at all times. Shore power is wired to several outlets but the evaporative air cooler, pumps, lights, security system, stereo and communications equipment operate from 12vdc at all times. When shore power is available the switching power supply comes on automatically and is connected to the main 12vdc buss. Two 105 A/hr batteries are used when shore power is not available. The batteries are charged by the engine and/or a 37 watt solar panel. The vehicle electrical system is seperate.

A major energy savings was obtained by using an ice box rather than a refrigerator. Starting with a conventional icebox having a molded ABS liner, I dismantled it and rebuilt it using foamed- in-place urethane foam so as to provide at least 3" of insulation on all sides. This makes the door something of an art-work since the foam had to be cut away to provide access to the handle. To reduce the introduction of air via the drain, it was fitted as a siphon. Thanks to the heavy insulation, ten kilos of ice lasts three to four days, depending on the temperature. The camper has been used mostly in Baja California and ice is usually available near most Pemex stations.

Thanks to the low humidity and good insulation, the evaporative air cooler is able to maintain a seventy degree cabin temperature on 100 degree days, although the water consumption of the cooler is rather high. One of the 12vdc pumps supplies the evaporative cooler with water.

Air Tools

You don't need air; it's an unnecessary expense for restoration of one vehicle.

Low-pressure, High-volume paint sprayers do a better job and are easier to live with.

Unless you're chipping concrete, sand-blasting, riveting or have some safety-related 'pneumatic-only' application, electric powered tools are less expensive overall. Besides, the smallest practical air-compressor starts at about 3 hp; pneumatic tools demand high volume AND high pressure.

Pneumatic tools were direct replacements for steam, mostly used for mining. Pneumatic hand tools came into vogue with the advent of all-metal aircraft. Not only was air the ideal power source for rivet guns, it was much safer; trailing a lot of electrical power cords around an aluminum airframe isn't exactly a good idea. While still a standard in factories, pneumatic tools have largely been replaced by inexpensive but powerful electrically powered tools, partly because modern electrically powered tools are more durable than their air-powered cousins, although pneumatics still have the edge in power..

It's very convenient to have compressed air piped around the shop, with the 220v, 5hp compressor and its 70 gallon tank tucked away in an out-building where the noise won't bother anyone. But compressed air would be pretty far down on my list if I were planning a restoration. What would come first? Probably a coffee pot.

A used gas welding rig, including bottles and cart, costs about as much as a cheap air compressor but is the kind of tool you'll use the rest of your life, and one vital in any restoration. Besides, you can heat your coffe with it.

Bad Tool

So I'm out there a'banging away, putting a stub axle of a gear reduction unit together when the copper-headed hammer flys apart. Literally. The head of the hammer shattered and the little biscuit of copper — weighs about a pound — comes flying off and damn near hits me in the eye.

New hammer. Bought from Harbor Freight.

Pick up the pieces and can't believe what I find. The head of the hammer is CAST IRON. The copper biscuits are just stuck on, recesses mebbe a quarter-inch deep to hold them. But that sonofabitch is CAST IRON!

Cast iron is fragmiable. It shatters. Copper is mallable. It bulges. Put copper in a cast iron ring, pound on it and the copper will swell, the cast iron will shatter and you're liable to kill someone.

What kind of a mentally retarded SOB would design such a thing? Better still, what sort of person would sell it?

Pittsburg Tools & Harbor Freight.

Buyer Beware can only go so far. Offer a tool as a hammer and if it looks like a hammer and feels like a hammer it's really stretching things to expect the buyer to run a metallurgical test to see if its really suitable as hammer.

Yeah, I wrote the company. But why is it that I got this feeling we'll still see this piece of crap in their catalog ten years from now? Anyone with a lick of sense knows better than to sell a CAST IRON hammer, so if they're selling the things it's a good bet you'd have to hit them over the head with a squadron of lawyers to get their attention.

This is a dangerous tool, fellers. If you got one, throw it away, cuz it won't give you any warning before it tries to kill you.

Big Batteries

The stock VW battery is a relatively small unit — about 85 A/hr — in both size and capacity. As we add electrical accessories to our buses it's common practice to install batteries having larger capacity. Unfortunately, the battery space is limited, blocked by the wheel well at the front and the protruding electrical fittings of the tail light at the rear.

One way to make room for a larger battery is to go UP. A simple wooden tray on a pair of traversely mounted wooden blocks about 2" high gives you enough clearance to install a 105 A/hr battery. With the tray shaped to match the curve of the fender well at the front and the blocks fitted to the indentations of the original battery tray, six deck screws — four from below, two from the front — will hold the tray in position. Well sealed with multiple coats of urethane varnish and fitted with cleats to restrain the battery, the tray is impervious to acid. A pair of shock chords are use to hold the battery in position.

My 1965 bus is unusal in having no rust on the battery tray. And now, with the battery elevated above the tray, there's even less chance of any rust — especially now that I use the space under the new wooden battery tray to hold a quart of oil :-)

When drilling the fender well to accept the fasteners — I used deck screws — you'll find it easier if you remove the wheel. All drillings were deburred and given a good dose of anti-corrosion stuff — phosphoric acid followed by red lead. After the screws were installed their heads were filled with wax and painted over with red-lead. I used a pipe cleaner for a brush.

The work was done about ten years ago. I took everything apart last year to check for rust under the wood. (Wood normally contains about 12% moisture by weight. Wood should never be installed against steel unless both surfaces are properly sealed.) There was no sign of any rust, either under the blocks or at the fastener holes. The urethane varnish was in good shape and did not justify refinishing.

Bodywork Book

One of the most common short-comings of books on body-work is that they're all writen by experts very obvious in their speaking 'down' to the likes of us mere mortals. They always have the right tools (and seem to spend a lot print promoting certain lines), always work in a neat shop and everything always comes out perfectly straight, better than new, shiny bright... until I sick-up all over the page.

You don't learn too much from such a book. Spend thirty years banging on body work and your results might look like those in the books. It gets pretty discouraging. Then too a lot of the books are oriented purely toward commercial repairs, geared to a standard level of acceptance dictated by insurance companies who are their ultimate customer. The books show you how to do it fast and pretty and cheap enough to make a fat profit. They don't always show you how to do it right.

On the other end of the scale is the guy who starts with a flat sheet of steel and ends up with a Ferrari 'America' after whirling about it like a dervish in a flurry of body hammers, exotic dollys, welding rigs we've never heard of and long lectures about the demise of quality craftsmanship in America.

Pour over any of these tomes and you may pick up a few hints that will help you with your project. Then again, you may not. The handiest book on body work I've ever seen was about twelve pages long and not much bigger than a hand of cards. It had one drawing per page along with a short paragraph that explained how to deal with that particular type of dent, wrinkle or tear. My dad bought it for a dime, mail order when he was a boy and learned body-working from it. He gave it to me, I read it, learned body-working from it and promptly lost it.

But there's still hope. A gentleman named Tommy Sandham has written a book titled 'Panel Craft', by Willow Publishing, Barecroft Common, Magor, Newport, Gwent, NP6 3EB. (Apparently, that is what passes for a street address in England. Good luck.)

The British Library Cataloguing in Publication Data spif reads:

Sandham, Tommy Panel Craft; Featuring Ford Cortina MK.1 bodyshell restoration. 1. Automobiles — Conservation and restoration — Amateur manuals

I Title 629.28'722 TL152.2

ISBN 0-9512523-0-5

The truly unique thing about Mr. Sandham's book is that it will show you auto-body repair from the non-professional point of view; it offers a glimpse of reality. This is a book without glitter. The repairs, while functional, do not have the polished perfection that comes from thirty years of experience. This rare viewpoint makes it clear that the novice is indeed capable of doing his own bodywork.

I do not mean to speak disparagingly of Mr. Sandham's efforts, but offer him sincere congratulations. He has done us all a service.

-Bob

PS - In an earlier post I uploaded a review of a repair and restoration manual specific to Volkswagens. I believe you'll find the post among the 'sermons' on Richard's web page. Since your question probably reflects the feelings of other list subscribers, I will make this a general posting.

Book Recommendation

“Guide to Purchase & D.I.Y. Restoration of the VW Beetle & Transporter, including information on building a Baja Bug”

Written by: Lindsay Porter

Published by:
Haynes Publishing Group
Sparkford, Nr. Yeovil,
Somerset BA22 7JJ, England

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Reviewer comments:

Mr. Porter’s book provides a comprehensive view of the history of Volkswagen vehicles and their specifications, as well as detailed information on performing repairs to the bodywork and engine with additional sections covering interior, electrics and some modifications.

The book is profusely illustrated and the photos provide the VW owner with a unique opportunity to see what’s behind certain body panels. Indeed, the photos may be used as a kind of X–ray eye, giving you some idea what may be lurking behind those innocent looking bubbles of paint in your fender well — and how to deal with the problem.

A copy of this book should be in every VW owner’s library. It offers material not found in other sources, including the official service manual.

Brake Grease

In 1957 I had a part–time job doing brake jobs at Pep Boys in Hayward, California. It was an after–hours sort of thing, six pm until ten or eleven; whenever I finished; two to four jobs a night. You had to provide your own tools and as a part–timer, I didn't have a regular bench or locker; haul them in when I started, haul them home when I was done. I used Pep Boys parts of course, and whatever consumables I needed were provided by the store. One of those consumable supplies was brake grease.

I quickly used up the tube of brake grease I had in my kit and replaced it with what the store carried, a fair sized can with a fitted top like a coffee can; you opened it with a key. I don't recall the brand name, maybe 'Whitmore' but that's just a guess.

The can held four ounces and since you only use a dab here and there, a can that large was just about a life–time supply. It was hard, yellowish stuff with the consistency of saddle soap. The last time I saw the can was before we took off for a month– long trip down to Baja in 1991 to observe the eclipse.

About a year after the eclipse trip I was doing a brake job, went looking for the brake grease and couldn't find it. No problem; there's two real parts–houses in the town I live in, plus three or four of the fast–food variety. Next time I was downtown I stopped at the biggest parts–house, asked for can of brake grease.

There were four guys working the counter and I knew three of them, having done business there for nearly twenty years. They all thought I was joking, including one old fart who's been around since Henry was making T's. But not a one of them had ever heard of brake grease; swore they had never carried it, hinted that there wasn't such a thing. Ditto with the other parts–house. And ditto on the humor, too. They were convinced I was pulling their leg — or someone was pulling mine, like sending a seaman duce to the bosun's locker for twenty fathoms of chow line.

I had to drive ten miles to another town, go to a Chevy dealer and pay a ridiculous amount for a tiny plastic tube of 'High Temperature Grease' and the gratuitous comment from the parts– guy, "Nobody calls it brake grease any more." I do.

If the counter–men at two parts–house had never even heard of brake grease it's a fair bet they haven't been selling much of it, which gives me a hunch a lot of you may not of heard of it either. And don't go a'waving St. Muir at me. Mr. Muir was a writer and a publisher; my grandmother was a better mechanic.

Before writing this I dug through a stack of shop manuals to see when brake grease lost its honest name. A couple of recent Haynes manuals still call it brake grease. Toyota calls it ‘Special High Temperature Lubricant (Brake)’. The Bentley VW manual (66–69 Sedans) doesn’t show you where to apply brake grease, although they offer a cryptic ‘Use lubricants sparingly,’ as if you’d been born knowing what, where & how.

Here’s the where: On the threads of your adjusters. Take them apart, clean them, apply a dab of brake grease, reassemble them and wipe off any excess. Then put a dab at any point on the backing plate touched by the shoes; I think the bugs have four such places, two per shoe (most cars have three, a few have four). Then you put four other dabs on the ends of the shoes, where they contact the pivot, adjuster or wheel cylinder piston. When you assemble the rear shoes, put a dab on the link pin before you install a new Circlip. Put a dab where the parking brake cable fits to the lever.

Here’s the how: A dab means just the lightest smearing of grease; use your finger. A two–ounce tube of brake grease should be enough for 25–30 brake jobs, mebbe more.

Here’s the what: Ask for ‘High Temperature Lubricant.’ (Even then I’d be wary if it didn’t mention ‘suitable for brakes’ or something similar.) And don’t be surprised if you have to go to a dealer to find it.

Sermonette

The geezer behind the parts–counter had been selling parts for forty years and swore he’d never heard of brake grease. That told me he hadn’t done too many brake jobs; from the look of his hands, he may not have done any at all. But he knew all about it and was quick to share his perception of reality.

On the other hand, when it comes to brakes, no grease at all is better than one dab in the wrong place. Your brakes won’t work as well but the wiser course is to know what you’re doing before you do it. Hanging around a professional brake shop and keeping your eyes open wouldn’t be a bad idea.

Drying Out a Gauge

I've noticed something quite annoying: Sometimes, on humid or rainy days or nights, when I turn the headlights on and, consequently, the internal gauge lighting, the gauges fog up from the INSIDE, and eventually the warmth of the internal light defogs them, but it takes a good long time. Why do they do this? Humid day at the factory when they sealed the gauges or what??? It's really really annoying. I don't recall the oil temp gauge I had in the '78 doing this.

The fog inside your instruments may not be water vapor. If could be volatile vapor from plastics or paint used in the gauge. If so, it may dissipate in time. But the odds are, it's water vapor. You are going to have to get the water out of your gauge or it will go bad.

You can 'de–mist' a foggy gauge by making a desiccant 'getter', such as cubes of gypsum board, baked in a warm oven for two or three hours then sealed into a balloon or Mason jar, having a brass nipple soldered thru its lid.

To demist the gauge you must make a hole through its case and couple the dry atmosphere from your 'getter' to the moist atmosphere inside the gauge using a bit of tubing. You can promote an exchange of atmosphere between them by using a bit of heat.

I realize there is some hazard associated with making a hole in your gauge but the risk is often less than the damage that will be caused by the moisture. If the body of your gauge is plastic you should be able to MELT a tiny hole in the case. If the case is metal, the best method is to punch a hole in the case using a needle you've made for that purpose.

But before you begin making holes in your instruments you need to figure out how you're going to connect the desiccant bottle and how to seal the hole when you're done. The usual method is make a nipple onto the instrument case by attaching a short length of brass tubing to the body of the instrument with one of the commonly available filled–epoxy resins such as J–B Weld or similar. Such nipples would normally be placed on the rear of the instrument.

To melt the hole in the case you pass the heated wire down through the brass nipple you've created. A paper–clip, straightened and secured to the tip of a soldering iron is handy for melting small holes in plastic. The nipple also serves to guide the needle when punching a hole into the case.

The instrument is then plumbed to your dessicant 'getter' using vinyl tubing. Obviously all components are selected for their fit. Hobby shops that cater to model airplane builders carry a variety of fine–gauge brass tubing as well as vinyl tubing of matching diameter. A straight piece of hard ‘music wire’ about 3/32" diameter by three inches long, sharpened on a stone to a fine needle–point, makes a suitable punch for metal–cased instruments. In the latter case the brass tubing for your nipple should have an ID to accomodate your ‘needle’.

Once the moisture has been absorbed by the desiccant ‘getter’, the hole in the instrument case is sealed with wax or an RTV compound.

But the odds are you needn’t go through all that trouble. It is rare to find a sealed automotive gauge. Nearly all inexpensive gauges are vented to the atmosphere for the simple reason they would implode at high altitude of they were not. And if there is already a hole in the instrument case it may be possible to replace its moist atmosphere with a dryer atmosphere by simply blowing ‘canned’ air into the thing.

On more complex instrument panels the gauges are often plumbed to a desiccant chamber fitted with a bladder to accomodate changes in atmospheric pressure.

Fids

Got something that needs plugging but ain't got a cork handy? Use a fid.

Properly, a fid is a cylindrical wedge. You use them when you're splicing line. But since fids are nothing more than tapered hardwood cones (steel, for steel cable), they come in handy for plugging holes, although softwood generally makes a better plug, hardwood a better fid.

The point of a sharp pencil is a miniture fid. Think big. You can whittle the things but if you've got a drill press, you can turn them; think of it as a vertical lathe. To turn a taper you simply hold the piece so the axis is a little off center. A nail in a board will do for the bottom center, a screw or spade-bit in the chuck will serve as the upper center. You need the screw or spade because you've got to impart rotary motion to the wood.

Such an arrangement will only work for small stuff. And don't try to make them too long; six inches is plenty. Start with a piece of 3/4" square pine or cedar, plan on making a taper from about 5/8" to 1/4". That is, the lower center should be offset about 1/4". Coarse sand paper — #80 or worse — will serve as your cutter. Keep the speed low; just try it out.

If the lower center is nice and sturdy you won't have any trouble making an even taper; the thing will look like a little carrot when you get done. Make a few of them then try a couple with a larger diameter.

If the taper is nice and long, the things make perfect plugs for hoses and the like. If you need a good seal, dip the things in hot wax to seal up the wood, or give them a coat of paint. Keep a couple of each size in your kit, you'll be surprised at how handy they are. Once you've got something plugged you can cut off the surplus length and secure it with bailing wire for a more-or-less permanent plug.

Wood is handy stuff. If you turn a very slight taper, you can even thread such a plug into a threaded hole and have the threads hold the thing, just like a bolt. The threads won't take much pressure, of course, but they will make a tight seal. And you can always rig something to provide pressue to keep it in the hole.

I suppose such things are more common around boats but I've found them to come in handy in the middle of a desert, when the only boat in sight said 'Volkswagen' on the hatch.

Get Hot

Heating a part as a aid to loosening it has long been a standard practice. Surprisingly, it often takes very little change in temperature to cause a profound change in the ease of disassembly. Simply leaving the part in a closed bus on a hot day will warm it to well over 100 degrees (F.) and the heated part always dismantles with less effort than when cold.

Of course, it's a bit hard to put a steering knuckle into a bus if the bus is still attached. Ditto for a CV joint. But that doesn't mean you can't warm the thing up.

Spraying a torch on the part for a few minutes is never enough. At best, the use of a torch is a psychological wrench. The whole part should be warmed up and that can take a bottle of propane... or set something on fire. A propane torch is a handy thing but it really isn't much of a torch. You need a rose-bud or fan-shaped tip if you're serious about heating a lump of metal.

One method lazy enough to draw my attention is to build a little oven around the part. The oven is nothing more than a cardboard box lined with aluminum foil. The fit doesn't have to be very good but the thing must be closed at the top in order to work — heat rises.

The heat comes from a couple of light bulbs.

It sounds sort of hokey but works surprisingly well and offers the advantage of allowing you to do something else — such as mowing the snow — while the thing heats up.

How long does it take? Overnight in most cases. Just don't forget it's there. :-)

It's best to heat parts that have been cleaned and are ready for disassembly.

On CV's it pays to remember that the bolt bore goes THROUGH the body of the CV joint. The bolt blocks access to one end but penetrating fluid — plus a little heat — can often find its way into the fitting through the opposite end. (Take a close look at the tranny flanges next time you get them off.)

Install CHT?

Should I Install a CHT?
.... or, Something Else to Worry About

Have you ever wondered why there aren't more mid-air collisions? I'm not talking airliners here, I mean Piper Cubs bumping noses as they do their bumps & grinds around the local pea-patch.

The answer is pretty simple: We keep to different altitudes. Head west, you do so at a different altitude than if you were heading east. Or south. Or north. The method isn't foolproof — nothing really is — but it reduces the danger of mid-air collision to acceptable levels.

The fun-part has to do with climbing-out and descending. When changing your altitude you must pass through layers of airspace in which you're liable to encounter traffic on a collision course. But here again, the risks are reduced to acceptable levels, partly because you do your climbs and descents in regions near airports where such things are expected, and partly because you don't mess around — when you climb, you CLIMB. Full throttle. Balls to the wall.

The object is to pass through the hazarous layers of traffic as quickly as possible. And it works. Of course, max throttle means about 125% of cruise throttle, and climbing-out means a steep angle of attack, reducing air-flow over the engine — which means your powerplant is living on the red-line — you're drag-racing to 8,000. Doing a quarter-mile drag, you're blasting away for ten or twelve seconds. In an airplane it's liable to take you ten to twenty MINUTES, which is one hell of a long time to run flat-out, max-revs, with a steep angle of attack and minimum air-flow.

Red-lining your engine is bad. You keep an eagle eye on — the Cylinder Heat Temperature gauge. Hours before the oil temp sez it's getting hot the CHT will tell you if you're pushing the envelope a little too hard, tell you when it's time to flatten your climb, trade a little more air through the gills for a little less feet-per-minute of altitude.

Not all aircraft are equipped with CHT's. It's a gauge seldom found on older lightplanes. And it's virtually unheard of on land-vehicles having air-cooled engines for the simple reason that it's not needed. No one in their right mind demands that kind of performance — for that long — from the engine in their bus or bug. Sure, we drive them flat out, but we do it with full airflow.

Climb to altitude, level her out, let the speed build up — and the temperature come down. Clean up the cowl — close the exhaust ducts to keep the oil temp in the green — lean that puppy out and see if you can get to ride the step. Then settle back for a couple hours of anxious boredom, wearing out the collar of your jacket. And you can ignore the CHT, unless there's something unusual going on.

If your bug or bus is running hot a CHT isn't going to tell you anything you don't already know — you've got a cooling problem, or a lubrication problem, or a maintenance problem. And none of those are problems that happened overnight. You saw them coming weeks away. Slapping a CHT on the engine of a bug or bus because it's running hot is about the same as implanting a pacemaker in someone with a broken leg.

Oil temp? Ahh! Now we've got a gauge we can use. Got a bug or bus — go get yourself a nice oil temperature gauge. Leave the CHT's for those guys with broken legs.

Keeping Clean

I love the idea of taking charge of my life and not being cheated by dishonest mechanics, but my first (and last!) attempt to do my own tune–up left my hands in such a state I'm terrified of trying it again. I know you'll think it silly, but the appearance of my hands is very important in my work.

I don't think it's silly at all; the appearance of MY hands is very important in MY work as well. For example, if they are dripping blood and missing a finger or two, I tend to get real upset :–)

But in all seriousness you have a valid point. Cars are dirty and that dirt gets onto your hands. And when a good, black greasy goo gets ground into the dead skin around your fingernails and on your knuckles, about the only thing that gets it off is pumice — you got to grind of the skin to get out the dirt. But when you do that, the result is sore, red hands that aren't much good for a couple of days, even to a hairy–chested mechanical type.

The trick to keeping your hands clean is to not let them get too dirty in the first place; you have to seal up your hands BEFORE you get them dirty using stuff like hair gel as a sealant. One brand is called 'Invisible Gloves' and forms a barrier strong enough to protect you from mild chemical burns; people allergic to epoxy resin and the like use it to keep from getting a rash. Just rub the stuff in like hand cream and let it dry. Soap and hot water takes it off.

My grandfather was a Mason, very involved with their affairs. He did all sorts of machinist work and blacksmithing yet had 'gentleman's hands' (my grandmother's choice of words). He used the hair–gel trick. He also scratched a little Ivory soap under his fingernails when he had an especially messy job.

There's a stuff called 'Machinist's Soap' that contains a chemical that will keep your hands from sweating. Politicians probably use more of it than machinists but you get the idea. If you can keep your hands from sweating you can wear surgeon's rubber gloves, or even those cheap throw–away plastic gloves, and still do some useful work.

You can buy both Invisible Gloves and machinist's soap from machinist supply houses (check your Yellow Pages) or outfits like Aircraft Spruce & Specialty Co., of Fullerton, California. They sell a lot of epoxy and the like. They're kind of expensive but you get what you pay for. Call them at (714) 870–7551. But if you check around, chances are you can get hand–stuff locally. (Everyone's got hands.) And after you're all cleaned up, go in and DO THE DISHES! Washing dishes (or just soaking your hands in hot, soapy water) is one trick every mechanic uses to keep his hands presentable. (But most don't have the courage to admit it :–)

The other side of the Getting Dirty coin is keeping your engine clean. It's no different than anything else; if it's dirty, WASH IT. Auto–parts places carry special stuff for scrubbing engines but your veedub engine is mostly painted metal; treat it like you would your refrigerator or stove. So long as you don't go at it with a fire hose, a little water won't hurt nothing. You don't want to get water in the alternator, or down the carb, and covering the distributor with a plastic bag makes good sense, but aside from that, just jump in there and give that puppy a bath.

If your engine is dirty you're bound to get dirty working on it. So clean it up. No oven cleaner or scouring powder, soap & water will do just fine. I use dishwashing soap, the cheap green stuff, and a stiff paint brush (cutting the bristles shorter makes them stiffer). A toothbrush is just about the handiest thing ever invented when it comes to keeping your engine clean; worry about the nooks & crannies and the open areas will sort of take care of themselves. Once you've gotten the engine clean, spend a little time keeping it that way. It will do both you and the car a lot of good; it's one of the ways you take charge of your life.

Another factor in keeping clean is Dressing For the Occasion. That means long–sleeved shirts buttoned at cuff and collar, long trousers, and shoes that cover your ankle. Working on a car is a job, not an adventure; dress like you're going to do some work. Then let the clothes get dirty instead of you. As to style, I can't say I ever thought about it. Good mechanics tend to be neat by nature; they'd starve to death otherwise. I wear levis or khaki trousers, khaki or denium shirts, good serviceable American–made stuff. You can wash them every day and they'll still last for years. Avoid synthetics and blends; plain cotton is the stuff you want.

There's no mystery to getting grease out of cotton fabric. Use something like trisodiumphospate (try dishwasher soap) and let the things SOAK. You're playing chemist here. You've got to give the chemicals a chance to work.

If you own a washing machine, figure out how to make the thing run two or more cycles. On ours, I just leave up the lid. It won't spin with the lid open. Next time I happen by, I reset it to start sloshing again. Do that a couple of time and even the greasiest levis come clean. Sorta faded, but clean. Same thing applies to getting the soap out of your clothes. After you get them clean, run them through another wash cycle WITH NO SOAP; really rinse them puppies. If you don't own a washing machine, get a 5–gallon plastic pail and start your own Grungy Laundry. Use a toilet plunger to slosh the clothes; you don't want to get that TSP on your hands.

The other thing you mentioned, the strength factor, is related to your remark about cutting your hand when the wrench slipped, but let me give you a little background on the problem. If you look at a new spark plug you'll see it comes with a washer, that circular metal thing just above the threads. Your spark plug is properly installed when it's tightened enough to compress that washer. There's a torque spec for spark plugs, and as you become more adept as a mechanic you should always torque your plugs to spec, but for now just get them tight enough to compress the washer and they'll work fine.

The compressed washer is why they were so hard to loosen. As you mentioned, once you got the wrench to turn, the plugs unscrewed easily so lets focus on loosening them. The secret here is to use a bit more leverage; a longer wrench. No, you don't have to go out and buy a special wrench, what you want to find is a piece of pipe or tubing that will fit over the wrench you already have. And yes, Craftsman tools are good ones. But Sears probably can't sell you a 'cheater,' which is what you call a piece of pipe when you use it to gain leverage.

What you want is a piece of electrical conduit about a foot long. Or even a piece of plastic water pipe. The diameter is determined by your tool.

When you've got the socket on the spark plug, position the wrench so you can slide the cheater over it and still have room for a short pull. Support the wrench — you never want to get too rough with spark plugs or you'll break the ceramic insulator — and take a strain on the cheater. Don't JERK on the thing; you've got more than enough strength to loosen the plug if the lever is long enough. The plug will come loose with surprising ease, so don't pull too hard or your hand will come flying off and you'll bark another knuckle.

It didn't come loose? Lengthen the cheater a little and try again. And make sure you're turning the plug in the right direction. On your Ghia the plugs on the passenger side will unscrew when you PULL on the cheater, assuming it is pointing UP. On the driver's side you'll have to PUSH on the cheater. (The manuals will say "Loosen in an anti–clockwise direction," or something equally unclear.)

And of course, you do the same thing when you put in the new plugs. Use your cheater to tighten them. Just be careful not to overdo it; with the right lever you'll have more working muscle than Hulk Hogan.

The principle of lengthening the lever–arm of a tool may also be applied to the generator pulley nut and those 'impossible' lug bolts you mentioned. Fact is, the lug bolts on your wheels should never be run up tight with an air–wrench or you won't be able to change the tire without help. Use a nice l–o–n–g cheater to loosen them, then re–tighten them, snug as you can. You don't have to take them out, just loosen then retighten them to YOUR specification. The stock Volkswagen lug wrench was designed to be used with a cheater. Get one made out of pipe, not plastic, and carry it in the boot. That way you'll know you can always change your own tire.

Along with the cheater you may want to carry some of those disposable plastic gloves; tires are dirty too. I've never used the 'paper' coveralls you mentioned but if the 'paper' is Tyvex, I know what you mean and I think it's a wizard idea; there's no reason to get filthy just from changing a tire.

I'm sincerely sorry you hurt yourself working on your car. It wasn't the cars fault, nor yours. The blame has to fall on a society that simply doesn't care all that much for the details of life. I hope this note will provide the encouragement you need to give the mechanical arts another try.

Poor Man's Press

If you've got a sturdy doorway, you've got a pretty good press. You will need a jack, a length of 2x4 and a socket that matches the diameter of whatever you're pressing into place (bearing race, oil seal, etc), but if you bought that $50 set of 3/4" drive sockets from Harbor Freight, one of the sockets will match the diameter of anything you need to press–on to a Volkswagen.

The trick is to use the frame of the door as your press frame. Put the thing to receive the part on a piece of plywood in the middle of the doorway, align the part being pressed into place, put the driver/pressor onto it and put a bottle jack or screw jack atop that. Then cut a piece of 2x4 to fit between the top of the jack and the top of the door frame. Make sure everything is nicely aligned, use the screw extension on the jack to take up any slack, then do what comes naturally.

A Douglas fir 2x4 will withstand an enormous load in compression, more than enough to install the typical bearing race (especially if you leave the hub in the sun and the race in the freezer before you do the installation).

Moving the World

If you've pulled the rear drums of a Volkswagen bug or bus you've already learned that a length of waterpipe on your breaker bar can turn a 97 pound weakling (even a girl–type weakling) into Hulk Hogan. The same principle of leverage can be applied to installation of bearing races and seals. Most oil seals go in quite easily when you put the short end of the lever under your bug or bus, position the seal driver and then lean on the long end of the lever.

This gives you the Poor Man's version of an arbor press, and will work right up to the point where your vehicle is about to tip over. And it doesn't take a rocket scientist to see that this technique can be used to change a tire without a jack or to free a mired wheel, assuming you have a strong enough lever.

Variations on a Theme

If you have a bottle jack and a doorway you can do most jobs that would normally require a hydraulic press, but ball joints take up to 10,000 pounds of force and assembling the gear cluster in the tranny at least 5,000. You will get the job done but your doorway is liable to take on a new and unique shape.

When you need to apply more force than a doorway will withstand, take yourself down to a scrap metal yard and prowl about for steel 2x4’s. The guys at the scrap yard will insist on calling the things ‘C–sections’ but they are really 2x4’s. Or 2x6’s. Get some that are at least 1/4" thick. Take them to a weldor and pay him to cut the steel C–sections into four pieces, two of them about two feet long, two of them about 18". Have him weld the four pieces into a rectangle with the flat side of the C–section toward the middle. Talk him into adding gussets at the corners. You now have a clamping frame.

Pretend your clamping frame is a little doorway. Sit it on the floor and proceed exactly as before, except you may wish to use pieces of pipe between the jack and the top of the frame instead of Douglas fir.

Such a frame will handle about 90% of your hydraulic press chores and when not in use it’s easy to store. If the welding is a problem you can assemble the thing with bolts but you really should ream the holes and use Grade 8 or better hardware. And you’ll have to do a lot more cutting and fitting. Of course, a bolt–together frame can be unbolted for storage.

Concrete Press

If all of this sounds too exotic, you can still come up with a pretty good press using nothing more than a hunk of sidewalk. Your front porch will work or mebbe the basement floor; any good hunk of concrete.

What you do is drill some holes in the concrete and install expansion bolts that allows you to bolt things to the concrete. A 3/8" bolt is about as small as you want to go; 1/2" is better. Prowling around a hardware store will give you some idea as to what’s available.

If you bolt down a piece of strap iron you can use it as an anchor for a lever, or if the strap is wide enough, as the top of a miniature doorway. Or you can drill some angle iron and build yourself a little press right there on the floor.

Sermonette

There’s no substitute for having the right tools, but any tool that accomplishes the job without damage to the part is the ‘right’ tool by definition. Often times it takes longer to make the tool than to do the job but if the part being installed is a bearing race with an anticipated useful life of years, but only minutes if done improperly, the time spent to do the job right is always justified.

Spring Clip Pliers from Sears

I use a pair of Craftsman spring clip pliers. This is a forged tool, nicely finished, that has no trouble dealing with the longing rings on crankshafts or CV joints. They were purchased about 1960 and were relatively expensive, meaning they are a bargain in the long run.

Now that Sears, Roebuck & Co. has taken to emulating K-mart they may not carry quality tools any longer — I stopped shopping at Sears when they closed their catalog sales store here in town. Proto and Snap-On still sell quality tools.

Cheap tools are no bargain.

-Bob

PS — Just because an outfit offers to replace a tool if it breaks is no reason to get all excited about their 'quality.' What you want are tools that DON'T break. Comparison of old Craftsman tools to their modern offerings will give you an instant education in how a good company can go bad.

Surface Plate

I'm kind of nosing around looking for a reasonable surface plate for cams and cranks etc.

Mike,

It is very astute of you to raise this subject. You don't often need a surface plate in automotive work but it is one tool for whose purpose and role there is no substitute. There are times when you must measure things relative to a known standard of accuracy. The dead-flat top of a surface plate serves as the base-line not only for basic measurements, it allows you to periodically gauge and adjust your precision measuring instruments. The precision and accuracy of your machine work, and much of your assembly work, depends on having a standard of known accuracy and precision against which you may gauge your tools and components for assembly.

Although a small, commercial-grade (as compared to laboratory-grade) surface plate is not especially expensive, for automotive work there are a couple of acceptable alternatives. The flattest stuff commonly available throughout America is a gravestone, a slab of polished stone, with granite preferred over marble. After that comes a hunk of polished plate glass.

Minimum size needed for working with veedubs is about a foot by a foot and a half.

Surface plates are usually made of granite. Their surface is true to within half a tenth (.0005") across the longest dimension of the plate, that is, from corner to corner. They must be properly supported. Even a three inch plate will show some droop if you support only the corners. The usual trick is to place the plate on a pad of felt or a piece of carpet.

A cover of light plywood, with a piece of felt or cloth glued to the contacting surface, is usually made to cover the plate when not in use.

After polished stone and glass, a heavy hunk of cast iron is probably your best bet. You can blue the top of the plate and work it flat with scrapers and chisels. This used to be one of the first chores for every apprentice machinest. Some machinest's training programs in England and Germany started with the kids making their (wooden) tool box. At each level of the program the bottom layer of students was peeled away, directed toward less demanding trades, each of which had paths of advancement paralleling the other trades. Woodworking is very much related to machine work since the patterns used in every foundry start as wooden models.

American programs of the same era typically started at the forge, the spun-off skills including farriers, wain-wrights (ie, wagon-makers), wheel-wrights, blacksmiths and so on up the ladder culminating with men who made the machines to make the machines, if you get my drift.

An engine lathe is often described as the only machine capable of reproducing itself (which happens to be true). One of the best stories of the modern age is how the FIRST thread-cutting lathe was created. Oddly enough, the tale involves computers, or at least their historic analog — Babbage's 'Analytical Engine'.

In the automotive world of today 'mechanic' is used to describe someone who can plug in a diagnostic machine, and who knows how to replace entire assemblies. Traditional automotive mechanics has become the realm of the 'automotive machinest,' the fellow in the back of the shop who understands tolerance and fit, a fellow who can build an engine from scratch if that is what's needed. Subscribers to this list are a lot closer to the back of the shop than the front :-)

There's more to being a good mechanic than owning a set of greasy fingernails.

Test Stand

Volkswagen owners who have embraced John Muir's Forever Car philosophy usually acquire a second engine, either one pulled from a running vehicle or one they've built themselves. Having a second engine in your warbag offers tremendous latitude in performing heavy maintenance, such as a valve job, since you can replace the entire engine, performing the work as time allows. But when the work is done you face an interesting dilemma, being unable to test the engine without installing it a vehicle. Should some problem be arise you've lost the benefit the second engine provides; you're grounded until you fix the problem or swap out the engine.

So test it first. On a test stand.

When the central saddle of a tranny gets pounded out its useful life is over. You can salvage some of the innards but the case is junk. Ditto if the thing cracks, as more are doing as they accumulate age and heat cycles, it's one of the disadvantages of magnesium alloys.

But so long as the bell housing is sound a junked tranny is perfectly useful as an engine test stand. Of course, it's a bit low. . . I drilled some 1/8" steel plate to match the side– plate studs, another to match the bull–nose, and welded legs to the steel plates. I jigged the tranny on its back, eye–balled the legs into a Vee and tack–welded them to the plates, stood the thing up, trued it up, and welded it up.

To be able to push it about the shop I added wheels — six inch diameter industrial–grade rubber–tired casters. No, the four don't match except as pairs, but it's what I had.

Cross pieces between the legs add the required rigidity and the rubber tires take care of vibration, which isn't very much on a properly built engine.

For a fuel tank I modified a 1–gal paint thinner can with a valve near the bottom on one side. Vented the cap. Painted it red. To support the gas can I added an upright from the rear plate, the one bolted to the bull–nose, stabilized with a strut to the centerline–lifting hole in the crankcase casting. I put the gas can on one side of the upright and rigged a simple instrument panel on the other. Starter button, ignition switch, warning lights. Oil pressure gauge. Ammeter. Tachometer, oil temp, CHT, ASI, T&B, altimeter. (Okay, okay, I was just kidding about some of those. But it does have a few dials to tell you how things are going.) Plus a CDI module. And a starter. And a battery in a well made, heavily varnished wooden box.

All up, fitted with muffler, flywheel and clutch, a VW engine is more than I can easily lift, plus it makes a very clumsy load; too clumsy (as I discovered) to lift and insert into the test stand by myself. You have to back it up against the wall of the shop then hold the engine in place while you reach around and get a nut on one of the upper bolts. I'm six feet tall and weigh about 190; I can lift the thing but you need arms like an orangutan to get that damn nut on!

So I built a hoist. On the test stand. I ran a horizontal piece of steel tubing forward from the upright, dropped a diagonal back to the base to take the load and rigged a little winch on the steel plate bolted to the bull–nose. Couple of aileron pulleys, a few feet of extra–flexible aircraft cable, a couple of crimped fittings . . . Hoist.

But lifting the engines by the lifting–eye cast into the crankcase caused them to hang nose–down. So I made a load– leveler. Piece of square steel tubing (3/4", I think). Piece of half–inch all–thread. Couple of nuts, plus a coupling nut for the traveler. Couple of lifting eyes. Little crank to turn.

Using the lifting–eye cast into the engine, plus a clip into the pulley, fasten the hoist to the load–leveler, take a few turns on the winch, crank the load–leveler until the engine is balanced, and hoist away. Slide it into position. Bolt it down. Test it out. And when you're done testing, it makes a handy place to store the engine until you need it. Just shove it over in the corner and put a tarp over it to keep people from laughing themselves to death. Odd looking thing. But it works a treat.

No, you can't borrow it! Build your own! Help us figure out how to post drawings and photos so everyone can get a laugh out of this thing. The instant people see it they either want to borrow it or modify it. (Does a test stand really NEED a sound system?) Okay, so horn and lights may be a bit overkill, but I do test things at night and you do need to see the gauges and the horn . . . I like the horn. It makes me feel good when I wheel the test stand up behind someone and honk my horn. The horn stays. Take the altimeter instead. (It always says the same thing anyway: 512)

Oh, and there's and oil filter mount. With its own hoses. And a voltage regulator, for those engines running generators. And some other stuff I'd rather not mention.

And it does other things besides test engines. Working on a manifold? Bolt the Hanger Queen onto the test stand and you've got the perfect welding jig; roll it inside when it rains. Turn on the lights, pop in a CD . . .

The legs are stuff that was around the shop; steel tubing for a couple of them (tail pipe stuff is fine if new), angle iron for other parts. A pair of bed rails got in there somehow. Shelves are aluminum plate, pop–riveted. (Because I had it, that's why!) Welding was done with gas (tacking) and MIG (finish). Various paint, the tag–end of cans. Joseph would dig it; Ruben would lust after it. (Paint it gray. Avoid Slavery!)

Because the hoist overhangs by quite a bit, the test stand provides a handy means of putting an engine into the back of a Transporter or pick–up. To carry, not to install. Just roll it out to the vehicle and lower it down. And it picks things up, too. Max lift is probably a thousand pounds, up & down. Cable is 3/16 so that's no problem, but the pulleys are only 3" all aluminum jobbies on 1/4" axles; you can break them easily if the load isn't straight up & down. The winch, a worm–gear type so it can't unwind on you, is rated 2,000 pounds. Should be able to hoist a Type IV . . . maybe.

All up, it's light enough to throw on the roof–rack of the bus. Looks a bit odd laying up there, feet in the air. The hoist unbolts. Gas can too. Baggie the hose–ends to keep them from dripping. Loan it to friends, take them to court to get it back. ('But I already HAVE a wife. I want my test stand back!')

Testing Oil Pressure Gauges

A dead-weight tester is a one inch piston with fluid under it, and weights are stacked on it pushing the fluid into the gauge you're testing.

The real problem is making a fluid-tight sliding fit. The simple answer is to use an old wheel cylinder that you've honed & polished. Automotive brake parts are usually good for about 1,200 psi. The cast iron VW wheel cylinder makes it easy to tap for various fittings, although you can make a very satisfactory job of the thing using brake-system parts. Use a single-ended (ie, front wheel) cylinder. If you use an open cylinder (ie, rear wheel) you'll have to close one end.

The other trick is making the 'pallet' that holds the static weights atop the piston. Since there is virtually no vertical motion, flexible positioners will do just as well as the more rods used in the laboratory models. Just be sure it won't topple/tear apart when you get into the 100 psi range.

The best static weights are made of lead, or from an alloy having a high lead content, such as used wheel weights. Weigh them on a bathroom scale to get the approximate weight. Melt them down and skim off the steel clips (they'll float on the lead — Archimedes was right :-), pour the molten lead into baked dry coffee cans. Use a more accurate measuring device to determine and adjust their final weight.

There are some tricks you can use here to keep the weights within reason, such as the use of an accurately made lever between your pallet and your cylinder, one having a known ratio. The problem with ratio'd standards, aside from the frictional loses in the lever's pivot, is the amount of travel you'll have to contend with. If you start with a wheel cylinder you'll probably want to stick to ratios of 10:1 or less, unless you want to calibrate gauges for high-pressure hydraulic systems, in which case you'll be limited by the sealing ability of your rebuilt wheel cylinder, probably to something between 1,500 & 2,000 psi — kinda low for a real hydraulic system.

The real message contained here is rather subtle. Once you have a calibrated gauge attached to a hydraulic system you can forget the weights and use a simple pump, such as a re-worked brake master cylinder, to pressurize the system, allowing you to check gauges in parallel with your calibrated gauge. (Remember to secure your static-test piston before you start pumping :-)

Even more subtle... knowing the precise input pressure and piston area, it's an easy matter to calculate the output pressure of a slaved cylinder, meaning you can adequately test high-pressure components with your simple hand-pumped input. So long as you keep in mind there's no such thing as a free lunch — your system will have to accomodate differences in piston travel and fluid volume — you can reliably test 2 kpsi aircraft systems with a test-bench assembled mostly from brake parts salavaged off old cars :-)

(Somewhere in my junk is a piece of paper saying I'm a certified metrologist, which means I can legally adjust speedometers to read furlongs per fort-night.)

Timing Lights

Engines are dynamic things. A static timing light is a smart way to set the base–line timing but once the engine is running you need a dynamic timing light to dial it in. In a high–time engine, the difference between cold static timing and hot dynamic timing can be as much as five degrees due to accumulated wear and other factors. Getting your timing correct within one or two percent is fine, if you can afford that amount of slop. But one or two percent on the wrong end of the scale can cost you an engine. On the other end of the scale that one or two percent can reflect a ten percent reduction in fuel economy.

One reason I like CDI modules (and run them on everything I drive) is because the timing stays dead–on for up to ten thousand miles, changing only as the rubbing block and distributor components wear.

Modern ignition systems use a host of sensors and a microprocessor to provide the most correct timing under all conditions. The opposite end of that scale is static (or mechanical) timing, which itself is a hold–over from the age of steam (yes, you need to 'tune–up' a steam engine now and then) and is only suitable for engines designed to run at a single speed.

Observing a degree wheel with a timing light provides an excellent reference to the condition of the mechanicals in your distributor. That small amount of 'hunting' you see usually reflects wear in the distributor shaft bushings. If the thing is really jumping around, it would be wise to find out why.

Torque Without Torque Wrench

Somewhere, you wrote about how to calculate the amount of torque applied to the gland nut using a scale, a cheater pipe and a mathematical formula. At least I think it was you. I can't find the info on the old bus web page, and was wondering if you could tell me again: How do you calculate torque without a torque wrench?

It's so easy you're going to laugh —

Foot-pounds means exactly that... the number of pounds of force applied at a distance measured in feet from the center of the object being rotated (or torqued).

Put your 3/4"-drive socket on the gland nut. Use the breaker-bar, not the flex-handle or ratchet. Slide a cheater over the breaker-bar to extend the arm out to four or five feet. Place a bathroom scale on the floor under a mark four (or five) feet out from the center of the gland nut. (You'll need to prevent the engine from tipping as you torque.) Stand on the scale and note your weight. Place your hands on the breaker bar and exert downward force. The scale will register a REDUCTION in your apparent weight. The difference between the first weighing and what you now read is the amount of force being exerted on the breaker bar.

Since you want the gland nut torqued to about 215 ft/lbs, simply press down until your weight has been reduced by about 54 pounds, if standing at four feet — 43 pounds if at five feet.

This same question has been recently asked by two other people (one for the rear axle nut — to which the principle also applies) so I'm going to make this a public post.

Transmission Drain Plug

A recent series of posts on the 17mm hex tool used on the VW tranny caused me quite a bit of confusion. I use a 5/8" coupling nut, an internally threaded sleeve used to connect threaded rod together. I've been using it (or one like it) for nearly 40 years; started using it about ten minutes after crawling under my first VW. (Back then [1956], metric tools were as rare as lips on a chicken.)

No, it's not a perfect fit; 5/8" is only 16mm, about forty-thou shy of the real thing; it wouldn't do in a 12-point socket. But when you're dealing with a hex-socket it works well enough. And you don't need a lot of force with VW drain plugs either coming or going; they're tapered. If you put them in with too much muscle you can crack the case. (I recall drilling a 5/16" hole through the first one I used so I could get a tommy bar in there; that way, you didn't need a wrench.)

I thought everyone used coupling nuts. They used to cost about a quarter; probably more nowadays. Get them at the hardware store, back with the nuts & bolts.

Machinists use a lot of five-eights stuff. If you're really strapped they'd probably give you a 5/8" hex-head hold-down bolt. The head will work for you. Grab the shank with vise grips. Or your teeth, if you're really strapped.

I see J. C. Whitney sells a 17mm hex-thingee for a 1/2" drive socket set. Three bucks. (14 xx 4740A). They've also got those intake manifold boots that don't leak; even got them in black if you're the shy type. Four bucks. (38 xk 2005T). And those 12- point bits for CV joints. Damn, but those things were hard to find! Had to drive all the way to Tijuana to get a set. (It's not the drive, only fifty miles or so, it's the border; takes you about two hours to get back across the line.) Now they got them in J. C. Whitney; save you that wait at the border. Expensive, though; ten bucks for a set of four. (14 xt 1662P).

I wouldn't buy a cow from J. C. Whitney. (Probably come with a little notice: "Teats available at extra cost") But I feel pretty safe using them for things like gaskets and consumable tools, stuff you want to keep on hand because you know you're going to need them. But no cows.

Tri-Sodium Phosphate

Cleaning Steel Parts

Go to a paint or hardware store. Buy some Trisodium Phosphate, often labled simply TSP.

In a metal container that is NOT used for the preparation of food, mix about a gallon of water with a pound of TSP. Put it on the stove and bring it to a boil.

Put your dirty steel or iron parts into the hot solution of TSP. Adjust the heat for a steady simmer. Now go do something else.

Check the pot periodically. If the part is painted, the paint will come off. If the part is greasy, the grease will come off.

A pound of TSP will break-down and absorb about three pounds of paint, grease or what-have-you. The solution may not look very clean but it will continue to work longer than you'll believe possible. But if it takes more than an hour to boil a small part clean, the TSP solution is probably depleted and should be replaced.

I get rid of old TSP juice by pouring it into my compost heap. I've noticed it sets-back the anaerobic action by quite a bit but appears to stimulate the action of oxygen- breathing bacteria (both of which are active in a good compost heap). I also discard lye-water in this fashion, and have been doing so since I was a boy.

If the TSP is not depleted, allow it to cool then store it in plastic jugs. (I use old Chlorox bottles or tranny-lube jugs.)

To degrease larger parts, such as blower-housings, axle- tubes or outboard gearboxes, I use a wash tub. For really large jobs I use a cut-down oil drum. The problem here isn't the container — you'll come up with something that works if you really need it — the problem is keeping the solution HOT. To provide boiling heat for occasional jobs, a couple of fire-bricks and ten pounds of charcoal will get the job done, but if you expect to do a lot of cleaning you should provide yourself with a gas ring of suitable size.

Cleaning and painting parts is THE major task when doing an overhaul, taking at least 80% of the time you'll spend doing a proper overhaul. In earlier articles I'm mentioned a number of useful cleaning techniques yet this subject continues to generate a surprising volume of mail, especially with regard to cleaning a blower-housing or tin- ware caked with years of baked-on oily residue. (This is also true of brake backing-plates and front spindles.)

The answer is to use a bit of basic chemistry. A HOT solution of Trisodium Phosphate will remove almost everything that needs removing. It does so fairly fast, at a price anyone can afford, and in a relatively benign manner.

In this message I've outlined how one goes about mixing, heating, using, storing and discarding a Trisodium Phosphate cleaning solution. If you have never tried TSP, I urge you to do so. And having done so, I hope you'll take the time to inform the List of the results of your experiment. The reason I ask this of you is that recently I've received several messages that imply hot TSP, lye or acid didn't work, at least in their particular case.

Frankly, I don't know what to do in such cases. With acid- etching the part simply hangs there — it's pretty hard to get the procedure wrong. Using lye or TSP, the most complex part of the operation is bringing a kettle to a boil. But I'll assume I've said something in an unclear manner, or that the TSP and lye of today is somehow different from the stuff I use. So please try the experiment and let the List know your results. (And if you've never used TSP you're going to be delighted with this most useful of tools.)

Warning

TSP, lye and acids are dangerous when mishandled. Follow the precautions on the container. And I mean FOLLOW them, not just read them. Rubber gloves, goggles and an apron should be worn. It's just common sense but that appears to be a very uncommon substance.

Useful Tools

Two of the most useful — and necessary — tools a Volkswagen owner can have are found at the scrap yard. One is a piece of angle iron, the other a piece of pipe, both about five feet long.

The angle iron is mentioned in the early editions of Volkswagen‘s ‘Locally Fabricated Tools‘ manual and is called an ‘anti–torque‘ device; it keeps things from turning. The piece of pipe is a leverage extender, a ‘cheater‘, and is often the first tool acquired by every shade–tree mechanic, after the 3–pound sledge.

The angle iron is used to prevent the flywheel from turning when installing and removing the center bolt. It is also the thing you need when doing a brake job, allowing you to remove the rear wheel nuts without heaving your bug all over the lot.

To make an anti–torque lever, start with a five foot length of angle iron having 1–1/2" or 2" flanges. A thickness of 1/4" inch is okay. Anything lighter and you‘ll bend it when doing a brake job, anything thicker gets a bit much to position.

To make it useful, drill holes in the flanges to match the bolt pattern you‘ll be working with. With two flanges on each end, you‘ve got four flanges to play with. Drill two holes to match the pattern for 5–lug wheels, 4–lug, and the flywheel (ie, to match the clutch pressure plate mounting holes). Position the holes accurately and drill them to match the bolts; you don‘t want any slop there or you‘re liable to shear a bolt.

The proper tool for removing the rear wheel nuts and the flywheel bolt is a 3/4" drive socket and a breaker bar. You can buy these things as needed at a well stocked auto parts store (not the chain–store type but a real grease–on–the–floor parts house) but they cost the earth. A wiser choice is to buy a complete set of 3/4" drive metric sockets from Harbor Freight (1–800–423–2567, 24 hour service; get their catalog) for about $50. The set comes with a steel case, breaker bar, ratchet, a couple of extensions, and seventeen(!) sockets, from 19mm to 50mm. Fifty bucks is about what I paid for a 3/4" breaker bar and a couple of sockets. And those were 1960‘s dollars.

Use the piece of pipe as an extension handle on the breaker bar when removing rear wheel nuts or the flywheel bolt. In conjunction with a bathroom scale, the pipe–extension also allows you to accurately set the torque on the flywheel bolt. (Stand on the scale, grasp the pipe at an accurately measured four feet from the socket and pull up while watching the scale. When your weight increases by 54 pounds, you‘ve torqued the gland nut to 216 ft/

lbs. Your anti–torque lever will be sticking out the other way, preventing the flywheel from turning as you torque the bolt.)

Two other basic tools in a VW mechanic‘s warbag are a set of jack stands and a garage jack, the kind with the wheels, having a lift of about two feet, sufficient to remove a VW engine. These things are also available from Harbor Freight and best of all, they don‘t charge for shipping when the bill is >$50.

Despite our preoccupation with engines, when it comes right down to it being able to stop is a lot more important than being able to go. If your engine is running now, you‘ve got the go part figured out. The tools above make a brake job an enjoyable afternoon affair, allowing you to take care of the stop part of the equation, which you‘ll have to do two or three times during the working life of a well built engine.

Useful Tools – Part II

The Motor Scooter and Pickled Engines

On 2 May 1995 Robin Amano mentioned his motor scooter. He called it something else but all shops that work on Veedubs have something similar. It looks a bit like a three–sided, open– topped box, with wheels. Not big; just wide enough to clear whatever floor jack you're using, which also defines it's height. The top rails are designed to accept a VW engine, with suitable cut–outs and braces. The wheels are whatever is handy; casters for a heavy chair work fine since a VW engine weighs less than the average couch potato. The reason for the three sides is to allow your floor jack to fit under the scooter. In use, you put the engine on the scooter for storage or just to make it mobile around the shop. When you're ready to install the engine, you push the scooter under the vehicle, run the jack under it and lift it off.

I've seen scooters made of sheet metal, welded tubing — even riveted aluminum. Wood works too.

Shops that assemble a lot of engines have a special wooden pallet, about a quarter the size of a regular shipping pallet. Assembled engines, bagged in heavy plastic, are strapped to the pallet. If shipping specs call for the thing to be stackable, a wooden frame goes over the engine and is secured to the corners of the pallet. Pickled, bagged and strapped to a stackable pallet, an overhauled engine can be stored for up to five years, after that you can expect to see some cylinder/ring corrosion due to combustion products not fully neutralized by the pickling oil you spray into the jugs & crankcase. Engines which have not been test–run may be stored indefinitely, at least in theory, so long as the desiccant plugs and seals are renewed periodically (but the seals take a set). (Desiccant plugs look like fat spark plugs; screw into the spark plug holes. Desiccant seals are used in the sump and oil filler; on VW's, the air inlet around the crank is sealed with tape.) It's standard practice to pickle & seal any engine for export since there's no telling how long it will lay around some warehouse while the bean counters play with the paperwork.

If you've embraced the Forever Car philosophy you'll probably wind up with two engines. If you plan on how to store/move the thing before it arrives on the scene, you'll be ahead of the game. The long–term trend shows a steady rise in VW engines and parts. The wiser course is to buy things you know you'll ultimately need as early as practical, preserving them until called for. If you see a good engine available at a bargain price, snap it up. Properly pickled, fan belt off, rockers removed, it can doze peacefully under your bench until needed.

Welding

Give a skilled weldor a source of sufficient heat and he will marry metal. The Greeks were doing intricate bronze work before the birth of Christ and significant quantities of high quality steel was being produced in India not too many years after that Event. By the 1300's European armorers had developed welding techniques that are the equal of the most competent of today's metal workers. Your Volkswagen is a rolling monument to all the metal workers who have gone before.

To maintain your Volkswagen you may have to join the historic ranks of the metal–working clan. From time to time it will be necessary to replace certain brackets and supports that fail due to stress or wear. If your VW has been attacked by rust, often times the most practical repair is to cut away the rusted part and replace it. At other times your bug or bus may suffer collision damage, the repair of which will require you to beat out the dents and weld any tears, or even to replace the damaged part entirely. There are many shops that specialize in this form of repair but the fundamental steps are fairly simple, easily mastered by anyone; strength is not a factor when dealing with metal, so long as sufficient heat is available.

The basic welding tool is the oxy–acetylene torch, commonly called a 'gas' rig. It consists of steel flasks of oxygen and acetylene gas, a suitable cart to move them about and keep them from tipping over, regulators to reduce the high pressure gases and control their low pressure flow to the torch, and the hoses linking the torch to the regulator. You'll need a flint striker to light the flame and dark goggles to keep from being blinded by the glare of molten steel. Leather gloves and apron will help keep you from setting yourself on fire, as well as sturdy boots and a handy fire extinguisher.

The best place to find a gas rig is in the newspaper; buy a used rig. Take the torch and regulators to a shop that handles the brand you've bought and obtain any needed repair parts. Then sign up for a basic welding class at a local school, or prevail upon a friend who welds to show you the ropes; your first project can be your welding cart.

Ideally, welding and the many safety–related rituals that must accompany it are the sort of thing best passed from father to son over a period of years but more formalized methods are widely available. One thing you don't want to do is try going it alone; gas–welding is pretty much a self–regulating procedure; if you do something wrong, it can kill you.

Like so much of mankind's store of knowledge, gas–welding can only be mastered by practical experience; no one has ever read a book, lit his torch for the first time and produced a perfect weld. Thor won't allow it.

Most of us start with a formal course then concentrate on the specific type of welding we plan to do, gaining proficiency through hands–on experience. How long this takes depends entirely on you, but be assured it is a skill that any one can master, and fairly quickly, too. During World War II thousands of American housewifes became weldors, often with as little as five days training. And like riding a bicycle, welding is a senso–kinetic skill involving 'muscle memory,' once learned, it's never forgotten; there is a certain magic in the inner cone of an acetylene flame.

A skillful gas weldor can weld steel or aluminum with equal ease using nothing more complex than the basic oxy–acetylene rig. Given a torch that is big enough (or small enough), the skillful weldor can tackle thick structural shapes or fragile sheet metal with equal confidence. But for general automotive maintenance and restoration there are some tasks best done with the least amount of heat. For those welds you will want to use a modern Metal–Inert Gas rig.

MIG welding is a form of electric arc welding and at first glance appears totally alien to your gas welding experience. But once the arc is struck — and miggers maintain the arc automatically – – you find the 'feel' is the same; you're dealing with molten metal, just as you were with your gas rig. It's different — much faster — yet it's the same; you may successfully transfer the bulk of your gas–welding skills to MIG welding.

MIG welding equipment is too new for many rigs to appear in the want–ads. They show up now and then but anything not a total wreck is immediately snapped up. Your exposure to gas welding will have put you in contact with welding equipment suppliers. Here in the States, Hobart and Lincoln are two of the most common names but MIG equipment is also available from mail–order outfits such as Harbor Freight, Sears and J.C.Whitney.

The modern MIG welding machine uses an electronically switched power supply. It still contains a husky transformer but the electronic circuitry allows it to work happily from your normal household mains, unlike older arc–welding equipment that used brute force instead of solid–state wizardry.

Since MIG is a form of arc welding its proper name is Gas Metal Arc Welding, or GMAW. The key–word here is 'gas.' You can also use most miggers without inert gas (I don't recommend it), in which case you'll need to feed it a special (and expensive) flux– cored welding wire. This process is properly called Flux–cored Arc Welding or FCAW. I mention these tags because they are internationally recognized and many MIG machines are imported. If you read the fine print you may discover that what is advertised as a MIG machine is in fact limited to FCAW operation, lacking the control valve and other features that allow it to use inert gas shielding. This is the case with the inexpensive rigs offered by Harbor Freight and J. C. Whitney. In my shop I have gas, arc, TIG and MIG welding capability but for most work I use a little Hobart MIG welder, their Model 120. It cost about $600 a few years ago but has since come down in price. It weighs 30 kilos (67 pounds) and operates on 120 volts AC, drawing a maximum of about 20 amps. I've used it for welding steel from .035" up to half an inch, and for some aluminum work; it will repair a broken fin on a VW cylinder head but is a bit small for general head rebuilding (that is, performing deep, high–volume weldments in cast aluminum, such as repairing a crack between the valve seats; high–amperage TIG is the best choice there).

The little migger is a marvelously handy tool. We've thrown it in the back of the truck with a 1500 watt generator and bounced seventy miles into the boondocks to repair a ranch gate with no more effort than that spent loading the equipment. To do the same with arc or gas meant mounting a major expedition.

A mixture of carbon dioxide and argon works best when welding steel; a 53 cubic foot bottle of mixed–gas costs about $20 and provides several hours of welding time. I use straight argon for aluminum. I'm still working my way up to doing stainless steel with the migger. For different metals you will need different welding wire, which also comes in a variety of sizes. You will also need ready access to the various consumables, such as gas, torch–tips and the like. When you buy a Lincoln or Hobart rig you are buying–in to their reputation for dependable, long–term customer support. It's hard to quantify customer support in dollar terms but without it your equipment is virtually useless; paying a lesser price for an imported migger is often a case of penny–wise but pound–foolish.

Once you gain experience (either arc or mig) 'nodding' down your helmet the instant before you strike the arc becomes automatic. But until you acquire that skill you'll find yourself striking the arc over here when you meant to weld over there. A piece of equipment that every novice weldor should own is, alas too expensive for most of us. It is the so–called 'Clear View' welding helmet. It uses an electronic circuit to darken the viewing window when the arc is struck. This happens faster than your eye can react; you never see the flash. One instant you're looking at the work, the next you are seeing a comfortable view of the arc and the pool of molten metal. The Clear–View helmet is an elegant, albeit expensive, solution; it will make you a better weldor. (I'm still nodding my helmet down… and occasionally welding my ground–clamp to the vise.)

Sermonette

This information is intended to provide an over–view of what may be a new subject for many VW owners. Autobody work is the major expense of any restoration. Time spent learning to weld, and the cost of buying your own equipment, is often the only practical means for many of us to accomplish a restoration. But welding, like spray–painting, presents a host of hazards, many of which are potentially fatal. Mastery of these skills is extremely rewarding and I hope you will at least look into acquiring them. But please do so with thoughtful caution.

More Welding

If you work on enough bugs you'll encounter some Monday–morning Specials; bugs manufactured with misaligned body panels and the like. Tom Wilson's praise of "old–world craftsmanship" ('How to Rebuild Air–cooled Volkswagen Engines') and the often lyrical praises sung in Volkswagen's name are mostly myth. The VW was intended to be a cheap car, and except for its suspension, it was cheaply built. Underneath the seam–sealer you'll often find missing welds along with rust under the paint and other problems common to low–priced, mass–produced vehicles.

When we overhaul the engine we can retro–fit modern engineering to the VW's sixty–year old engine design by adding full–flow oil filtering, hydraulic valves and adequate cooling. In the same vein, when we do a body–off restoration we can do a lot to improve body strength and rust resistance.

Like most cars, the VW was assembled by spot–welding. Spot–welds serve as fasteners on the same order as rivets or bolts. Often times you'll see where the overlap of the body panels, necessary in spot–welding, produces wrinkles or creases. These are covered by seam–sealer — putty — and given a coat of paint. If you peel off the seam–sealer you'll often see daylight, and if you examine a lot of collision–damaged VW's, you'll see where the panels failed at the welded seam, many of the spot–welds having peeled apart without any tearing or distortion of the metal, the sign of a bad spot–weld.

As part of the body–off overhaul you can re–form poorly fitted edges, usually found where the luggage compartment floor plate (VW's terminology) joins the side panel. Using heat and hammers, you can generally improve on the existing fit, then edge–weld both surfaces after sandblasting the mating line. Instead of a stitchery of spot–welds — load concentration points and gaps that encourage rust — you'll end up with a continuous welded seam, maximum strength and a joint that will not rust.

The front and rear quarter–panels benefit the most from this treatment, followed by the body–attachment brackets.

Even with a row of spot–welds holding things in alignment, running a continuous weld will cause distortion. (Gas welding is not suitable in this case.) You have to work in small sections, sucking the heat out of the surrounding metal with copper blocks or a packing of wet rags. And your MIG welding skills must be above average. To achieve a flat bead you'll be using skinny wire (.028) and higher than normal amperage for this thickness of metal; it's easy to blow a hole in it. Don't grind the weld, except to get rid of the occasional 'lumpy.' You can smooth the weld with a wipe of Bondo or brushable seam–sealer, but if properly done the weld is handsome enough to finish and paint; it's an honorable scar, more attractive to my eye than the pock–marks left by spot–welding.

If you've already enjoyed the experience of replacing some of your bug's body panels you will have used the technique described above. If you hold a copy of Lindsay Porter's 'VW Beetle & Transporter…' restoration guide you will have seen photos defining the technique far more clearly than I've managed with words alone. The key point is the understanding that spot welding is a manufacturing expedient; whenever possible, a continuous seam weld is preferred.

Sermonette

In a perfect world auto bodies would be assembled using roller– seam welding, as is used on the VW fuel tank. Historically, such welds were restricted to flat seams but robotic all–position roller–seam welding machines have recently been developed. Hopefully, we'll one day see vehicles assembled using this technique. But until then, when dealing with our rust–prone antiques, the skillful use of MIG welding can provide you with the same benefits — a tighter, stronger Bug less prone to rust.

Bob Hoover's

Sermons