I have really had a good time in this trade. As a hobby or making a living, I have always had a good time. I am of the firm belief that just about anyone can do this stuff with the right instruction. It doesn't replace the years it takes to learn it, but you sure can do a certain procedure with just a little instruction. I saw the proof of this in some of the tech classes I have attended. I have seen women (some of the best students) walk in never having even held a paint gun and painting like a champ by the end of the course.

I have a particular affection for the home hobbiest just trying to do his car. If I can help him get more done this weekend I am happy. That time is SO hard to come by as we have to make a living every day. And the youngsters who are interested like Bull, man, that is so important. There is a big shortage in this trade for techs. Most of the kids of the last generation don't give a crap for cars or working on them. I try to encourage them so when I wreck my car after I have retired someone will be there to fix it. 

Anyway, it is fun to hear from guys who have been able to do things that they never thought they could, that is a kick. I am just glad there is the net so I can do it so easily.

"Basics of Basics" MIG welding

MIG Welding Basics

Let me start with safety, DO NOT SKIP, YOU NEED TO READ THIS. The UV rays that are produced at the weld can and will cause damage to your eyes you know that. But did you know that it WILL damage to your skin as well? I have gotten "sun burn" from welding. I have only "peeled" from regular sunburn a few times in my life (I have a dark Portuguese complexion) I have peeled from MIG welding more! This was a long time ago, I would never let that happen again. Wear a light long sleeve cotton shirt at the very least. You want jeans and high top boots on too. Wear welding gloves, go down to the local auto parts or hardware store and get yourself some nice SOFT gloves. Some are made so stiff that it is hard to work in them. I got some at ACE hardware that are dang near sensual ?. Get a good helmet, I have a Cherokee (http://www.accustrike.com/) that is only about $90.00. It is a hands free helmet that you open the shaded lens with your chin! I have had it for about 15 years without a problem. When open it gives you a full 4x5-inch or so CLEAR lens, unlike the "self darkening" helmets that are always shaded. You can flip up the lens and grind anytime you want. I want the full control of when to see through a shade or not. I highly recommend this helmet. Also, another thing that I have only begun using a year or so ago (I hate thinking about how long I didn't use it) a welding respirator. A 3M NOISH approved are available at ACE hardware for about $18.00. If you are welding with weld-thru or "E" coat primer you are making ZINC FUMES! And can get "zinc fume fever" VERY easily. Even when welding clean metal, you are still making fumes that are hazardous. Be sure the respirator fits under your helmet. The Cherokee helmet for instance doesn't have room for a cartridge mask so a single throwaway is all that will work. HEAR ME NOW BELIEVE ME LATER, PROTECT YOURSELF. Even if you don't care about the protection because you are such a bad-a$$, do it because you will produce a better weld. It is hard to lay a nice bead when you have a hot molten ball of steel in your shoe or pants. ?

I would like to start with this "disclaimer". These are tips in welding in the real world by real human beings that are not pro welders. A pro welding under controlled conditions would possibly disagree with some things here. That is fine if you get other input to better your skills, this is for basic understanding of MIG welding in the real world.

MIG welding is actually just a "controlled short". It is a short just like if you touch your two battery cables together on your car and it sparks.

The MIG does the same thing, you just are in control of it. You are melting the metal with heat created by this "short".

Basic principles of MIG welding are this: You have VOLTAGE, the pressure that pushes electrons through a circuit. Then CURRENT, (same as amperage) the amount of electrons being pushed. And RESISTANCE this restricts electrons from flowing. The gas (Argon, CO2, or a mixture of both 75-25% is most common) is blowing away the impurities in the air around and on the surface of the weld. If there is a breeze you may need to up the pressure from the recommended 25-30 cubic feet per minute or 3-4 PSI.

What the heck does this mean?

The arc that is formed when the wire comes out of the gun and hits the metal is your "CIRCUIT" (or current path), The welder has to have enough voltage to keep the current flowing. You control these variables with the "heat" switch (VOLTAGE) the wire speed knob (CURRENT) and the "stick-out" and or "arc length" (RESISTANCE).

The MIG welder has to be "tuned" just like a spray gun or your carburetor on you car. That perfect balance between too hot a weld (blowing holes) and too cold a weld (not enough penetration) is where you want to be. Fortunately this balance is pretty wide for at least "normal" welding on your car.

"Hot" or "Cold" weld. I will refer to welds in this way to describe them. Extreme "Hot" would be heavy melting, puddling, burning holes. Extreme "Cold" or "Cool" would be not enough melting thus not enough penetration.

To find this balance, get a piece of scrape metal that is the same thickness as the metal you will be welding (or very close to it). Clamp your ground clamp to it and lay a bead on it. Start the bead with the MIG set at the recommended settings on your welder. You don't have to lay a bead to be proud of here, just weld. If you have someone to help this can be a big help, but if you don't go it alone, you'll need to learn to do it someday anyway. While you are laying a bead have your partner turn the wire speed (CURRENT) up and or down till you hear that perfect ZGHZGHZGHZGHZGHZGHZ and you will see in the bead that it is perfect. The weld will be laying out relatively flat with no "undercut" (at the edge of the weld there isn't a low spot where the weld has burned away the metal and not replaced it with melted wire).

If your wire speed it too slow there will be gaps in sound then pops. Watch the weld and see if the weld is "crawling" up the wire, that is a dead give away speed is too slow. If it is too fast, it have faster pops as the wire is burning away and quickly hitting the metal arcing again. These sounds can be very subtle so it may take a while to learn the sound, have patience.

Now if you have to do this alone, just hold the gun one of your hands and have the other on the wire control, it is very awkward at first but you will be able to do it well in no time.

I have to clear up an "old husbands tale" about the sound of the weld. I have heard and read many times that your weld should sound like "bacon frying". Let me tell you right now, if your welds sound like bacon frying, you are laying some crappy welds! It should sound more like an electric buzzer "ZGHZGHZGHZGHZGHZGHZGZHZGH". If it sounds like bacon frying "ZGHZZ-POP-ZHZGHZ-POP-CRACKLE-ZHZGZ" You are doing something wrong.

So, what does this technical stuff about voltage and current have to do with learning to weld? Well if you understand WHAT is happening, it is easier to MAKE happen what you want.

If you are welding a little too "hot" and are blowing holes, you could adjust this simply by creating more RESISTANCE by lengthening the "stick-out" or distance that you are holding the tip of the gun from the surface being welded. So as you weld a bead, if you see the weld puddling too much and fear that it may blow through, you can back the tip off the metal a little and create more resistance. If you are welding thin metal you can start with a longer stick-out and produce a "cooler" weld also. Now, this has to be done with caution because if you rise up too much, the gas does not shield the weld leaving the weld porous.

The direction of travel and speed WILL also effect the "heat" of the weld. If you use the "drag" technique with the gun dragging away from the weld, it will be "cooler". If you are using the "push" technique with the gun pushing into the weld it will produce a "hotter" weld. So, if you were to start on the left side of a seam and with the gun leaning to the right at 45 degrees welding from left to right, this would be "dragging". If you were to start on the right side of the seam with the gun leaning to the right as before and welding left, to the left side of the panel, that would be "pushing" the weld. I find that when welding sheet metal if there is a burning through problem, changing to the pull

technique will do the job most of the time.

Of course speed is obvious, the slower you go the hotter and flatter the weld. The faster you go the taller and cooler the weld. All of these techniques can be used with one and other through out even one seam (though you wouldn't likely change from push to pull or vice-versa) to control the weld. Ideally you would have the weld set up and cleaned so you wouldn't have to do this, but realistically you do have to change gun distance speed as you weld.

The first BIG tip I can give is to have a nice pair of angle wire cutters beside you at all times. You will want to cut the wire off at the proper length EVERY time you start a weld. This does two things, first of all it gives you the "stick-out" that you want every time. Second, it will give you a sharp tip to "pierce" the metal or weld-thru primer. Third, that little ball of metal on the end of your wire, it is oxidation! That is right, if you leave it there, you are pushing RUST into your nice new weld! I learned this tip from a certified pro welder (underwater even) and it totally changed the way I weld.

The second BIG tip is to have everything CLEAN and set up TIGHT for the weld. Like with painting, the preparation is KEY. Even the slightest grease, tar, paint, rust, etc. can cause BIG problems. As a rule the smaller lower the voltage your welder, the more critical this is. Clamp the pieces TIGHT, and keep the metal clean at least one inch from the weld with two or three inches preferably.

So lets weld a "lap" weld where a piece of sheet metal is laying over another and you will be welding the top piece to the one laying under it. I find that a pull technique with the gun at a 45 degree angle and pointing right straight at the seam the most effective. But the thing is, the upper sheet will burn MUCH easier than the bottom. The edge of that sheet has much less of a "heat sink" effect than bottom sheet. Sort of like starting to burn that log in your fireplace, if you start on the edge where it is thin it will start burning MUCH easier than if you started right in the middle right? Well, when you are welding this lap weld you want to start the weld on the bottom piece and even concentrate the weld on the bottom.
This may sound funny but if you get a piece of paper and fold it so you have a "lap" seam you can see what I am going to tell you. Hold this seam flat with a few pieces of tape but leave it exposed so you can "weld" it with some white glue. Lay a bead of glue on the bottom paper right next to the edge of the upper paper just as I described above. When you get real close to the upper paper edge you will see

the glue sort of "grab" on to the edge. You don't even have to move the bead all they way over to it, if you are very close and you just barely hit it with the glue, it will "hang on" to it. Continuing the bead down the edge with most of it laying on the bottom sheet, the edge of the bead will "grab" the edge of the paper, without any effort on your part.

Your weld bead will do the same thing. When you are concentrating on the bottom, harder to melt metal just move the bead over to touch the edge of the top metal and it will "grab on" to it. You can run the bead with most of the heat being directed on the bottom and just "grabbing" the top without blowing it away.

This goes for plug welding too. The size of the hole depends of a few factors, usually 5/16" is the norm. But sometimes you could go down to 3/16" or up to 3/8" depending on the thickness of the metal or how important the strength of the weld is. That sounds funny but if you are welding in a "backing" for a butt weld for instance, it is only being plug welded to hold it there till you lay the bead into it while welding the two adjacent pieces together. As before with lap welding you want to direct the weld into the "bottom" of the hole to hit the bottom piece of metal first, then melting it into the surrounding metal just like the lap weld. If you have perfectly prepared plug welds, you should easily be able to fill the hole with weld leaving the top almost flat. If you are ending up with a large hump, you need to raise your voltage, or wire speed to weld "hotter". Weld a number of tests before going on to your car. Weld as hot as you can without burning through and look under the panel to see your penetration If the weld is coming through the bottom producing a hump under it, the weld is too "hot". Either speed up, lengthen the arc or stick-out or lower voltage.

Hope this helps you produce better welds.

Expanded "Basics of Basics" Inverted welding

Inverted welding basics

Did I say welding UPSIDE DOWN? Boy I'll bet that got your attention. Really, these tips are for all welding done with the MIG. In fact, there really is no difference in welding upside down or laying flat, it is all in the mind where the difficulties come from. I have to say that I use to cringe when I saw that I had an inverted weld to do. Then all that changed I took the ICAR (a nation wide organization for standardizing repairs) welding test. It included two each of a plug weld (where you weld through a hole to the sheet below) and a "bead" weld. Both had to be done in a horizontal, vertical and inverted. That inverted was the only one I was worried about. Well I knew I would have to practice a LOT. The funny thing is I found the answer not so much in practice, but in studying HOW a MIG works (this can be found in my "Basics" of MIG welding) and I found out how important clean metal was. Don't get me wrong, the practice did it for me, however the understanding of how the MIG worked helped me more than anything. I had a basic idea how the thing worked, I mean come on, it is a direct short where a wire coming out of the gun melts into the metal because of resistance. I studied the science as well as the art of welding, so I really got a grasp on what exactly the wire speed did and what exactly the voltage did. For the first time I understood what was happening when that wire hit the metal. On the first official practice, I set up the work area just like it would be at the test site. I took sheet metal "coupons" about the size of a playing card, punched holes in a few for plug welds and started welding. The thing I noticed right off was that it really wasn't that hard, why? I was welding really nice welds including the inverted. These welds were much nicer than I do at work. It hit me that the reason was, I was sitting properly and the metal was clean. That was it, that was the magic. By the time I practiced a few hours and took the test I was welding like I never had before. I now prepare cars the same way I did those coupons, SPOTLESSLY clean. Now I weld the same way on my repairs.

The thing is, there is a point where you can simply pull the trigger and you will weld. No burning holes (to speak of) no dripping molten metal, no popping and flying fireballs, you just weld. I have gotten so that I can weld "blind" with only the "buzz" as a guide. I trigger the gun with my thumb, index finger, left hand right hand, it really has changed things with me.

Without the thorough understanding of how the MIG works one can

not properly "tune" it. Creating the balance between voltage and wire speed is the key. With the proper balance, you literally point the wire where you want it and pull the trigger. It WILL weld perfectly (providing the metal is clean). With the proper balance you can hold the gun up against the metal without even moving it at all, pull the trigger and just...hold it welding away. The wire will feed into the molten metal at just the correct rate. The weld will not blow through because the wire melting into it will "keep up" with the rate of the melting and cooling (solidifying) metal.

However, the first thing is GET THE METAL CLEAN and the pieces fitting tight. Nothing but nothing will aid more in welding inverted than clean metal and a tight fit. Of course it should be no cleaner than all your other weld areas, but if you are going to need it, its' here. When I say clean, I mean bare metal. Not even traces of paint or primer should remain. This includes the BACK of the metal that you will be welding. That's right, the back of the metal. Remember, the metal is going to be melting when you weld, right? Well, when the metal melts as it is welded it will bring into the molten area the impurities from the other side of the metal. THIS CLEANING IS VERY IMPORTANT. Don't use a grinder to strip the metal. It takes off too much metal. Use something like a 3M "Roloc" disc (#07485) or a "Clean and strip" disc (#07466) In hard to reach areas I do use a cut off wheel or carbide bit. But this is a last resort and only used because there is no other way. Just don't cut too much metal off. On a long "pinch weld" for instance, you should have the entire length BARE METAL (with only weld thru if it is going to he between two sheets). Not just where you will be welding, but the whole area where metal will mate. I say this because if you start "cheating" and only striping right were you are welding, you will soon get into a situation where you are welding up to that dirty metal and WHAM you have a contamination problem. So, if you clean it ALL you will never have a problem.
Yes there are some times when you leave primer there, but only when you KNOW what it is. What I am referring here is "weld thru" primer. This could be an existing primer found on the new parts you bought in the form of an "E" coat. Or one that is specifically made for this purpose. "Weld thru" primers come in aerosol cans (3M # 05913) and brush on. They are made by a number of manufactures. They should be lightly applied over the metal after it has been THOROUGHLY cleaned as described previously. Put a light coat, some are even transparent so don't think it has to cover like regular primer you would paint over. It is simply a zinc coating similar to galvanizing. So look at it like an at home galvanizing job. Look at a piece of galvanized metal like chain link fence, you can see right through the coating to the

metal. It should be totally dried by the time you weld. If it has any unflashed solvent it will burn and your welding will be negatively effected.
The "E" coat primer (the "E" stands for "electrically" applied and obviously NOT something you would do at home) is also zinc rich and is a "weld through" primer. When I install new parts, I don't remove ANY of this primer. I punch holes through it for plug welding. I weld to it, through it, whatever. It is a perfect weld thru primer. And please, when welding the weld thru primers wear a welding respirator (3M #07187). They are zinc rich remember and the fumes are VERY harmful. The factory "E" coat may be in black, gray, green, and other colors. To be sure you have a real "E" coat rub it with a lacquer thinner soaked rag. If it comes off, it is NOT an "E" coat. If it does rub off on the rag, strip it like you would any paint or primer around a welded area and coat it with "weld thru" primer.
Weld thru primer does not have good adhesion properties (E coat has excellent adhesion properties). It is only to be used where metal will be over lapping and hidden. All other areas just leave bare metal until after welding and then treat them the same as you would any bare metal on your car. By the way, after welding the "ROLOC" or "Clean and strip" discs also work very well in cleaning the welded areas of discoloration and any welding residue. This is very important, that welding residue is a poor substrate for your undercoats. The "ROLOC" discs will actually cut metal, so you can use them to "grind" down any slightly high weld too. They work nice and leave a gentle, rounded surface. If you have a particularly large amount of metal to grind, go ahead and do so with a grinder and then before you get close to the base metal change to a ROLOC and finish it off. They really leave a nice look.

DON'T use a liquid "metal conditioner" on these welded areas, use an etch primer and or epoxy instead. The liquid "metal conditioner" is not recommended by any auto body or welding organizations because it can get trapped in between the layers of metal. This however is a whole different topic, I just wanted to mention it.

Okay, you have nice clean metal to weld, now be sure it is fit tight. The metal should be laying nice and flat on the lower piece. If it is not, you have to make it fit. This can be done with clamping and or tapping on the edges and reforming them with your hammers or other tools. Sometimes this is a problem because the metal springs back up after you have struck it down (or up in the case of inverted welds). If this is the case one way you can do it is to put a little tack weld and then tap on the surrounding area. The fact that it is tacked will hold the metal

where you want it. It will then bend instead of bouncing back. After you have the metal laying nice and tight and clean, you can then put all your thoughts in welding. Instead of fighting contamination or poor gaps, you can just simply weld. That is one step in getting nice welds and being able to do those elusive inverted ones.

I have to reiterate (from "basics of MIG welding) trimming off the wire to the proper length before every weld, I mean every weld. I just today finished up the insulation of a rocker panel on a full size van. There was about 50 inverted welds. I paid particular attention to the wire cutting trick. I just went about my welding, sometimes trimming the wire, sometimes not. There was a very noticeable difference when the wire was cut or not. The cut wire provided a faster initial arc, every time. It didn't matter whether it was on bare metal, weld thru primer I had applied or the "E" coat. This is very important, you want the arc to start as soon as possible. Especially on a plug weld (where you are welding through a hole, usually 5/16"), you need that arc to start so you get good penetration. If you hit the metal with the wire and it doesn't arc fast enough you will then pile up weld in the hole before the weld can heat up and melt into the base metal. This of course can happen with any weld that is small. If you are laying a six inch long bead, it is not so critical. However, if your weld is like a plug weld or a short tack and you don't get that initial arc to start melting the metal. This is very important if you are doing a series of welds down a seam for instance. You may be welding little half-inch welds to keep the heat (warpage) down. Well, if you don't get a good, fast arc you may not have very good welds. They may look decent but there will actually be only melted wire sitting on top of the metal. Their penetration may not be sufficient and you can't tell because the weld is laying on top of the metal. You may grind it down flat and never see that the seam is still there.

Okay, we have established that you should weld to get a fast arc. One way to help is with more voltage. If you hit that metal with a hot sharp wire, it will start welding right NOW. One of the reasons inverted welding can be a bare is if you are popping and cracking and not getting the darn weld going. Plus if it is hot and fast you get the weld done, and get out of there. This means less time to get "extra" molten metal falling on your chest. The hot, fast weld also lays flatter. If you are welding hot and fast, the wire is running into the molten metal instead of laying on top ready to fall because you have poor penetration.

Always set the welders voltage and wire speed at the setting for the

thickest metal you are welding. In other words, if you are welding a 22 gauge piece of metal to an 18 gauge piece you would set the welder up to weld the thicker 18 gauge. As pointed out in the first "Basics of Basics- MIG welding" you want to direct the weld on the thicker metal when you are welding too different thickness. You start the weld on the thicker piece and then when you have a good arc started and the weld is molten on the thicker piece you move the weld over to "grab" the thinner metal. This is particularly important when you are making a small weld like a "plug" weld. If you are plug welding a 22 gauge metal to an 18 gauge (a hole is drilled or punched in the 22 gauge and you are welding through it) you REALLY need to get that weld started hot and fast. You need to start the weld right in the middle of the hole on the underlying 18 gauge and get a good arc. Once you are melting that 18 gauge you simply move the weld over to the edge of the hole and it will grab the 22 gauge and you can weld a nice flat weld.

Now, If you are butt welding tow different thickness of metals you need to target the thicker one for the first arc. However if you are lap welding two different thickness metals you may still want to strike the first arc on the underlying "base" metal even though it is the thinner of the two. The reason being striking the arc on the center of the thin metal STILL may take more time to get the established than the edge of the thicker one. That is an example of how much harder it is to establish the arc on the center of metal as opposed to the edge. The edge will start melting long before the center will.

Note: I refer to the "base" metal as the metal that is usually under another piece. I am not sure if this would be a common term, it just makes sense to me to call it this. If for instance you were welding a patch over the floor in your car. The old floor that the patch was laying on would be the "base". While the patch would be the "overlaying" metal in my descriptions. The "base" is metal that you are NOT welding at the edge. I needed to make some way of describing the metal that is NOT being welded on the edge and came up with the "base" as a name.

Whenever you are welding a lap weld you have to use the same procedure. The plug weld would be a lap weld. You are welding on the flat of a piece of metal up to the edge of another piece. The edge is going to melt much faster than a weld you are starting in the center of a piece right? Well, you have to get that arc started hot and fast on the "base" piece and then move over to the edge of the other piece. If you start right at the edge where you "really" want the weld to be you will likely burn the edge and blow it away before the bottom "base"

metal ever gets molten.

If after you hit the trigger and the arc is established you start to blow a hole or the surrounding metal starts to melt too fast, let off the trigger. Then, just as the metal starts to cool and solidify hit the trigger again. This is sometimes called "popping", you "pop" with the trigger over and over as you fill a hole. The molten steel solidifies in the second that the trigger is off and then you hit the trigger again and it arcs real fast because the metal is so hot. But it has cooled and solidified enough that it forms a stable base to continue
the weld.

Learn to work with gravity.

I am sure you have learned that molten metal will run down. It will not run up or sideways, so you are one up on it already. If you know where it the molten metal "wants" to go, use it to your advantage. It is like using a long wrench over a short one, you can take advantage of the science of leverage or you can fight it, it is up to you. When welding a vertical weld you start at the top and go down. This way you keep the weld arc ahead of the molten metal. The molten metal will start to solidify staying in place behind the weld arc as you go. If you were to start at the bottom and go up, the molten metal would hang off the bottom of the weld arc. It will at the very least make for an ugly, lumpy weld, or at the worse cause the molten metal to fall right off the weld arc. You can "fool" gravity and go up that vertical weld however you will find that you will work with the gravity most of the time.
This fact that molten metal will want to flow down is the reason you need your arc to start hot and fast. You need to "push" the molten metal into the weld when you are welding inverted. The arc has to be established fast on the base metal with the MIG tuned well. At that point you have the luxury of making a nice molten puddle that will not fall. Only then do you move "it" over to the edge of the overlying metal. This will produce proper penetration, which of course is the main objective. The weld needs to be well established in the base metal first, then only a little on the edge of the overlying metal is needed.
The rule on penetration is you need the weld to melt into twice the thickness of the metal. So if you were butt welding to .035 thick pieces of metal by this rule if you melted into each piece .070 you would have proper penetration. It makes sense doesn't it, it does no good to pile on weld when the metal is only .035 thick anyway. If you had a piece of metal that was not cut, it is doing its job at .035 thick, you do not

need to pile on a weld to make it strong. All you need is that .070 penetration and you will at the very least have it as strong as if there was no weld at all right? If it were perfectly flat and only had that .070 penetration it would be at the very least as strong as with no seam or weld at all. The thing is, you must get the penetration. Without the penetration a pile a inch high of weld is NOT going to hold the two together.
Starting the weld hot and fast is going to provide you with the needed penetration on the base metal. Once you have that going all you need is that little on the edge of the overlying metal and you are done. You don't need to pile on a bunch of weld. This weld I am describing is a very flat weld. You want to melt your metal together not make a pile of melted wire. If a pile of weld is started, it will only grow and fall. If you are welding inverted and the weld is not flat and melting INTO the metal, I guaranty you will have a pile of weld. Many times that pile of weld will drop off onto your chest, YEOW!

Should a weld start piling up, STOP. You can not save it. If the base doesn't have good penetration it NEVER will. The piling on of weld is not going to do a darn thing about your penetration. As my dad would say "The boat has left for Rangoon". You see, you can use the gravity to your favor but that is another "basics". What is happening when the weld piles up is it is forming a "barrier" to the metal under it. That weld is solidifying as it cools. You can pile on all the weld you want, the metal under it is NOT going to melt. I don't have how red, how molten that pile is, the weld underneath has cooled too much.

If your welds need a lot of grinding, you are piling on too much weld and possibly they are lacking in penetration.

I can tell you right now, there is not a bit of difference in a horizontal, vertical, or inverted weld. The only difference happens between your ears.

Good luck and weld safely.

"Basics of Basics" Templates for accurate cutting and drilling.

Making templates is something that a lot of guys have a hard time doing. It is not that it is hard to do, it's that we hate to "waste" time. Let me tell you right now, making templates SAVES time. You can quickly make them while installing emblems, patch panels, quarters, roofs, floors, and more. Anywhere you would splice, drill holes, or even painting graphics or stripes. With a template you can copy dimensions off the old part, the new part, or even another car you have access to. You can then these to the car you are working on.
The need for a template comes into play when you are working with an odd shaped part in particular. Is easy to mark something like a 1/2 pipe. You just measure the length with your tape or ruler, mark it and cut it. It is not that easy to measure and mark something like a roof post or fender.
I may have over simplified the process a little in my drawings but it really is this easy.

Now, this is not a "Basics" on quarter panel or roof replacement. You wouldn't necessarily splice a quarter or roof this way, though you could, this is just not that "Basics".

Figures A and D are the starting points on cutting off and replacing this roof or for that matter the quarter. You'll need to find a place to cut it, then transfer this information to the new part. You could of course make the template off the new part and then transfer the information to the your car. By doing this you will cut off the old part and be able to set the new part right up on the car and it should fit perfect or near perfect.

These drawings show two different ways to use and make templates in body repair. There are other says, these are just two and of course this roof post is just one of the many, many places you can use a template.

Figures A, B, and C show using a thin paper template over the pillar. Figures D, E, and F show using a cardboard or poster board to make a template along the edge of the pillar. I use the paper method about 90% of the time. The cardboard or poster board technique is good for things like locating a heavy angular item like a frame cross-member.

I have found that 3M welding shield paper (part number 05916) works well for the templates. It is flexible yet stiff enough. And the best part is it has a mild adhesive on the back to hold the template in place

while making it and while transferring the information to the other part. The glue is sort of like a "Sticky note" and the template is easily removed and reapplied without tearing the paper or leaving any glue behind, it really works well.
You want to apply whatever paper you use like a sheet of contact paper. You want it to "hug" the lines on the metal like a sticker would, with out air bubbles even. An air bubble wouldn't make a bit of difference, but just so you have a good idea of that I mean, it should fit like a tight glove over the part. The closer it is to the actual shape of the part the closer it will be to the OTHER part where you will be putting it to transfer your information.
Now, I know what you are thinking. The paper will change shape as you pull it up off the first part right? Yes it will, but if you have press it down tight and marked it with your "control points" it can easily be removed and reapplied to the other part perfectly straight.
"Control points" (numbers 1 thru 9 in the drawings) are points of reference that can be found in exactly the same place on both the new and old parts. These control points can be mounting holes, sharp folds, sharp edges, some panels even have notches that line up parts for assembly. If you make your template using these control points, then transfer your template using them to the other part, you can be assured it will be perfectly aligned. You now transfer the cut lines, holes or what ever to the other part.
One very important thing about these control points is you have to be sure they are EXACTLY the same from one part to the other. You can do this with a measuring tape and/or another template. As an example look at the B or C drawing. If you were to measure or make a template that included number 4, 8, and 9 then you could go to the other part and ensure they were the same. Now, you could with confidence use the number 4 as I did in the drawing. You need to REALLY be sure they are the same from on part to another because if you use something that is not the same from one to the other, you template will mean nothing. The control points number 1, 2 and three are a little different in that it really doesn't matter if they are off a little tiny bit from one part to the other because you KNOW they are at least close enough to work, I mean they did, right? You are not always going to use some thing like numbers 1, 2 or 3. In fact, you hardly will. Most control points will be like the others in the drawings.

In the figures E and F you will see that the cardboard or poster board is held behind the panels and then you just run your pen or pencil along the edge to mark it. You can cut the template as I did in the drawing E. Or you could just mark it and then hold the template next to the other part and line up the marks as you made them on the first

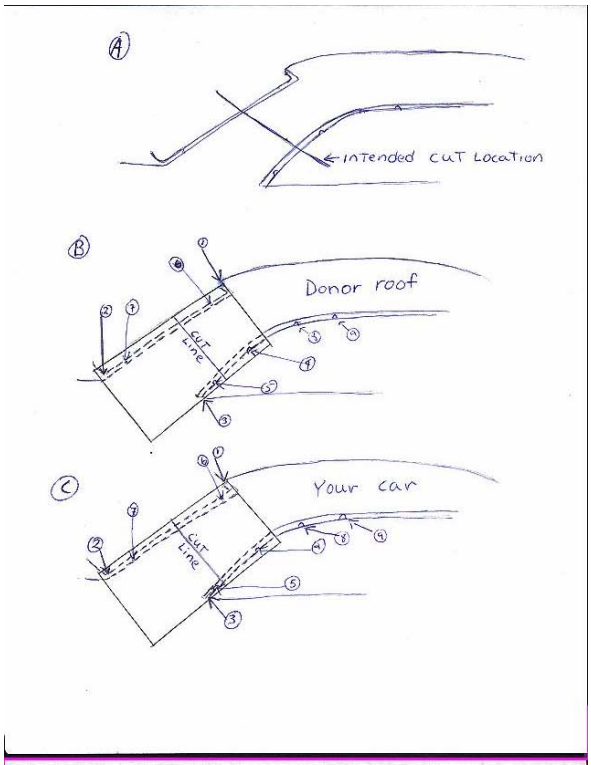
part. Then you could make a little mark on the part where the cut line will be and then draw a line across the part to meet the other mark. By the way if you are going to use anything like masking tape to mark for cuts, be sure to mark the side of the tape you will be cutting on with arrows or something. If you think that I have never cut on the wrong side, you would be wrong. I started marking the tape long ago, it doesn't take me too many times cutting on the wrong side to learn that trick.

Just today I used the A, B, C method. I spliced a new quarter onto a VW Jetta. This template was for the rocker area. The old quarter was very badly damaged right at the front of the wheel well. And the new quarter was cut off right in the middle of the rear door jab in the rocker (on most late model cars the rocker, front hinge pillar, center hinge pillar on a four door, roof rail, and quarter are all on piece). I forgot to make a template before cutting the new quarter off the rest of the part. So now I had the back half of the rocker connected to the "dog leg" on the new quarter. And the same area on the old quarter was destroyed . This left me with a little harder template to make. I found that there as a holes along the bottom of the rocker that were the same on both parts. There was also a little notch on the top of the rocker where the door rubber went on. So that is all I needed. I laid the 3M welding shield paper over the new part so it hung off the end of the front where I had cut it off and it was hanging off the top and the bottom of the rocker right where it spot welds to the inner rocker. As I said, it was pressed down into the body lines TIGHT. I even pressed the paper as it runs down the edge of the metal almost cutting the paper. I pressed it down into the holes on the bottom and into the notches real good. Then I took a razor blade and cut off the excess paper on the top, bottom, and end. The other end of the paper ended right at the dog leg. The length at that point really doesn't matter, as long as it includes a control point. Like in figure B, the paper above the number 1 control point and below the number 2 control point is doing nothing, so it could be a foot longer or an inch longer it really doesn't matter. Mine ended right in front of the lower hole in the rocker and upper notch. I then carefully peeled it off the new part and stuck it onto the car lining up those control points. I pressed it down into the body lines just as it was on the new panel. The cut line was marked on the out side of the end of the template where I had cut the excess paper off when it was on the new quarter. This would ensure that the cut would be EXACTLY in the same place as the cut on the new quarter had. I removed the template, cut the rocker on the cut line, drilled out all the remaining spot welds and removed the rocker and quarter. I then trial fit the quarter and rocker and the rocker cut lined up perfect,

providing me with a perfect door gap even. It really is that simple! The top of the roof post on this particular car was installed as it was from the factory with only a little splice in the jamb area. For that "template" I actually used a little piece I cut off the old quarter to mark the cut line on the new quarter, worked great.

Now the nagging on getting as much education as you can. I used these methods every once and a while. Then after almost 25 years in the business I went to an ICAR class (a nationally known training and testing group for auto body professional) and they drilled templates into us as being the RIGHT way to do it. I went back to work and started using them all the time. They really do save time, it is amazing how much time they save. No cutting and grinding, trial fitting over and over. I also find that template work great for reinstalling glue on emblems and mouldings. Most cars these days have glue on emblems, no holes, just stick them on. So what I do is as I am taking them off, I run a strip of tape under them right along a body line. Then off the edge of the panel (this is usually on the deck lid where you find these glue on emblems) and mark it on the edge and on the tape where the emblem is located away from the edge of the lid with a "Sharpie" pen. I even write the word that is on the emblem and maybe a note if needed about location, left right, that sort of thing. I then peel this tape off the lid and stick it to the inside of the window on that side of the car. When the car is all done painting and back in my stall for re-assembly all I do is peel the tape off the inside of the rear window, stick it on the car where it was before and install the new emblems.

You could use them to record how high the fender sat compared to the rad support. You could record where the bumpers sit in relation to the body, the uses are endless. If you are pulling a car apart for a restoration, you know it will be apart for a LONG time. If you think for one minute that you will remember these little details you're wrong. Make templates, mark them and store them. You will be very glad you did.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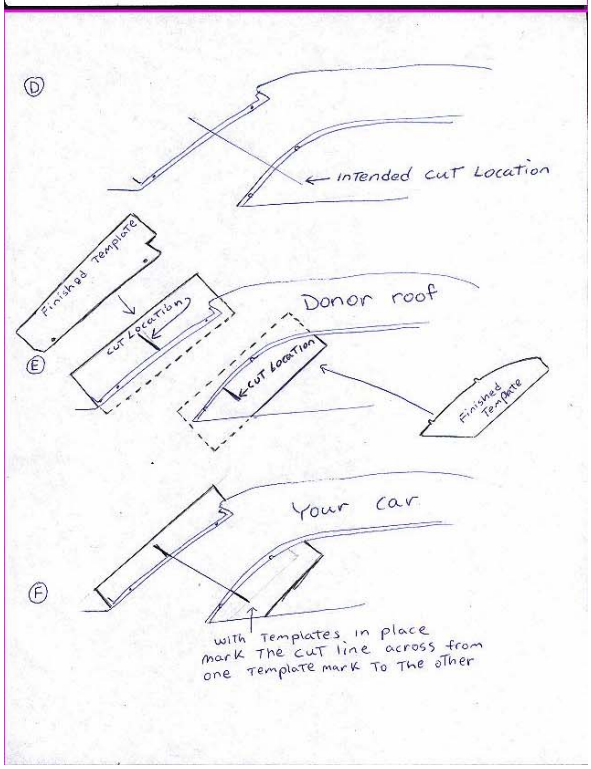
D
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CUT Location
Finished Template
Your car
F
with Templates in place
mark the cut line across from
one Template mark to the other

"Basics of Basics" Plastic Filler aka Bondo

What ever tools you use the trick is to not add the last "skim coat' till you KNOW that it is all you need. Don't try to block out that first coat, just use it as a base for the LAST skim coat.

I was taught this procedure after doing bodywork for a number of years and it really works well:

Just apply a nice coat of filler (what ever brand, whatever style, we will put that aside right now). Cut that coat NOT to make it perfect, but to get the basic shape and filling you need as a base for the skim coat. You can cut it with 36 40 or 80 depending on how big the area you are working is. In other words, if you can cut it fast with only 80 then do it. But I would say that this would be limited to an application that is no larger than about 8 inches.

If you happen to have a few high spots, see if you can tap them down. If you have a few low spots add a bit more filler to ONLY those spots.

Re-cut these last low spots you have just filled with the same grit you have been using (most likely 36).

If you now have a surface that ONE skim coat will fill, then apply it. If you don't work with it a bit more, but NEVER add a little here or there and think you will finish it without a skim coat.

If you have a surface that is very close with only a few VERY MINOR low spots like poor feathering onto the metal, poor transitions from one application of filler to another, or from the metal that is "poking" up here and there you can do the LAST skim coat.

This skim coat is very important, you want it to extend over the COMPLETE area, this is well past the damage you have been working. Maybe as much as 3 inches past the plastic that you have applied to "rough" it out.

This skim coat can be regular filler or a polyester glaze like "Icing" or "Polyester glazing putty", that is your choice, I use both depending on the size of the area being worked. Do not use anything that doesn't mix with a hardener. NO, "Spot putty" in a tube, only polyester putties or fillers. If it uses a hardener, it cures to a hard film. The "spot putties" stay soft and can become even softer when the solvent from the primer coats it.

You now run a block, long board, or hog even over this skim coat with a little bit coarser paper than you plan on finishing with to cut off the resin that has surfaced in the filler. I usually just use the 36 or 40 or whatever I have been on the "rough" work. BUT take CAUTION not to cut much off, you want to JUST take the very top, don't really sand AT ALL.

Now finish sanding with your longboard or block or hog or whatever using the finer paper like 80 on a large area or 120 on that small 8" sized area. Block it out to perfection with a nice feather edge to the surrounding metal.

I can't stress enough, the trick is to know when just ONE LAST skim coat will do the job. And apply it COMPLETELY over the surface. If you only one little low spot in the middle, DON'T just do it, skim the ENTIRE thing. You HAVE to have one LAST skim coat over the ENTIRE thing every time. If you get in the habit of this you will do it over and over on every dent you repair and find that you can do just about any dent with just
two applications.

As you sand the filler let the board or block you are using run over the surrounding metal. If you only work on the filler you will sand it too low. You need to keep it as high as the surrounding metal, so use the metal as sort of a straight edge that you run the block or board off of.

Don't worry if you cut through this skim coat here and there. In fact, you WILL most likely cut through. The point of that "LAST SKIM COAT" is that after you add it, you don't add ANY MORE filler. That "LAST SKIM COAT" is just that the LAST filler you add. If you hit a little filler below, or metal, that is normal and fine. The only thing you are looking for at that point is if the panel is FLAT. The filler skim coat is serving no other purpose than to finish you filler work, it is not a "sealer" or anything like that.

You can add fiberglass resin ("A" coat if you have a choice) adding the resin was exactly how I learned from the great Emery Robinson (my personal hero in the auto body world). But remember there was no products like polyester putties back then. When you add resin, that resin comes to the top of the film of filler. It is then something you have to deal with. The whole purpose of the SKIM COAT is to put a layer of filler over the top that is easy to block out with as little effort as possible. You want to be able to concentrate on making the panel

FLAT not fighting with gummy resin, sand scratches and the like.

So the polyester putty though expensive is what I use.

How is this for an idea, a co-worker of mine showed me this very obvious tip.

Add pour-able polyester putty to the regular filler! What an idea! LOL A little pour-able squirted into the "bondo" really thins it out nicely.

The "LAST SKIM COAT" should be left to cure a good long time. Where you may jump on filler and sand it as soon as it is hard, the skim coat should be GOOD AND CURED for an hour or more. If you can of course, in the production shop you may not be able to wait that long. The benefits of the procedure will not be diminished.

A little added note, I have found that I don't use 36 or 40 grit at all anymore. I went to work at a shop that didn't use the coarser grits so I had to learn not to also. I have found that using just the 80 and then finishing the Skim coat in 120 or 180 works great, even on large panels.

At this shop it was the first time that I wasn't doing my own primer work. This meant that I couldn't "cheat" with a lot of primer and blocking the body work "one more time". I found that I had to get the work PERFECT, then give it to the painter. I did this in an interesting way, I look at the last skim coat as even a more "final" step. I now look it as "primer". You see I have used polyester primer, which is like spraying "bondo". They are both polyester resin based and act and sand very much the same. So, I figured why not just "spread out my primer" as the skim coat! It has worked GREAT, the painter jokingly says, "do you think I'll need to prime this or just paint it?" I tell him, "Just clear it, it's a shame to hide that work under primer".

This method has worked great for me, it's more of a state of mind than a procedure.

And don't be afraid to buy the best sand paper and use a lot of it, the cost of the paper will be nothing next to the time and muscles saved. Find the paint store in town that services the PROS the Body shops in town, that is were you will get the right stuff and the right info.

Flat panel basics.

When you have a large flat panel that is flexing the first thing you need to do is find out why. Sometimes you can stop it, other times you can't. But if you can stop it, you'll have a much easier time with the body filler work. Hoods, decklids, and the roof are particularly difficult because the heat and weight of the plastic filler can have an effect on the metal. The good news is many times it is very easy to repair.

First off, there is no such thing as a "flat" panel. All panels that appear flat actually have a slight crown or gentle bow up in the middle. Go to a flat panel and lay a straight edge across it. You will see that the straight edge in not touching the panel at the on the outer ends. If the panel were perfectly flat it would appear to the eye to be concave. It would also have no "body" and flex very easily. This is the problem with your large flexing panel; it has "lost" its crown and is now weak and flexible.

The first place to start your search for a culprit is under the panel. Many panels have inner structure that supports the outer skin. When the outer panel has been damaged the inner structure was bent down along with the outer. This inner structure can be in the form of just a simple inch or so wide support running across the panel to the complete support by a stamped panel that goes covers the underside of the panel. These full inner structures can commonly be found on hoods and decklids. The inner structure can sometimes be bent down, causing your flexing. It usually is very close to the outer skin, with just a thin layer of a foam or urethane adhesive. It may have small "dollops" of this foam or adhesive that has been squished between the inner structure and outer skin or even a thin piece of tarpaper.

You can push up on these low spots to return it to supporting the outer skin, as it should. But it is difficult because you can't push it past where it needs to be. On this particular type of damage, the inner structure would need to go past the correct shape and then "relax" back down to where it belongs. It can't do this of course because the outer panel is there and limits the inner structure from going up where it needs to go. Just as with looking at the "big picture" when you look at any dent, you need to search for a kink or bend that is holding the inner structure down in that area. If you apply pressure up on the low area and tap out these kinks, you may get it to stay back in shape. If these methods don't get it back up to support the outer panel properly, you will need to "shim" between the two panels to get the outer panel up where it belongs. This can be done with sheet of

tarpaper or more adhesive. As a last resort a thin piece of wood like a paint stirring stick can be used. Of course, this is a little on the funky side but if you are haven't been able to correct the problem, something has to be done. What you have to watch out for is applying too much pressure in one area. If you were to force a piece of wood in there, you will likely be making a high spot on the outside. That would just give you in a whole new problem.

Sight down the body lines that are nearest the low, "oil canning" , or just plain flexing area. A body line is effectively the "edge" of the panel. Those crowns in the flat panel that I mention end at the body line. So each area in between the lines is sort of like an individual panel. Look to see if the body line is low, it may be holding down your panel. If it is, you need to push it up. To help you determine how straight the line is sometimes you can use a metal ruler as a "straight edge". How can this be done on a crowned panel you ask? A metal carpenters yard stick will bend very easily, right? So what you do is lay the yard stick on it's back against the panel and apply a little pressure on the outward edges low area where the metal is OK. You will then have a "curved straight edge". I have a drawer with a number of these metal or aluminum rulers in it and find them very useful. I treat them like rice paper and they will last a lifetime.

So lets say that you have found that you have no low spots in the body lines or there were one or two and you repaired them. Now you have to look for something else that is holding the panel down. This can usually be found in the form of a "crown" or "brow". When you put a dent in any panel the metal has to "go" somewhere. All panels have this crown, right? So as an example picture a metal rod that is 3 feet long. This rod has a slight bend to it. The center of the rod is up from the ends about three inches. If you were to push down on the center, the rod would get "longer", right? So, if the ends of the rod were clamped in vices, the "extra" rod would force the areas on the sides of where you were pushing to go up. You panel does the same thing only on a much smaller scale. Most brows will be found on the outer edges of a panel, this includes of course at the edge of the body line. They are VERY common around the outer edges of a roof. Search around the outer edges of ANY bent roof and you will find them.

The brow or crown is a U, C, L or even I shaped high spot. In the center of that curved high spot is a low spot, sort of like a "pocket" in the brow. Just one or two of these will make a panel, especially a large panel look like a cotton sheet! What you have to do is to push up on that low spot while tapping down on the brow. When I say "tap" I

mean TAP. Just the weight of the hammer bouncing off the brow will do it sometimes. Use a large VERY flat body hammer or a flat body spoon for this repair. If you are careful you can repair these brows with little to no plastic filler. Just take you time and keep checking the area with a block with sand paper or a vexon file if you have one for low and high spots.

Now, if you simply can eliminate the brow and low spot, you have won the battle. If it takes some plastic filler, so be it, you have given the panel it’s strength back and that is what matters.

"Basics of Basics" Body panel alignment

Nothing adds to "detail" on a car more than nice fitting panels. If the car is a light color it is even more important. Those "black lines" that are the gaps between panels really look bad if they are not a consistent width. While using this guide and aligning your panels be sure that you open and close the moving ones very carefully after a change. You can loose the gap fast which will allow the panels to hit, so be careful.

I have to start with this very important point. ALWAYS have the car sitting on it's wheels or at the very least the weight of the car should be on the axles. That being if you want it on jack stands to raise the car up and give you more access to the bolts and such, place the stands under the control arms as and rear axle. They should be out as far as possible towards the wheels. This can still cause problems on the front. Even in a little from where the tire actually holds the car up can change the amount of pressure being exerted on the car's body. A car can be twisted or bent more than you can imagine up on jack stands when the stands are set on the frame allowing the weight to hang off the ends. This is VERY, VERY important. Of course this goes for anytime a panel is being fit, either welded or bolted on.

Hood alignment:

Let's start with raising and lowering the rear of the hood. If the car you are working on has a hinge that sits on top of the cowl, your only options are to shim or bend the hinge. Bending the hinge slightly is one way to move it. If you need to come up in the rear you can put a small block of wood or other item on the hinge, to bend it. When you close the hood down (NOT ALL THE WAY) it will get in the way of the hood closing and bend the rear or the hinge up. If you need to bend it down, the only option may be to remove it and bend it a little. You can also shim the bolts between the hood and the hinge, more on this later.

If you have a hood where the hinge mounts on the side of the fender or the side of the cowl like with an older car or truck, you want to "rotate" the hinge on the fender. Just pushing the hinge up and down will give you very little movement on the top of the hood.

This is the strange little trick that you have to remember, if you raise the back of the hood on the hinge or raise the back of the hinge on the fender the hood will go up. If you raise the "front" of the back of the

hood ON THE HINGE or the hinge to the fender it will go down. What you have to remember is you are working with a pivot point in the hinge, not a stationary part.

If you loosen the FRONT bolt on the hood (where it bolts to the hinge) and put a shim, or washer between the hood and hinge, this will LOWER the hood on that side. If you put that same washer under the rear bolt it will RAISE the rear of the hood on that side.

So, if you loosen the bolts from the hinge to fender and close the hood, the hinge will rotate on down in the front right? This will raise the REAR of the hood like putting a shim in the back bolt between the hinge and hood!
What you need to do to lower the back the hood is to loosen the bolts (only slightly) and PUSH UP on the front of the hood. This rotates the hinges back, thus raising the front of the hinge and lowering the hood in the back.
If the hinges are warn out it won't change how high the hood sits when the wear, not by more than a fraction of an inch. And I have never seen a car with these style hinges that you couldn't put the hood a half inch LOWER than the fenders if you wanted to. The adjustment is HUGE on these cars. That is one of the things that is easy to do on them is align panels.

I recommend you remove the striker or latch from the hood so that you can move it up and down without worrying about the latch grabbing the hood. After you have aligned the hood, take a piece of dumb-dumb or clay or something similar and put it on the latch. This way you can see exactly where it hits when you do install the latch. You bring the hood down till you just tap this dumb-dumb but DON'T LATCH IT. Just so the hood makes an indentation in the clay/dumb-dumb. This tells you where you have to move the latch.
I do this at work everyday, by my self so if you can't get help this is the trick. Always leave one bolt on the hinge tight. If you want to rotate it back, leave the front bolt tight. If you want to rotate it forward, leave the rear bolt tight. When you move the hood forward or back on the hinge, leave the bolts snug enough that you have to tap on the edge of the hood to get it to move. Or if it needs to go back, leave the bolts a little snug, and wiggle the hood up and down and the weight of the hood will make it slide down. Remember it only needs a 1/16" or so to make a 3/16" or more change at the front. To pull the hood forward on the hinge loosen them so they are still a little snug so you have to pull up on the back of the hood to make it slide that little bit. If you loosen it up so it moves anywhere you want it, YOU WILL

NEVER KNOW HOW MUCH YOU MOVED IT AND YOU WILL MOVE IT TOO MUCH, GUARANTEED.

Get the hood laying flat first, then move the hood forward or back on each side to make the hood fit the hole between the fenders. If the gap is large on the front right and small on the front left, then the hood needs to me moved back on the right side. As you move the hood back on a side it will close up the gap in the front of that side and open it at the rear of that side.
You may need to move fenders too. Just do each change slowly, move it VERY LITTLE. Look at the bolt and washer as you move the panel, you will see where the washer used to be, the amount is much easier to control if you watch the washer movement.
If you need to move the hood up or down at the front, you have a few ways to do it. First, on each side there are the "bumpers". The hood bumpers are located at each front corner and look like a bolt with a rubber pad on top. Just unlock the jam nut and raise or lower the "bolt" so it holds the hood at the height you need to match the fender. You may find that the hood won't go low enough even with the bumper down far enough. The latch may not be down far enough. When you close the hood, you shouldn't be able to pull up on the hood or push it down. The latch should be tight enough to hold it against the bumpers tight, but not too tight. If you have to apply too much force to open the hood or it opens with a loud POP, the latch is probably too tight. If it is at the right height but you can lift it up some, then the latch needs to be moved down.

Doors: If the doors are off the car, bolt the hinges to the door and the cowl in the middle of the movement allowed. Let's face it, it "shouldn't" be too far off the center of holes. If the doors are on or if after putting them on things are way out of whack, raise the door up on the hinges as far as it will go while still staying about the right height. You always want to start high, it is much easier to come down than go up. Besides this is the ONLY time you will loosen all the bolts on the door. I don't mean ALL the bolts, leave the hinge to cowl (or center post on a four door) tight. Only loosen the door to hinge bolts. Unless it is WAY down then you may need to move the hinges up too. But do one at a time, both door to hinge or both hinge to cowl/center post.

While moving the hinges aligning the door NEVER loosen all the bolts on the hinge, NEVER. Loosen all but one, just till it is still a little looser than "snug". Leave that last on just a little snug. Let's say the door fits well but is a little too far forward. NEVER loosen top and bottom hinges

and move it forward. Loosen the top hinge to cowl/center post as described above and lift the rear of the door, a LITTLE. This will push the upper hinge forward. Now TIGHTEN that one bolt that was left snug. Do the same on the lower hinge, pushing down, but remember the weight of the door is helping, so little push is needed.
If the door fits well but is out at the top or the bottom, again, loosen ONE hinge to DOOR in the manner described and push it out or in. If it is out or in at the top rear for instance, move the bottom front in the opposite direction. This will pivot the door on the striker, and move the rear top where you want. Moving the bottom rear takes moving the top front of course.

You may need to twist the door. If the front fits well and rear is out at the top (or bottom, just reverse) you can put a block of wood at the rear of the door at the top lets say and push in on the bottom to twist the door. Some will take a LOT of force to bend, and be VERY careful not to let your fingers hang around the outside of the door edge!! I lost a finger nail doing this on a '69 Shelby GT500 convertible once (remember it well) when the block of wood fell out with all my weight on the door while twisting!!

Tip: If you are hanging the door and you have access to the hinges (either through the wheel well with the skirt off or if the fender it's self is off) you can simply hold the door up to the opening and push the latch shut. Then put the bolts in the hinge. I can often install doors all by my self in this way.

Deck lid: The trunk lid is pretty much like the hood but the hinges don't move at all on the body (usually). So shimming and twisting are a few of your only options beyond the movement in the slotted holes on the hinge. Bending the hinge or pushing up or down on the sides of the quarters, front or rear panel are the others. These should be done ONLY after all other things are tried.

Fenders: Most of the tips for doors and the hood work here, with a little twist or two. Start with fitting the rear top of the fender. I like to put all the bolts in, loose. Not falling out loose, just so the fender would easily move. Close the door, and with the hood open adjust the gap at the top of the rear of the fender to door. After you tighten other bolts this cannot be modified so, do it first. Tighten the bolt under the hood closest to the door to secure the position. You may need to shim a bolt at the rear of the fender to the cowl, to move the fender forward or back. After you have that bolt tight and the gap is to your liking open the door and tighten the rear fender bolt that is at the top of the

fender in the door jamb. Now do the bottom bolt, with the door closed, adjust your gap. You may need to wedge a flat blade screwdriver or body spoon to "force" the fender forward to get the desired gap. Or just the opposite, use a 2x4 or something similar off the front tire to force the fender back to get the gap. This is one of the hard spots to get nice because you have to get both the gap and the in and out of the fender to door at the same time with the same bolt. Some cars have two bolts that are far enough apart to get the gap and tighten the front bolt and then pull the fender in or out and tighten the rear bolt to get the flush fit of the panels.

General tips: Bending a panel or adjacent panel is sometimes required. You can get this done in a number of ways, one is to use a block of wood. Let's say that along the edge of the hood there is a spot that is high. Well you can't adjust it down, the front and the rear are perfect. So you can lay a block of wood on the spot, right at the edge where it is strong. Using a big hammer (the bigger the better, trying to make a small hammer do the job can cause a lot of damage) hold the block and strike it nice and solid. Then check the results, you may need many strikes to do it. In doing this you may want to support the hood at the front with a block of wood under the hood. This way the hood is up off the fender and it will bend easier because of the solid rest it has. You can also put the block under the edge of the hood at a low spot and with steady pressure bend it down at a point if you need it.

If you are working with very tight tolerances, you can actually grind the edge of a panel or jamb to get an extra fraction of an inch. Be VERY careful and using a fine disk like 80 or 120 take a LITTLE off. You don't want to grind the metal thin of course but a LITTLE can make a big difference when you are fighting for fractions. Now, you really won't be cutting too much metal, you are really just cleaning off ALL the primer and paint there. Then when you prime it, don't put a lot or sand it thin so there will be very little on the edge.

You may want to paint the hinge with a little contrasting paint. Do it with the hinge bolted on, right over the bolts. This way you can see easier how much you have moved it.

These directions are for doors where the hinge bolts flat to the side of the cowl and then flat to the front of the door. There are of course many ways the hinges can be mounted on cars. If yours are different than you need to use the "concepts" that I have described here. If for instance you have a 1950 Chevy pickup. The hinge bolts flat to the back of the cowl but will work the same way. The door hinge bolts flat

to the side of the door. In this case you do just the opposite as I earlier described. You would loosen the hinge to cowl bolts to move the door in and out and the hinge to door bolts to move it back or forward. If you find that your car has a design that hasn't been addressed, take a good hard look at your hinge arrangement. If the door is open, close it enough while you can still see the hinges and imagine what direction will it go if you loosen a particular set of bolts. Get an idea of how you can move it, then start the alignment process. These are just ideas that I have used over the years and some may work for you some won't, but it is a start. Above all, have fun!

"Basics of Basics" Frenched (sunken) antenna

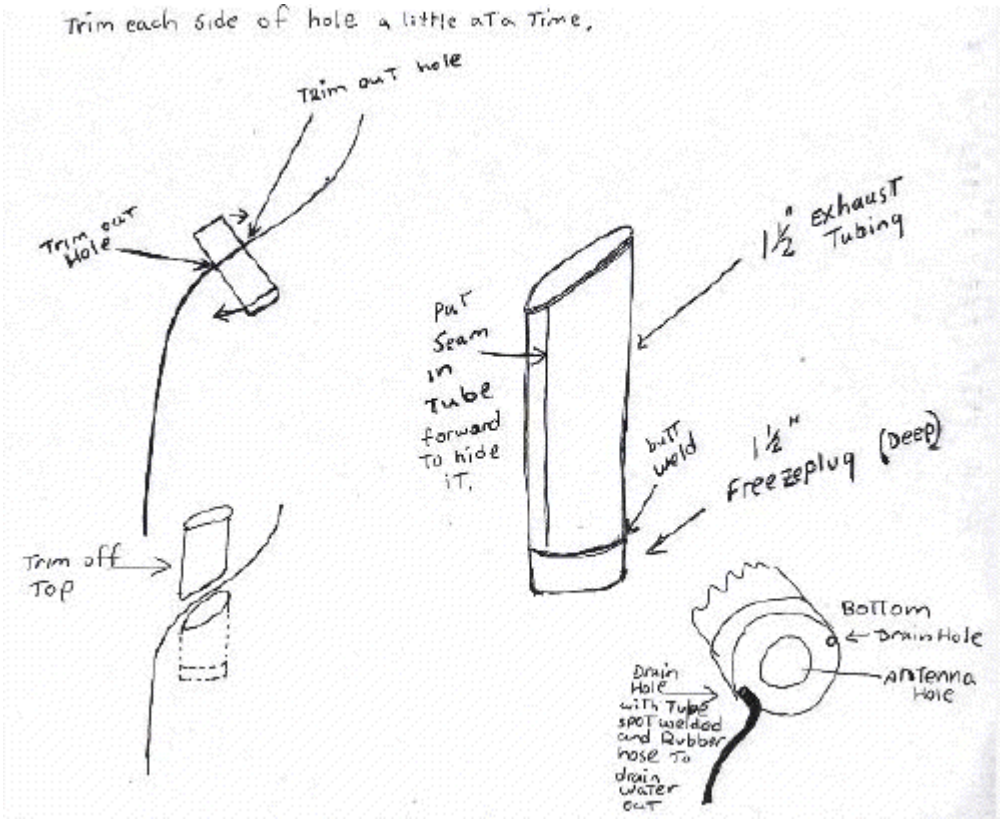
One of the classic custom body modifications, the frenched or "sunken" antenna. I have always like the frenched antenna look. One of my favorites is on a '59 Chevy where the antenna is sunken in the quarter below the fin and then it runs through a hole you put in the fin up into the sky, cool, very cool. You can put them vertical, leaning or even horizontal. Find where you would like to put your frenched antenna. Make sure that your antenna base (be it power or manual) is going to clear everything on the inside of the panel. The next thing is to take a marker pen and put a line down the outside of the tube over the seam. Most all tubes (unless they are seamless) are going to have a seam that you don't want to be seen. Make the tube where it is and that way as you set up the tube you keep that on the outside of the hole and unseen, or at least nearly unseen. If you ignore this, you will end up with the tube welded in and the darn seam right in front of your face and you will have to grind it off or fill it with polyester putty or something. Doing "body work" inside of a 1 1/2" tube is not fun. Mark a round hole the same size as your tubing you are going to use (I prefer 1 1/2"). Cut the hole and stick the tube through it. You then lean the tube in the direction you want to go and start trimming the hole out on each side so it will lean up right. Trim more and more but only a little at a time. Let's say you want to make it perfectly straight up. One way would be to hang a string from something above the car with a weight on it next to your work area. There is your perfect vertical line to aid in making your antenna straight. Now, I don't recommend you making it perfectly straight, it will have the illusion of leaning forward, tilt it back just a hair. Once you have the hole cut out into the oval so the tube stands up straight, mark the tube around that edge of the hole so you can cut it.

Along the way or now you can put the bottom of the tube. I have found a very cool way to accomplish this. I use a deep freeze plug in the exact size as the tube. It has a nice radius on the end and looks very nice. Just fit the freeze plug up to the end of the tube and put a nice weld around the seam, that is all there is to it. All you need is to drill a hole on the bottom for the antenna. Of course a drain is highly recommended. If the antenna is going somewhere that water won't hurt then just drill a little hole on the bottom of the freeze plug next to the antenna. If it is in a place where you need to contain the water, just tack weld a tube on the hole and put a rubber hose exiting out the bottom of the panel to drain the water. At the top where you tack welded the tube put same seam sealer so it doesn't leak.

At the top of the tube, place it up into the hole from underneath and tack weld it. Making sure that it is still in the angle you want, tack weld around the edge a little at a time until it is fully welded. If you do this carefully, you will only need a little grinding or filing for near perfection. At the very least, a little plastic body filler will do the trick.

Tips on cutting out the hole. You could use a die grinder with a carbide tip cutter, a rat tail file, or sometimes even tin snips. I highly recommend getting two pairs of nice high quality tin snips if you are going to be doing any work like this. Wiss makes some of the best. Forget the yellow handled ones, they are for straight cuts only and to tell you the truth, I never even use mine. The red and green "right and left" handed ones are the way to go. They are not for left and right handed people, nor are they for only left and right handed turns. They are for when you are cutting on the left or right hand side of the metal. They will make a perfect straight line, better than the "straight" cutters. I'm sure I am missing something with those straight cutters but they just don't do the job for me. The die grinder or file is really the best way to go, nice and slow so you don't cut too much.

Anyway, have fun and be careful.



“Basics of Basics" Color choice, buying paint

Color choice basics

Color choice is so much more than simply picking a color because you 'like" it. Not every color "works" on every car. Some will argue "to each his own" or "It's your car, paint it what ever you want". This is true, but you are painting it to look better, right? Why just get color on it for the sake of getting color on it. Why paint your favorite color on it when your favorite color is not going to make the car look it's best? We have all heard that black will show waves or poor body work. White on the other hand hides them. This is just the start of color choice. We can agree that even though you may love black cars, painting a wavy old beast a cut and buffed black would be wrong. It goes beyond "taste", it is just plain wrong, if your desire is a nice looking car.

There are a few different issues when talking about color choice.

Cost:

If you have a budget for you paint you best check on the cost before you commit to a color. In one brand of basecoat a price can go from approximately $185.00 to $420.00 a gallon. Any color with a lot of red or pearl is going to be more expensive for instance. These are not custom colors, just regular old colors off new cars. Whether you plan on BC/CC (base coat/ clear coat) or SS (single stage, where no clear is applied over it) will effect cost. Pick a color and go to your paint store to see all costs, color, clear, hardeners, reducers, any sealers you may want, etc. You don't want to be surprised when the car is sitting there ready for paint.

Resale Value:

Yeah, I know, you'll never sell it. Well, I have to tell you, you most likely will someday. There are lots of cars painted pastel pick from the 1980's that are darn near un-sellable today. I know of one, a friend of mine passed away unexpectedly and his wife almost had to give away his '34 Ford. It would have probably gotten up to $10,000 more if it wasn't a out dated trendy color from the 80's. Really watch those trendy colors, they can kill you.

Does the color "work" on this particular body style:

Not all cars look good in all colors. Again, I am not talking "taste" here, I mean some colors just DON'T "work" on every car. There is a 4dr '59 Cad in my area that is painted a fire engine red, I am sorry, it doesn't work. In fact, it looks like hell. Is that just my opinion, well yes and no. It is also the publics opinion in large too. GM spends a LOT of time and money on marketing and research to come up with the colors it offers. That red would not be a color offered on that car for good reason. This is a very gray area (if you will pardon the pun), it does come down to "opinion". But it is like speaking your mind about politics, sure you have the right, but you better "know the room". Or you will suffer the consequences. The resale of the Cad is in the tank. The likelihood of a crowd gathering around it at a show is in the tank. He too the chance when he opened the can. Because of this rule it is not likely you will ever see a white Lamborghini Countach or a candy apple red Rolls Royce.

What do you want the color to do:

This is where we return to the black show waves stuff. Sure black shows waves, but did you know it hides body lines? That's right, it "softens" body lines. If you have a car with features you want to hide, black is the color. This is one of the reasons it is known for being "mysterious". It hides a lot, leaving it up to the imagination. It also makes the car look smaller. I am not kidding, park a black '68 Camaro next to a white one and you darn near have to take a measuring tape out to prove they are the same car. On something like a '27 Ford model T the doors lay on top of the cowl and quarters. It kinda looks like a tire patch on the side of the car. In black they "melt" in and don't pop out as much. White is just the opposite, it may hide waves in flat panels, but it shows off body lines. This includes how STRAIGHT the lines are. Panel fit is very critical with white. The gaps look like black pin stripes, if they are not perfect it will look like wavy inconsistent width stripes. We all know what black and white do, any other color just falls in the middle. It is a sliding scale, the darker the color the more it's effects are like black and the lighter the color the more it's effects are like white, simple.

> Tip 1. There are thousands and thousands of colors out there. To pick one from that huge pallet would be very hard. This is what I feel is the best way to start the color search, find a car the color you want and get the color code off it. It is that simple, the new car deal lots are full of cars in every color imaginable, find the color and there you will find the exact code of that color.

Tip 2. When you go to get your paint at the paint store ask if there are any "alternates" or "Variants" of the color you have chosen. These "alternates" can be VERY, VERY different from the "standard" color. The car you may have seen was one of these "alternate" colors. These alternate colors are different "batches" if you will.

Tip 3. DO NOT PICK THE COLOR OUT OF A CHIP BOOK! These chips are usually not even paint, they are ink. They are a "close" representation of the color, they are NOT the color. (for instance the alternates will not even be represented in the chip books).

Tip 4. I highly recommend you buy a pint of the color you have

chosen, take it home and spray it out. Use an old fender or something and really get a good feeling for the color before you layout your hard earned dough for a gallon or two. This is not only to see if the color is right, but to see if it covers well, and just how easy it will be to paint. The difference between colors and brands can be night and day in how user friendly they are. If you find that the color is nice but it takes 6 coats to cover, you may want to change the color choice or change the brand of paint. Some "value lines" can be very transparent, so you save no money because you may have to put on twice as much. A high pearl or metallic color may "model" easily, that may be a reason to scrap the color or brand.

Tip 5. After you have your color picked for goodness sakes don't be a cheapie when buying your paint. Figure out how much you'll need for the whole job. We are talking every thing you plan on painting, outside, inside, dash, jambs, trunk, everything. When you have an idea how much, add at the very least 20% more. If one gallon is enough, buy another quart. Buy all the paint you will need before you start painting anything. Get a few extra gallon cans and use them to intermix ALL the paint. You then have all the paint you need, no mismatched parts, no running out, you are set to go. If you have that quart left over when you are done, so what? Running out of paint is NOT pretty, it is a disaster in many cases. Now, why intermix? This is a VERY painful lesson you don't want to learn the hard way. This is

it in a nutshell, if you were to go to the paint store and have three gallons of the same formula mixed you would end up with three different colors! I will bet you a dollar, here is why. Some toners are very strong, just a drip will change the color. A couple of different people could mix them, some people mix better than others. There are other variables such as one toner used gets emptied and the next toner used has more solvent in it because it is new and has less strength. Now, these colors may not be "that" different. If you were to paint three different cars with those gallons you may not even see it. But if you were to paint your hood, fenders, and quarters with the three different gallons you sure would! I repeat, this is a VERY painful lesson you don't want to have to learn the hard way, BUY ALL YOUR PAINT UP FRONT.

Tip 7. If you follow tip #6 you can skip this one. It is something that comes up once and a while. When you have chosen BC/CC, SS, Lacquer, enamel, what ever, paint the WHOLE car the same. Don't paint the jambs SS and the outside BC/CC or something like that. Yes, it "can" work, but seldom does. The formula for the SS and BC of the same color is NOT (usually) the same. The SS paint is not just the BC that you don't put clear over. For that matter just clearing a color will change it.

I could bore you with example after example of how I learned this information. Follow these simple tips and you will have fun doing your car, instead of experiencing the pain on your own. These are lessons that are very painful, believe me. Let me also say that I love color. It has been a big part of my life for over 25 years. I can appreciate just about any color as long as it is done nice. That does not mean that any color belongs on any car. It also doesn't mean that because I would like a car a particular color that I would paint it that color. It has to "work" or it was a waste of time and money. There are many cars that you have seen grace the front cover of a magazine that would be a big ZERO if it were painted another color. And likewise there are many cars that just don't get the attention they deserve because they were painted the "wrong" color. This may be the only car you ever restore, or at the very least one of only a few. The time you take to pick the color is time very well spent, that I guarantee you.

Paint technology basics

There are many different types (or more correctly, technologies) of products you can use in the restoration or repair of your vehicle. Some have a variety of uses while others are very limited with only a few of specific uses. Proper choice of products can help you get the job done faster and/or help with the longevity of the repair. Let's start with some basic definitions. I couldn't possibly know every paint manufactures terminology or product use. These are generalities and should be used as a guide only to then read the tech sheets of the products you have chosen for proper use. These tech sheets can be found at the jobber and are given away free. Or most manufactures have them on line, USE THEM. They are a wealth of information and can save you many headaches. You don't need to read every word in the mind numbing text, they usually have a "product at a glance" or something like that will cut to the chase and give you what you need.

Basic terminology's:

"Solvent" is a generic term and refers to any "reducer", "thinner" that is used to reduce the viscosity ("thickness") of a product to aid in spraying or applying. It could be acetone, lacquer thinner, urethane reducer, a special "basecoat" reducer, water, alcohol, etc. These solvents ARE NOT INTERCHANGEABLE; each product MUST be used with the specific solvent recommended by the manufacture. "Etch primer" an acid containing primer. "Primer" a product that can be applied to bare metal "Surfacer" (or "primer surfacer") A primer that has "body" or solids and is used to fill imperfections and provide a film thickness to sand or block a surface to a smooth base for paint. "Sealer" a non-sanding product that is applied prior to painting. "Primer-sealer" A sealer that can be applied over bare metal and then top coated without sanding. "Flash time" the time you allow the solvents to evaporate out of the film you have applied.

Basic technologies

"Single component" or RTS (Ready To Spray). This is a product that uses no additional components. Just pour it from the can into your gun and shoot. Examples are: Some plastic adhesion promoters and primers and even some top coats like vinyl colors.

"1K" This is a product that uses no hardener, catalyst, activator, etc. It may have an added solvent, but no hardener or activating reducer. 1K products like RTS dry with the evaporation of solvents and are soluble,

meaning that they are could be wiped off with a rag soaked with lacquer thinner. They could in THEORY be scraped off and put in a can with solvent and stirred back to a sprayable condition. Of course ALL RTS products are 1K. Examples: All lacquer products, some synthetic enamel products, and some acrylic enamel products. Because of the low VOC regulations the 1K product options are getting scarce, with most limited to "specialty products" like adhesion promoters.

"2K" or "Two component" is any product that uses a hardener, activator, catalyst, etc. It may or may not use a third component in the form of a solvent. 2K products don't "dry" like a 1K. The 2K product "cures" by molecules linking together to form a whole new compound. Most high quality 2Ks are insoluble after a full cure and will not soften when exposed to solvents like thinners or gas. Examples are urethane under coats and top coats. Epoxies, ISO free products that use a hardener, etc.

Basic tip, ALL 2K products should be mixed as accurately as possible. As a rule 2K products need a minimum of 55 degrees to cure with an ideal minimum of 65 degrees. MIX THEM AS DESCRIBED BY THE MANUFACTURE. They have spent hundreds of thousands, possibly millions of dollars developing the product, they WANT it to work as BEST it can. Do as they say, don't become a "Junior Chemist".

Types of products and their uses:

Etch primers (some are 2K)

"Wash" or "Vinyl wash" are for bare metal applications for the ultimate in adhesion and corrosion protection. They are very low in solids with next to zero filling qualities. Some are even semi transparent. They are usually not to be top coated with paint. You apply them to aid in adhesion and corrosion protection under other undercoats such as epoxy or urethane primers.

Benefits:
- Very thin, keeps down film build
- Cost effective
- Fast application
- Non-sanding
- Super high corrosion protection.

Disadvantages:
- Some have a very small re-coat window

"Etch primer" (some are 2K):

Typical "etch primers" have much more solids and body than "wash" primers. They are more forgiving than "wash" primers, one thing being a much longer re-coat window. They are basically used to aid in adhesion and corrosion protection as with "wash" primer. You would choose "typical" etch over "wash" if you have some paint or plastic filler as a substrate along with the bare metal. Some brands have a recommendation to apply top coats over it also. This could be very useful in a money saving or time saving is important.

Benefits:
- Easy to apply, smooth, easy to sand
- Some can be applied over plastic filler (not that you need itover the plastic filler, but if you have some, it is nice to not have to go around it)
- Some can be top coated, which can be a big time and money saver.
- VERY cost effective

Disadvantages:
- Added product to buy and apply.

IMPORTANT basic! If you have used ANY metal treatment or "conditioner" read tech sheets carefully for compatibility . The acid in the metal "treatment" or "conditioner" can attack the acid in etch primers and it can LOOSE adhesion from the metal!

Urethane primer (2K) Urethane primer is the most common primer used in auto body and restoration by far. It has good solids and fills well. It is easy to sand and can provide you with a perfect body when blocked properly. Care should be taken when applying it as to not use too much. It can shrink when applied too heavy. It is the best all around primer for applying over plastic body filler and for surfacing your work. If used properly it provides the proper film thickness under top coats and is the perfect substrate for bs/ss and SS.

Benefits:
- Easy to apply, and sand.
- Applies smooth.
- Fills well with minimum of shrinkage

Disadvantages:
- Contains Isocyanates.
- Should always use an etch primer under it.

Epoxy primer (2K)

Epoxy is a good corrosion fighter. It is has a very sticky resin and will provide good adhesion to MOST substrates. It typically has poor filling and sanding qualities (that sticky resin makes sanding difficult) . It is ideal for use as a "primer/sealer" on bare metal that requires no surfacing. Perfect for frames and components, radiator supports, items that are sandblasted and you only need to prime and paint. You use it as a non-sanding "primer/sealer" and then paint right over it.

Benefits:
- Good chip resistance (it isn't as hard as a urethane)
- Perfect for a "primer/sealer" over bare metal.
- Etch primers can skipped because of its excellent adhesion and corrosion properties. (although for maximum corrosion protection apply a wash etch under the epoxy)
- Provides good base under plastic body fillers (skip the etch if you plan on using plastic filler over epoxy) - Epoxy has no isocyanates .
Disadvantages:
- Poor sanding qualities
- Poor filling

Polyester primer (2K)

Polyester is a very specialized primer used in very small amount in most shops across the country. But when it is needed, it does a job like no other. Polyester has a huge solids content and will fill 80 grit scratches in one coat or 36 grit in two or three! Urethane for instance provides about 1/2 or 3/4 mils per coat while polyester can give you as much as 4 to 6! Because of it's high solids, it shrinks very little. It is basically like spraying polyester putty. Look for a manufacture that has a recommendation to apply etch primer under it. I see NO reason to use polyester on a straight panel. It is for use only when you need some serious filling and surfacing.

Benefits:
- VERY high filling
- Low cost
Disadvantages:
- Very high texture
- Harder to sand than a urethane
- Possible need to purchase a large gun to shoot it. - "ISO FREE" (2K)

"ISO FREE" is a urethane type primer but without the harmful isocyanates that a urethane contains. The problem is ALL refinish products should be used with the same care and concern for your health and others. ISO FREE is like "low tar" cigarettes, don't kid your self, it is still VARY harmful.

Benefits:
- Isocyanate free
- Smooth, easy sanding
- Good filling Disadvantages:
- You need an etch over bare metal before it.

Basic tips... Etch primers can be skipped on spots of bare metal smaller than a dime or so when using all primers listed. Most "quality" 2K primers need NO sealer before top coating with bc/cc or SS when applied properly.

Sealers

All RTS or 1K sealers should be reserved to VERY low end jobs to save money. They do NOT offer the benefits of a 2k, PERIOD.

Reasons to use a sealer:
- Makes up for "some" poor preparation
- Provides a uniform color for better coverage when you apply paint.
- Helps with providing a uniform substrate for paint.
- Helps provide a better substrate when painting over a 1K primer.
- Can Help with "covering" poor prior repairs

Under collision repair conditions a shop may use sealers on every job as an "insurance" protection against problems. In a restoration environment where complete panels are primed with a 2K there really is no need to use them. If you have chosen to use a sealer there now are a few more choices to make. First, you need to decide what kind of sealer to use. As I mentioned in the beginning, RTS or 1k could be used to save money. Why put a 1K sealer over your 2K primer (I hope you are using a 2K primer) then apply a 2K top coat? It is like the old saying, "It's only as strong as it's weakest link". If you use a 1K sealer in this fashion it is like replacing a link in your tow chain with a nylon tie!

With 2K there are a few options, epoxy and urethane being the most popular. I don't feel that there is a huge difference in the two as far as how they apply or work. Epoxy is more forgiving with sensitive

substrates. It really comes down to what you feel more comfortable with. The epoxy has no isos so that would be one reason to choose it. Now that you have decided what sealer to use you have to decide on what application. Most sealers give you the option of a "wet on wet" (or very close to it) or a full "barrier coat" application. The difference being with "wet on wet" the sealer is applied and then allowed a short flash time before the basecoat or SS is applied. A "barrier coat" is where the sealer is applied, then allowed to cure or at the very least to totally flash. This allows the sealer to become a barrier so the solvents from the color coat can't penetrate it and attack the substrate. The barrier coat procedure allows for he sealer to do MUCH more of what you choose to use a sealer for in the first place. The choice is made taking into account a few factors. How sensitive is the substrate? Or, how aggressive are the solvents in the color coat that you are applying? If it is very hot weather and you are using a slow solvent in the color coat to help it lay out, you may choose to use a sealer because you know that the substrate is sensitive and the slow solvent will attack it. Well, that is about it for the basics, have fun!

Rattle can basics:

There are many reasons why we would choose to us an aerosol or "rattle can". The convince of a small container with no clean up, or the lack of a compressor, or the product needed commonly comes in an aerosol like spray adhesive. Now, I know that you are saying, "come on, what could I need to learn about rattle cans". One of my job duties as a paint rep was doing the "defects" every month or so. I would go into the distribution center and find six or seven cases of aerosol cans among the assorted sandpaper and bondo that "didn't work" for the customer. I say "defects" because there are very, very few actual defects, most were returned do to misuse. With about 99% of these aerosols only problem being that they were plugged up I figure there are a lot of people out there doing as I always did and some "basics" could be used.

First off, what makes the thing work? The aerosol can is simply a tank filled with compressed air that pushes out the product when you open the valve. In a 12oz aerosol can there is about 4oz of paint product, 2 or 3 ounces of solvent and the rest is the propellant (compressed air basically). The nozzle is hooked to the pickup tube that runs down to the bottom of the can into the product. If you were to turn the can upside down, the end of the pickup tube would be up at the bottom of the can in the propellant right? More on this following.

The propelent is at the top of the can pushing down on the paint product. When you push on the nozzle the valve is opened to release the pressure. The propellant pushes down on the paint product forcing it up the pickup tube, out the nozzle onto the surface being painted. About the only thing that can go wrong with this simple design is for the tube or nozzle to get clogged.

This is exactly what would happen to a huge majority of the aerosols in the defect department. There is a very simple procedure that will eliminate this.

First: Shake the can like it says in the instructions. Most say for two or more minutes. Look at a clock and shake it for two or more FULL minutes, not the 20 seconds we THINK is long enough.

Second: Turn the can upside down and give it a spray to clear the nozzle. Most of the time there should only be air at this point. You are now ready to spray.

Third: When you are done spraying, turn it upside down and clear the nozzle and pickup tube by spraying out all the paint that is in the tube and nozzle. Remember, the end of the tube is up in the propellant at the "bottom" of the can. It is like spraying air through a spray gun when you clean it.
THIS IS VERY IMPORTANT!

If you do this EVERY time you use the can, you WILL use it till it is empty and never throw away a can for being clogged again.

You can even save clogged cans with this method, I used to save cans in the defect department all the time.

Remember, there is very little actual paint in the can and it is very thin. You need to apply a number of thing coats to get good results. I have never did a mil thickness test on an aerosol but I would venture to guess it is somewhere .05 mils a coat. The average paint product shot out of a gun is about 1.5 mils (some etching primers are down to .05 all the way to high solids clears and primers giving 4 or 5).

So if you only apply a coat or two, you are not getting the mil thickness needed for good protection.

Advanced rattle can use: Aerosols you buy at the parts store are pretty limited. Limited to 1K (though there are some 2K aerosols now hitting the market). Limited to color or product you can get. But there are a few ways to use aerosol technology in your projects. You can move up to unlimited color, and product choice, even hardener!

One is to have cans "Custom filled". This is a really neat process where the paint store puts the paint of your choice in an "empty" can (it already has the solvent and propellant in it). The "empty" can looks just like a normal aerosol, it simply has no paint product in it. The paint store employee puts this aerosol in a "press" like device. A funnel is install right into the top of the pickup tube where the nozzle fits. This funnel is actually a cylinder in which a piston is installed, after the cylinder is filled with paint product. The piston is pushed down with a manual handle or even air powered ram.
You then have an aerosol with any product you want, as long as it is compatible with the solvent in the can. They were limited to lacquer, synthetic enamel and enamel. There are now "universal" fillable cans that will take darn near anything. I have even seen a guy mix the hardener in with the enamel paint, rush home and paint with it before the paint "kicked". Sounds crazy, but it worked.

Check with your local paint supplier, he may have one of these filler in the back hidden from view. The seldom make it well know that they have it being it is kind of a pain to use. Ask and you may be in luck. You may have to buy a pint of paint and then fill a few aerosols if you need a color mixed.

Another way is with a “Preval” system. I don’t know of any other brand names but there may be others. This is a glass jar with a removable, replaceable propellant can that screws on the top. The disposable propellant can has the pick up tube hanging off the bottom that goes down into the bottom of the glass jar into the paint product. The top has the nozzle just like a regular aerosol. I am sure you get the idea. Any paint product can be put in the jar and sprayed. This includes epoxies, or urethanes using hardener. Is that cool or what?

Some products may need some over reducing to get them out of the nozzle. Some may not work at all because of their high viscosity like polyester primer. But your range is much wider with these two advanced aerosol systems.

One of my street rod mentors who lived near me as a kid sprayed an entire “T” bucket hot rod with aerosols and showed the car! You can get good results, just give the preparation the same respect as you would spraying it with a gun.

Basics of "surface cleaners"

They are commonly called "Wax and Grease Removers" but many manufactures have changed the name to "Surface Cleaners" or similar names. I think the biggest reason is because the name "Wax and grease remover" implies that they will actually clean all of the wax and grease off the surface. The other reason for a name change is the simple point that wax and grease are only a few of the contaminants that you battle against while painting.

The basic idea behind these cleaners is simple, they are designed to lift the contaminant up off the surface long enough for you to wipe it away. The surface MUST stay wet and HOLD those contaminants up in the cleaner for you to wipe off with a clean/dry rag. That is mistake most make, they let it dry and the contaminant ends up laying right back on the surface. First of all let's clear up a few things; Lacquer thinner, acetone, MEK, and enamel or urethane reducers are NOT surface cleaners. Lacquer thinner evaporates too fast and doesn't give you time to wipe it off wet. It is also much to strong a solvent for most cleaning and can get under the edges of sand thrus or soften substrates. Enamel and urethane reducers often have resins and other components in them that are designed to be added to the product they were INTENDED to be used with. To put it in a nutshell, buy and use the products recommended by the manufacture of the paint SYSTEM you are using. A gallon of the proper surface cleaner runs about twenty or twenty five dollars it is money well spent. The gallon will last you through many projects, a few cars even. The pint of paint or clear to do one small redo will cost more than that.

I checked on our paint dept. at work to see how much surface cleaner they go through. We do between 100 and 150 cars a month and purchase three to five gallons of surface cleaner. We purchase about $12,000 a month in paint materials and only about one hundred bucks of that is surface cleaner. So that being said, at that rate a gallon should last a home hobbyist a lifetime, so buy the right product for the job.

One reason we use so little is how we use it. Here in the San Francisco bay area with strict VOC rules we are not allowed to pour the surface cleaner out onto a rag. We have to spray it out of a spray bottle. Like most things we are forced to do, we resist. But it has turned out to be a great way to use this product. You should give it a try, it works real well. You spray the panel and then wipe it off.

I like to have lots of clean rags when I am doing paint work. Clean rags are one of the most important item you can have in a shop. In the last few years this has gotten much easier to do. I remember having a can of paint covered rags in the corner, thinking I could wash them. I would wash them and they would be clean but the dried paint on them would be hard and make the rags unusable. Then of course you don't want to wash them in your home washer anyway, unless you want your wife's bra to smell like enamel reducer.
Now a days the disposable rag is king. You can get a box of "rags" for a pretty fair price and just throw them way when done. You always have nice clean rags. They are not "just" paper towels, so don't think that the "Mr. Cleanup" paper towels you get at the supermarket are going to do the job. Go to your paint store and get the real thing. There are many different kinds, from cheap wipes similar to your kitchen "paper towels" to lint free towels for final wiping. TORX products are available at NAPA auto parts and is one source for these towels. Again, yes they cost more money than washing rags or your wife's "Mr. Cleanup" paper towels but what kind of money are you spending on your paint products?

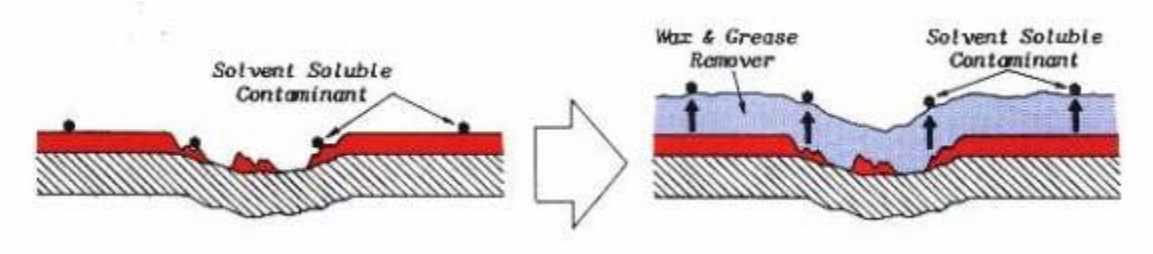
So let's go over exactly how you use it. As mentioned earlier, you need to keep it wet prior to wiping it off. The best way to do this is keeping your cleaning area down to a manageable size. I usually wipe no more than a half a panel at a time. About six square feet is all you can do without problems of it drying to fast, and even then you have to keep moving pretty fast. You just don't want it to dry, if you do, you have wasted your time. You haven't done what you intended to do, at all. It was not even close, you wasted your time.

When should you wipe the surface?
Well first of all, BEFORE you sand. If you don't wipe the surface before you sand you will not sand off the contaminants, you will sand them INTO the surface. So a good cleaning before sanding is recommended. If the surface is really dirty, clean it a few times changing to clean rags every time. Remember, you want to wipe off the contaminants, so if you use the same rags on the subsequent wipes you can leave the contaminants you wiped off on the first wipe!

Wiping before applying primer or paint of course is also recommended. Broom and/or blow off the sanding dust (I have bench brooms for wood working that are fine bristled and work great). Be sure to use the proper cleaner and wipe it dry really well. Then be sure that any remainder has flashed off (evaporated) before applying your primer or

paint. You don't want any of the cleaner to be trapped under your primer or paint!

Have a few rags ready to go folded in fourths. Put the rag over the opening on the can of surface cleaner and give the can a "slosh" getting the rag wet, not too wet but wet. You don't need to have it dripping all over the floor, but it should be good and wet. Get in the habit of wiping things down like you are painting it. Use a back and forth pattern with an over lap being sure to wet EVERY square inch. The entire area should be shiny wet, then switch to a clean dry rag and wipe it dry using the same "get every inch" procedure. If you feel it dried before you could get it off, repeat the cleaning. As a painter I worked under many years ago would make me repeat like a private in boot camp "YOU CAN NEVER GET A CAR TOO CLEAN, SIR"



Because the term "wax and grease remover" is thrown around so much little is said about the how different they can be. Until I had became a paint rep I didn't even know there were different kinds. After painting for twenty years I had always just grabbed the "wax and grease remover" without a thought as to what I was using it on. When I bought a cleaner and found it worked different I just attributed it to the brand and not the fact that it was just not the type of cleaner I had been using.

Just like solvents you add to your paint products there are different "temps" cleaners. Not that they are to be used in different temp shops but that they flash faster or slower than another. This is important in that you don't need a super slow flashing cleaner on your final wipe. Nor do you need a super fast one when you are doing your first wipe down of a greasy car prior to sanding.

There are also different "strengths" of cleaners. Some are designed for cleaning soft substrates like lacquer while others are much more harsh for cleaning enamel substrates. Most all of them "can" be used at most

times but, there are some that are better than others for particular circumstances.

There are four common groups. I don't have every cleaner listed here but this will give you a good idea at what is available.

1. A very slow evaporating cleaner. It is also very weak, and actually only mineral spirits or mostly mineral spirits. This does NOT mean you can go to the hardware store and buy their mineral spirits, for goodness sakes just but the high grade product from the paint manufacture. This is the type of cleaner is the most common found in the shop. It is a good cleaner because it is weak and will not attack any soft substrates like lacquer, uncured enamels, etc. But it will not clean a lot of strong contaminants like vinyl treatments. When you have a reason to believe there is a particularly bad contaminant you may need to go to a stronger cleaner. It is very slow evaporating so you have to be sure it is fully evaporated after wiping before you apply any paint product over it. Specifically those nooks and crannies, be sure it is good and gone before you apply any paint product. It gives you lots of time to wipe it off because it evaporates so slow.

Examples are:
Sherwin Williams R1K213, Martin Senour 6387, PPG DX330, DuPont 3939S, BASF 901.

2. This cleaner is fast and strong. It is commonly recommended as a "pre-cleaner" before sanding. It will attack some soft substrates like lacquer and uncured enamel but if you are using it before sanding you can correct that. It will clean the stronger contaminants like tar and unseen ones like silicone vinyl protectants.

Examples are:
Sherwin Williams R7K156, Martin Senour 6383, PPG DX440, DuPont 3919S, BASF 900.

3. This cleaner is a weak solvent with fast evaporation and is usually used just prior to painting, while the car is in the booth. It is very fast evaporating and is necessary in the production shop where you don't have the time to wait for a cleaner like #1 to evaporate. It is perfect for this use, just getting those finger prints and dust residue off.

Examples are:
Sherwin Williams R7K158, Martin Senour 6384, PPG DX30, DuPont 3901S, BASF 901.

4. Because of VOC rules a waterborne solvent cleaner was developed. It is not needed in most of the country but it has been found to have an interesting use there. Because it has water in it (water and alcohol molecules share a common atom so they are a "link" between the water and enamel based solvents) it actually helps with static electricity. Washing the car with water is the best, but that can't always be done.
It is also the recommended surface cleaner for plastic parts with many paint systems.

Examples are:
Sherwin Williams W4K157, Martin Senour 6388, PPG DX380, DuPont 3909 or 3949, BASF 905.

If you find that you have been using the "wrong" cleaner, don't sweat it, it is not THAT critical. As I said, there are cleaners that work better than others in certain circumstances but few would be "wrong".

I know of one particular mistake I made for many years. I was using one from the number 1 example. I used it all the time as I still do. The problem was I was using it wrong. Back in the days of lacquer primers and paint I had a few problems that I just couldn't figure out, till years later that is. I would see a lacquer paint job I did a year or so later and there would be water spots on it, coming from under or within the paint. It looked just like you would have when you dry a car in the sun and the water would dry in the patterns that the wet towel left. I always knew it was the surface cleaner but just couldn't figure out why it would happen. I now know that the cleaner was just too slow evaporating and some stayed on the surface to be buried under the paint. The lacquer primer soaked it up and held it. If I had waited a little while longer before painting or used one from the number 3 example I wouldn't have had a problem.

Hopefully this info will help you choose the best cleaner for the job. But most off all, I hope it puts to rest all the "old husbands tales" of using thinner or enamel reducers as cleaners.

"Basics of Basics" of atomization

Painting basics
Being HVLP and low VOC products are the way the industry's going I will be referring to them in this discussion on painting and paint guns. Most all basic issues dealing with HVLP can be applied to conventional guns, atomization is atomization. The HVLP just arrives at it differently.

The object of the spray gun is to break up the primer/sealer/paint/clear (I will call this "PSPC" from here out) into small particles and lay them in neat little rows on the panel being PSPRed. So the whole outcome rests on how well the gun is doing this. Picture the droplets of PSPC coming out of the fluid tip of the gun and then the air "slapping" them into smaller droplets.

You have two things that help you with this process, air and solvent. Solvent can mean something that is already in the PSPR from the manufacture or something the manufacture has told you to add to it. By the way, you should always mix in proper ratios as instructed in the tech sheet. The thinner (less viscosity) you get the PSPR or the more air you have at the fluid tip of the gun the more it will break up the PSPR. The target for you is getting the perfect balance needed. Too much solvent and the PSPR will have no body, fill, durability, etc. Too much air and you blow the PSPR everywhere but the car, poor adhesion, excessive texture, etc.

So, the answer is proper air supply and gun (and fluid tip) choice and how you adjust it.

With today's high solids-low VOC (Volatile Organic Compound, you know the bad stuff that goes up into the air we breathe) products there is less solvent. And with HVLP guns there is less air at the cap to break up the PSPC, proper air supply and gun setup is more important than ever.

FIRST THINGS FIRST, your compressor and air supply.

An HVLP gun requires more VOLUME of air to operate (the V in HVLP, High Volume Low Pressure). Now you may notice that your HVLP gun is adjusted at maybe the same PSI as an old conventional gun, around 50 lbs at the gun (many HVLP guns are set at much lower though) so where is the "Low" in PSI they are talking about? It is at the actual air cap where the air and paint come out. An HVLP gun has only 10 lbs at

to the side of the door. In this case you do just the opposite as I earlier described. You would loosen the hinge to cowl bolts to move the door in and out and the hinge to door bolts to move it back or forward. If you find that your car has a design that hasn't been addressed, take a good hard look at your hinge arrangement. If the door is open, close it enough while you can still see the hinges and imagine what direction will it go if you loosen a particular set of bolts. Get an idea of how you can move it, then start the alignment process. These are just ideas that I have used over the years and some may work for you some won't, but it is a start. Above all, have fun!

the cap while a conventional has upwards of 50! So the VOLUME of air (CFM, Cubic Feet per Minute) is the key to proper atomization with an HVLP.

If you have a gun that requires 15 CFM you will need a compressor and plumbing that will produce that at a very minimum. There are HVLP guns that need as little as 7.5 CFM so you can get good results even from a smaller compressor. Air supply is a complete subject by it's self so lets assume that you have the air supply needed and move on to gun set up.

So atomization is the key, but why? Why can't you just lay it out wet and let it "flow", as an old painter will say. Picture a jar full of bb's, they will represent well small, atomized droplets of PSPC. The gaps in between the bb's is solvent. Now picture a jar filled with marbles, they will represent large, poorly atomized droplets of PSPC. The gaps in between are, you guessed it, solvent.

If you apply your PSPC in large poorly atomized droplets, what you will have is a film full of solvent. This can and will cause slow curing, shrinkage and dieback (the loss of gloss in the hours and days after application).

So, now that we have learned the need for gun set up, how do we do it? Lets start with the fluid tip choice. The newer high solids low VOC PSPC products need to be broken up more, so a smaller fluid tip is needed.
Basically you want the smallest fluid tip that will still allow you to PSPC the particular part you are PSPCing keeping the entire thing wet and in a fair amount of time. In other words a 1.0 tip would be beautiful for clearing one fender, but would be lousy to paint a complete. The application would be way to slow and the first panel would be way to flashed by the time you got around back to it. So you need to compromise, a 1.3 is a great all around tip, while a 1.5 though getting a little big, can get you by. If you read the tech sheet on the particular product you are shooting, it will have a recommendation for fluid tip size.
There are needs for other tips, for instance when shooting polyester primer you may need as big as a 2.3, but for urethanes and epoxies, the 1.3 or 1.4 will work great. If you plan on using a pressure pot or paint a bus, all bets are off and we would need to study a little bit more.

As an example of the use of a 1.3 tip I did a test once that proved the

point well. I shot two panels of metal with a med solids urethane primer. One was shot with a 1.3 super high atomizing top of the line topcoat gun. The other was shot with a 1.5 (or a 1.7 I can't remember) "hoser" primer gun. Three coats were applied and after a full cure (the one shot with the larger gun took MUCH longer to flash and cure by the way) the film thickness was measured. The one shot with the 1.3 tip was 2 tenths of a MIL thicker! The larger gun laid out the marble sized droplets full of solvent and when the solvent flashed the film shrank.

Air supply is a subject that could fill many pages by it's self. So we are going to assume you have that covered and move on to gun set up.

You need to "tune" your gun EVERY TIME you use it just as you would tune a guitar before you perform. This is done with a very basic spray out pattern test. This very basic test tells you how your gun is atomizing and you adjust it to achieve the best atomization you can.

Lets do a spray pattern test:

Set the fan width as need (you don't want to change it after you have "tuned" the gun). Turn out the material knob about 2 1/2 turns. This is the "mixture" adjustment, kind of like the idle screw on a carburetor. The farther in it is screwed the lower the fluid to air ratio is and the smaller the droplets will be. The farther out it is, the higher the fluid to air ratio is and the larger the droplets.
Set the air pressure at the inlet to the gun to the manufactures specs. On an HVLP gun this spec is usually found on the gun and is the maximum PSI it can have while still maintaining the maximum 10 lb at the cap for legal HVLP transfer efficiency (68 %). You are now ready to do a test spray out.

Tape a piece of masking paper on the wall for the test. Hold the gun at a right angle to the wall, just as if you were going the wall. Hold the gun at a spread out hands distance (about 8" or 22cm). Pull the trigger to completely open for a split second and then close it. You want an ON-OFF wide open-completely closed in ONE movement. You should have a cigar shaped pattern with complete coverage in the center with fading coverage going away from the full coverage cigar shape in the center. The center should be fully covered without any runs. If you have runs, either you are holding the trigger too long, you are too close or the gun is simply applying too much material. In which case you need to screw in the material knob or turn the air pressure down. But most likely if you have turned the material knob out the 2

1/2 turns and the air is set at the factory specs, you are just too close or holding the trigger open too long.

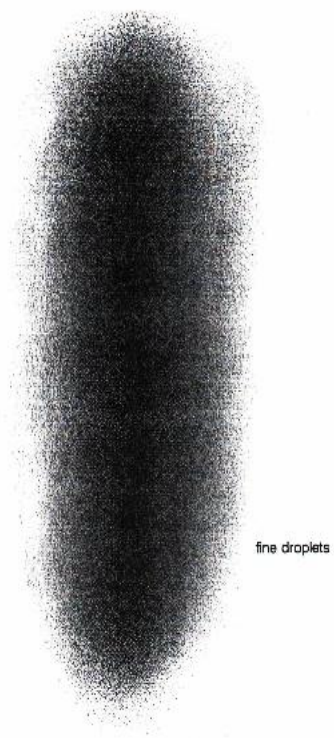
The droplets you see trailing off the center are what you will use to "tune" your gun.

Turn in the material knob to make the droplets smaller (and or raise the air pressure). The balance you need to attain is the smallest droplet size possible before you loose the coverage desired. In other words if you turn in the material knob too far, not enough material will be coming out to cover the panel!

Now, you'll notice that I said, "raise the pressure to the gun", while earlier I said to set it to manufactures specs. We are talking a very small adjustment. It is a fine balance in material to air ratio and a little more air than specified is okay. Even if it is an HVLP gun the inlet pressure recommended is to maintain the 10 lb limit at the cap. Well, about three quarters of the country has no regulations for HVLP use so if you go over the 10 lbs all it will do is atomize the material a little better. You may loose a little of the benefits of HVLP though. But remember you have a lot of control with the material adjustment knob.

After you are happy with the droplet size, DON'T TOUCH THE FAN CONTROL. It will change the PSI at the cap and will change the atomization you worked hard to get.
Do this spray out every time you spray as material change, temp, and humidity will necessitate a spray out droplet pattern test. Good luck!

Coarse Spray Pattern FIG. 7



Normal Spray Pattern FIG. 6

Basics of gun travel

The sequence of how you walk around a car painting is really “learned”. If you understand the “why” the “how” will come to you.
I started out painting lacquer completes on restorations in the late seventies. My boss preached a lot of tricks and they have provin to hold up over the years.

On a 15 coat lacquer job you definetly didn't want the dry spot in the same place with every coat, so you have to “move it around” he would say. This has always stuck in my head, move the dry spot around or "chase" it . I start at a different point every coat, so that dry spot is moved, every coat. As you enter and exit a panel, you must do this little "dance" with the dry spot.... Coaxing it along from one panel to the next.

Doing the roof first lets it stay wet while you go on. If you do the hood first and then the roof, the overspray from the roof falls on the hood and "dries" it. This is what happens with every panel, it is just on a smaller order.

As far as "carrying" the gun, this is a long learned skill. But the basis is the idea that you are a ROBOT and you are to hold the gun a certain distance from the surface of the panel. This distance MUST BE maintained. The height is the same way, as you go across the panel (commonly called "down" the panel even though you are not going "down" but across) the height MUST BE maintained. So your overlap % is maintained. These two things are what keeps each coat uniform with an equal/even about of product being applied.

So with this in mind what ever YOU do to "make" the gun do this is up to you.
Some of us look like a Ballerina painting, others a mechanical robot.

All the time I spent boxing helps me a bunch. I stay on the balls of my feet with knees bent and carry the gun out in front of me. Everything that happens between the gun and the soles of my feet is a fluid motion. I watch the paint hitting the surface, and with my peripheral vision look ahead for where the gun has to go.

You need to separate the body and the gun and think about "where" the gun needs to be, your body will make it go there.

I remember watching a pinstriper (who was a childhood friends dad) stripe a very long front engine rail, he just walked backwards down the length of it with his hand flowing over the top of the rails in the same fashion I have talked about here. His Dagger brush left PERFECT stripes, it was amazing. Well holding a spray gun is no different. After a while you can walk down a 40' semni trailer and the pass you are spraying looks like that pinstripe!

Practice on a car with no paint, just move up and down (across) the panels holding the gun that perfect distance. If you waver, it isn't the end of the world, there are many factors to "makeup" for your "mistakes" but the closer you maintain the gun to perfection the better your work will be.

Painting Rubber Bumpers

The best all around user friendly paint would be Acrylic enamel. On the bumpers, using an "adhesion promotor" for plastic or rubber parts helps a lot. When you choose a paint manufacture (PPG, DuPont, what ever) just ask the counter guy and he will have it for you. I personally wouldn't worry about the flex additive in the bumper paint. But it really isn't that big of a deal. If you painting them off the car, go ahead and add it. If you are mounting them first for some reason, don't mess with it, just paint he whole car at the same time.

Following Directions

Rules, rules, rules, so many rules. Use this don't use that. Sand this, don't sand that. These companies must think we are stupid right? They tell us to buy their products only. Of course they do, so they can make money off of us, right?

That is how many people feel. They mix and match products thinking they can out smart the chemists that created the product!

The manufacturer spent hundreds of thousands of dollars, possibly even millions, developing the product. They did EVERYTHING possible to make it perform it's best. Heck, if they found it worked better if you painted it while standing on your head, THAT would be in the tech sheet!

Did you know that most of these products you use have a lifetime warranty? That's right. The manufacturer will stand behind their primers, paints, and clears for your LIFETIME. Now, as a DIYer you can't have this warranty. What makes the difference between the warranty YOU have (usually none) and the lifetime warranty a shop may have? The training, that's what. The manufacturer has classes for the painters to go to. He then takes a test, if he passes, the manufacture knows that he understands the procedures and proper product choice. The manufacturer has learned that it is likely the painter will use the product properly and it will perform as expected. The manufacturer puts hundreds of millions of dollars on the line with this warranty. They know they can, if the product is used EXACTLY as they have instructed on the tech sheet.

I have always been the kind of guy to follow instructions. Even before I had the training I used the products exactly as I was told to. I am sure this accounts for the very few failures I have had in the 28 plus years I have been doing this work.

Five of those 28 years I was a paint rep. If there is one singular thing I came away from that job with it would be importance of following the recommendations. As a rep I visited hundreds, possibly thousands of shops. These shops were in every shape and size. From one with seven frame machines and five paint booths doing a million dollars of business a month, to a one man shop with two stalls.

Among these shops there was a very distinct pattern: the ones who went to tech school, had only ONE brand of product on the shelves,

and REFERRED to the tech sheets, had fewer problems. Most of these shops had NO problems, EVER.

They were open to hear about new products and ready to learn about how to make any product or tool perform better. Oh yeah, and they made more money.

Then, there was the "dark side". These were the shops that would buy any product, any brand, just to save a dollar. Their shelves were covered with so many labels, it looked like the cans of soda and beer in a Quickie Mart cooler.

If, and I mean a BIG if, you could get them to a tech class, they were disruptive and later told me how they "could have taught that class". They were quick to tell you how smart they were and how the paint company didn't know jack about the "real world". These shops took up about 99% of my trouble shooting time. They didn't have little "how can I get this primer to dry faster?" sort of problems. They had TOTAL catastrophic failures! I was the first one they called because we must have put out a "bad batch" of product.

I tell you this only so you can understand where I get this passion that I have for using products properly. It was like watching a basketball game where one of the teams was wearing wet jeans and cowboy boots! After a while you wouldn't even have to watch, you would know what the outcome was going to be.

Most product data sheets can be read in a few minutes. They are available on line, as well as in the store where you bought the products and many are even available on "Fax Back" right over your phone.

Get proper mixing containers. Be sure the solvents used match temperatures of the booth. Double check to be sure you have ALL the components (and enough of them) BEFORE you start so you don't find yourself tempted to be "creative".

The three most important things and the most common cause of failures are as follows:
1. Mix the proper components accurately .
2. Use the correct solvent for the temperature.
3. FOLLOW THE RECOMMENDED FLASH TIMES.

All this info is on the product data sheets, use them.

Painting can be difficult, there are things that are quite honestly out of your control. So, why not do EVERYTHING that IS in your control correctly.