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# Repairing Windshields

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It's a fine day. The sun is shining, traffic is moving along smartly and you haven't a care in the world. Whack! Until now, that is. Now there's a rosebud the size of a quarter smack in the windshield. What's worse, it's directly in your line of sight. It must have been a hypervelocity railgun pellet fired at you by an Imperial Stormtrooper, because you didn't see it coming or going. And as your heartbeat returns to normal, the awful truth soaks in: You're going to have to have the windshield replaced. This means dealing with the glass shop, being without your car for a day or two, having a potentially leaky windshield and, worst of all, higher insurance premiums.

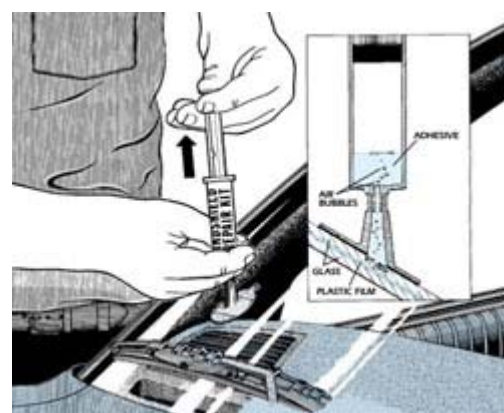
Actually, it's worse. Some insurance policies won't even cover chipped glass. Maybe if you just raised or lowered your seat an inch so you didn't have to look right through the chip...

## Better Living Through Chemistry

Before you panic, drive home and get out your magnifying glass. Take a really close look at your new chip. It just might be possible to repair the chip instead of replacing the entire windshield. The technique is to inject an epoxy or acrylic adhesive or filler into the chip.

Even if your chip isn't in your direct line of sight, it's a good idea to try and repair it. Water will find its way into the chip, pulled in by surface tension. If the chip goes all the way through the top lamination, any moisture that gets that deep can delaminate the glass from the center membrane. Eventually, the membrane will fog, causing a larger blemish. Water also can freeze in the chip, causing a larger flaw or even a crack. Also, water can carry dirt into the crack--and there's no way to flush it out.

As you can surmise, it's best to do the repair as soon as possible,

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Alternating cycles of vacuum and pressure will push adhesive into the chip, and evacuate air from the bottom of the chip.

assuming that it's repairable. Remember that not all chips can be fixed. The best you can hope for is to fill most of the chip. It may still leave a visible flaw. But the improvement on most chips will be dramatic, and at least you've sealed the chip from the atmosphere and probably eliminated the possibility of it growing larger or discoloring in the future.

You can't fix long cracks. So it's critical that you fill chips before they turn into cracks. Basically, any chip that goes into the surface of the glass perpendicular to the surface or at a shallow angle can be repaired. That includes cone-shaped chips, leaf-shaped chips or almost any chip that hasn't flaked a big piece of glass off onto the road.

### Let's Go Shopping

Windshield crack repair kits can be found in the auto parts department of many mass merchandisers like Kmart, Sears and Wal-Mart, as well as more traditional auto parts stores like Pep Boys and AutoZone. Failing that, the warehouse-distributor auto parts stores that cater to professional mechanics can supply you.

In the New York area, we found two different types of repair kits and there may be others. Expect to pay around 10 bucks. Procedures differ marginally, but the principle is the same. We fixed a couple of windshields, and the results were excellent.

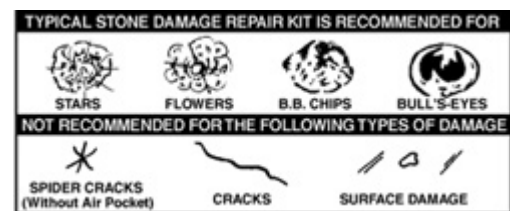
### How Dry I Am

Start with an absolutely dry windshield that's somewhere near room temperature. Tough on a rainy or wintery day, so you may need to park your car indoors for a while to equilibrate. Dry is really essential--you don't want to trap any water in the repair. Use a hair dryer if the window is wet. If the surface is dirty, don't use any detergents or window cleaner. Lighter fluid or acetone can help dry and clean the surface, but don't use so much that it dribbles down the glass and peels the paint, or worse.

### Chips Ahoy

We first used a simple kit from Loctite with a one-part adhesive and an uncomplicated syringe to apply it. Start by peeling off the backing film on one side of the precut adhesive strip and applying it to the precleaned glass, centered over the chip. Burnish with the back of your thumbnail or a blunt object. Now peel the remaining film. Orient the plastic adapter so that the fitting is as close to vertical as possible and stick it to the film. Burnish again.

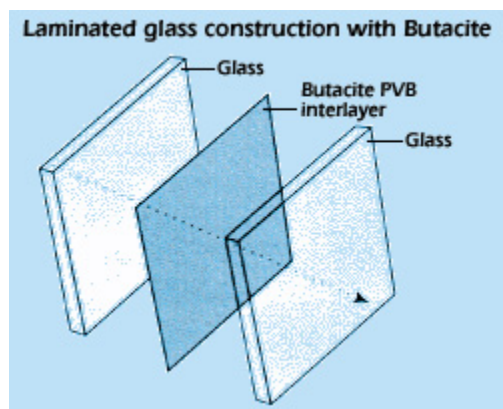
Pull the cap off the syringe, keeping it pointy-end up so the adhesive doesn't wind up on the fender. Attach the syringe to the adapter. Now here's the tricky part--lay your watch down



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Many chips will be repaired almost completely by adhesive injection kits. But some damage requires complete windshield replacement.

somewhere so you can see the second hand. Grasp the syringe body with one hand to stabilize it, and pull the handle of the syringe out as far as it will go. Because you've taken your watch off, you can hold the handle in this position for a full minute. This pulls a partial vacuum in the syringe--and in the crack. While you're holding this vacuum, the air in the crack bubbles up through the adhesive in the syringe, while adhesive creeps down toward the glass and chip.



## HOW IT WORKS

### Laminated Safety Glass

Ordinary window glass, like you have around the house, is pretty amazing stuff. It's clear, strong and cheap. But it's also brittle, shattering into long, dangerous, wickedly sharp shards when overstressed. Plastics would be as strong, but not nearly hard enough to resist scratching and remain clear enough for a car window--just look at any plastic-glazed outdoor bus stop or phone booth, with its patina of fine scratches. For the side windows of cars, automakers have come up with a good compromise: tempered glass. It's stronger than standard, but more importantly, when it does shatter it breaks up into small granules. These granules are still sharp, but should do less damage than the long shards of untempered glass. However, for a windshield, constantly bombarded by pebbles, tempered glass would have a short life span.

So, many years back, the car manufacturers switched to a laminated glass sandwich for the windshield. It's a simple process. Two thinner sheets of glass are fused to a rubber inner layer. The tempered-glass outer layers are then independent of each other. The rubbery center sheet provides damping to any shock waves from errant stones, reducing the probability of breakage. And if the glass is hit by an object smartly enough, odds are that only the outer sheet will break, as is the case with most stone chips. If a really big piece of debris hits the glass hard enough to break both inner and outer layers, the tough membrane prevents it from winding up in your lap. Even better, the shards of glass from the inner lamination wind up stuck to the membrane, keeping them from spalling away from the windshield at a high velocity, causing great havoc.

Now let go of the handle. Don't follow the handle, let it go abruptly. The pressure wave from the handle slamming down will force adhesive into the crack. Repeat this suck-and-slam operation a half-dozen times or so, forcing the crack virtually full of adhesive.

Now remove the syringe, adapter and adhesive sheet. There will be a film of adhesive on the surface of the glass. You can chase that back with an alcohol-dampened paper towel, but leave the pimple of adhesive right above the crack undisturbed until it cures for a few hours.

With the pimple hardened, simply take a single-edge razor blade and shave the protruding adhesive off. Use a sharp blade, and you'll be able to do this in a single pass.

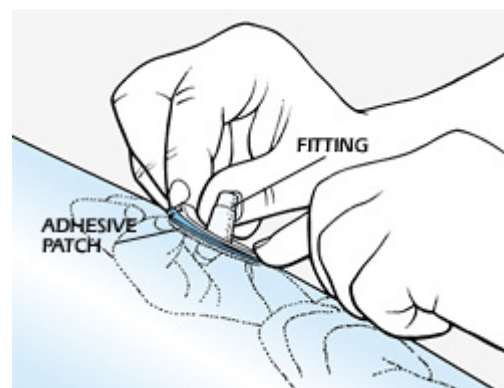
### The Other Path

We tried a different crack repair kit as well. This differed in that it used a two-part adhesive. This required us to mix two small vials of adhesive and hardener in the syringe before starting, which was simple. The adhesive disc and syringe adapter were similar (if not identical) to the simpler kit's, and were applied in an identical fashion. The syringe, however, was more complex. It used a wire latch arrangement on the body that dropped into two notches on the handle when necessary. A simple pushpin stuck into the body was used as a very crude valve to let air in and out of the body. Once the syringe is attached to the adapter (the adapter already being stuck airtight to the glass), the pushpin is removed. Now bottom the syringe plunger, pushing the air out. Insert the pin, and pull the handle out until the clip clicks into the slot. This will hold the plunger out, and the partial vacuum under it for the designated time.

Now, rather than rapidly releasing the pressure like we did with the earlier kit, remove the pin, admitting air into the syringe barrel. Now replace the pin, sealing the hole. Release the clip, and push the handle in, lightly pressurizing the barrel and forcing adhesive into the chip for a minute or so. The second slot will trap the clip as soon as you've pushed in far enough. Repeat this "vent, suck, vent, squeeze" operation several times to force adhesive into the crack.

While the ingenious clip-and-slot and vent business relieves you of the necessity of constantly grasping the syringe barrel like it's the last beer at the picnic, there are caveats. The vacuum pulled isn't as good, purging less air on every iteration. And the simpler kit seemed to force the adhesive deeper into the crack faster by using the plunger as a piston to rapidly pressurize the system.

Having said that, both kits did a bang-up job. After shaving the excess adhesive off, both cracks are barely visible. The adhesive is



Take care to burnish the adhesive patch to a perfectly clean windshield and adapter, or you'll make a mess later.

clear, and has the same refractive index as the glass so that it renders the crack invisible from almost any angle.

One warning: Don't get cute and try to depress the plunger by hand and squeeze the adhesive deeper into the glass with either kit. The adhesive patch might become unglued and squirt adhesive all over your windshield and fender and shirt. Don't ask how we know this.

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