Exterior Panel Straightening- Part Two

PART one of this two-part series discussed the basic science and theory behind metal shaping and how it relates to straightening damaged panels. The article also touched on some of the benefits of straightening a damaged exterior panel. Part two will discuss the procedures and techniques used to apply this knowledge during the straightening process.

Restoring Two-Dimensional Shape

Remember from part one that the first step in repairing a damaged exterior panel should be restoring the basic two-dimensional shape, or basic length, height, and curvature in each direction individually. To do this, the structure of the vehicle that the panel is attached to must first be dimensionally correct. If the vehicle structure that the part is attached to is moved, the part will be placed under stress that causes changes in its two-dimensional shape. Restoring the vehicle structure to proper dimensions will remove the stress from the panel and correct the two-dimensional shape changes in the panel, as long as all of the induced damage is within the elastic range.

Once the vehicle structure is verified as dimensionally correct, any remaining changes to the two-dimensional shape of the part can be corrected. There are a variety of techniques that can be used to do this, depending on the location and type of the damage. Remember that when restoring two-dimensional shape, the repair technique should not stretch the metal. For damage that has pushed a large portion of a panel straight in, using hydraulics cushioned with rubber pads or sand bags to push from the backside is a good choice. Pulling on a large area of two-dimensional shape change from one small spot will tend to stretch the metal where the pulling force is attached. Pushing the damage out, with the force spread over a large area, will help avoid stretching the metal.

If the exterior skin of a panel has been hit in a way that its length has been shortened, it may be necessary to pull the proper length back into the panel. Try to pull from a large cross-section of the panel and move a lot of the damage back at once. Gently stress-relieve the buckles that have been induced into the panel while pressure is still applied to the pull.

When using striking tools to restore the two-dimensional shape to a panel, be sure that not to stretch the metal. A common mistake when straightening a panel is to grab a hammer and start pounding on the damage from the backside. Often times the damaged panel will already have areas of stretched metal, and doing this will only add to the problem. Use wooden- or plastic-faced striking tools when restoring two-dimensional shape. A wooden slapper used with a small hand-held sandbag as a dolly works well for moving the metal without stretching it. Wood “corking” tools can be shaped on a band saw and belt sander to work in tight areas or to restore feature lines. Corking tools are similar to blunt-ended chisels that are struck with a hammer to force the metal into a particular shape. The end of the corking tool should be shaped to match the contour of the area, or feature line being repaired.

Picks and pry tools similar to those used for paintless dent repair can be used to gently lift damage out from the backside. Use tools with rounded tips, and work slowly from the outside of the dent inward to avoid creating dimples in the panel where the pressure is applied.

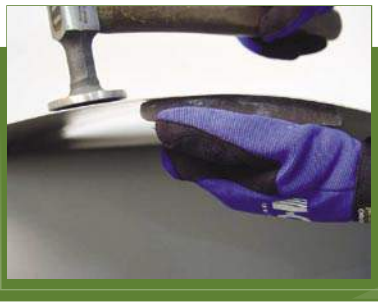

FIGURE 1

The hammer-off dolly technique where the dolly is held against the panel to the side of where the hammer strikes the opposite side helps avoid stretching the metal.

FIGURE 2

On-dolly hammering or striking the panel with the hammer directly on top of the dolly will cause the metal to stretch where the hammer contacts it.

FIGURE 3

This example shows how a paper pattern can be cut and taped, creating a compound curve.

FIGURE 4

Layering masking tape on a panel and carefully peeling it off can create a mold of the panel shape.

FIGURE 5

This cardboard has been cut to make a template of the two-dimensional up-and-down shape of the quarter panel at the door opening.

When using steel hammers and dollies to restore two-dimensional shape, many light hammer blows should be used instead of trying to move the metal with a few heavy blows. The off-dolly technique should also be used. Off-dolly hammering is where the dolly is held tightly against a high spot and the panel is struck on a low spot on the opposite side with the hammer, or vice versa (see Figure 1). For restoring two-dimensional shape, the hammer should never hit the panel where the dolly is being held. Striking the panel where the dolly is being held is called on-dolly hammering and will cause the metal to stretch where it is being hit (see Figure 2).

Patterning a Panel

When restoring shape to a damaged panel, how do we know when we have it right? There are a number of ways that a panel can be patterned to ensure that the shape, both two-dimensional, and three-dimensional, of the repaired panel are correct. Paper can be used to make a simple pattern of the panel shape. The paper can be cut, tucked, and taped together where the metal is shrunk, and cut, spread, and taped together where the metal is stretched (see Figure 3). Layers of masking tape can be built up on a panel surface and peeled off creating a mold of the panel shape (see Figure 4). Both of these types of patterns can be made off of the panel on the undamaged side of the vehicle and then inverted for use on the damaged side.

The contour of the panel can be traced onto cardboard and then cut out. Again, this would be done on the undamaged side of the vehicle. This works especially well at the panel ends, such as at the door jamb, tail lamp pocket, or wheel opening area of a quarter panel (see Figure 5). The cutout can be compared to the shape of the damaged panel during repairs. Depending on the location of the damage, cross-sections can be made in both the horizontal and vertical planes. The problem with cardboard cross-sections is that they are difficult to trace out in the middle of a panel. Commercial contour gauges are one solution to this problem. Contour gauges have either wire or plastic pins that float on a holding bar. The pins will conform to the shape of whatever they are pressed against. The biggest drawback to contour gauges is that they are typically only available in lengths of 305 mm (12 inches) or less. Whatever method used, having a pattern to guide you can be an invaluable tool when straightening damaged panels.

Restoring Three-Dimensional Shape

After the basic two-dimensional shape of the panel has been restored, it is time to refine the repair technique, and repair any areas that have a loss of three-dimensional shape. Collision damage typically stretches the metal in the area of the direct impact, and will typically never cause the metal to be shrunk on the molecular level. What this means is that restoring three-dimensional shape loss is almost always going to involve shrinking and not stretching. Shrinking metal is much more difficult to do than stretching metal. This is why damaged panels with a large amount of three-dimensional shape change will typically not be good candidates for straightening.

Using your eye, hands, and patterns, identify areas where the panel is “fat” and needs to be shrunk. While restoring the three-dimensional shape, continually monitor the two-dimensional shape as it may change slightly as the metal is shrunk or stretched and require refining before continuing.

Shrinking Metal

There are a number of techniques that can be effectively used to shrink metal. Metal can either be shrunk cold, or by using heat. To cold-shrink the metal there are a couple of options. One is to use a wood hammer on a steel dolly or a steel hammer on a wood dolly. The soft wooden face draws the metal together onto the hard steel. This technique takes practice to become effective, as the direction and force of the hammer blows are important to the success of the procedure. On the edges of a panel, small tucks can be made in the metal and the tucks hammered flat using a wood tool against a metal backing.

Shrinking with heat is another option. Before heating a part, check the vehicle maker’s heating recommendations for the type of metal. The theory behind heat shrinking is that when metal is heated it expands. The surrounding cooler metal keeps the heat and metal contained, causing it to bulge up (see Figure 6). As the metal cools it contracts and eliminates the stretched metal. Quick-cooling the metal causes it to contract more than cooling naturally and will eliminate more stretched metal.

To heat-shrink steel, heat an area about the size of a dime to a dull red. An oxyacetylene torch, stud welder with a shrinking tip, or an induction heater all work well for this. The heated area will expand and rise up. Using a dolly on the backside, lightly hammer the raised area almost flat, either starting in the center and circling out or starting at the edge and circling in. The area can then be allowed to cool naturally, or quick-cooled with compressed air or water. This process may need to be done in a number of closely adjacent areas until all of the stretched metal has been shrunk.

Another way to heat shrink is with a tool called a shrinking disc. A shrinking disc is basically a metal disc that is placed on a high-speed grinder and run over the panel in the area that is stretched (see Figure 7). The friction of the disc running over the metal will create heat. Since the disc will only ride on the high spots, which is typically the stretched metal, that is where the heat will be generated. The area is then quick-cooled, which causes the metal to shrink. Monitor the panel and continue this process until all of the stretched metal has been shrunk. It will typically require multiple passes with the shrinking disc to shrink all but the smallest of stretched spots.

Final Finishing

If an area has been over shrunk it can be stretched slightly using the hammer-on dolly technique and light blows with the hammer. In fact it is sometimes actually somewhat beneficial to slightly over-shrink an area and then go back in with a hammer and dolly and plannish the entire area. Plannishing is using many light overlapping blows with the hammer, hammering on-dolly, to cause a very slight amount of even stretch to the panel. This can be done to every part of the area repaired and into the surrounding areas of the panel around the repair. Doing this helps to smooth out any minor irregularities and remove any stresses that have built up in the panel during the repair process, leaving a very stable and stress-free panel.

With the panel successfully metal straightened, a skim coat of finishing filler can be used to smooth out any hammer marks and small irregularities if necessary. Also be sure to repair any damage to backside coatings on the panel, and ensure that proper corrosion protection has been restored.

Conclusion

Often a panel that could be straightened is instead replaced. Many times, replacing is just the best option when all things are considered. However, with the proper understanding of the theory behind metal shaping, the right tools, refined metalworking skills, and patience, damage can often be successfully repaired. For some repairs this means less intrusion into the vehicle and less factory welds and corrosion protection disturbed.

This article series is not meant to be all inclusive of every technique used to straighten a panel, just to give some examples of ways that damage can be removed. Every damaged panel may require a different technique, depending on the damage, the amount of access to the backside, the type of metal the panel is made from, and the tools available to the technician doing the repair.

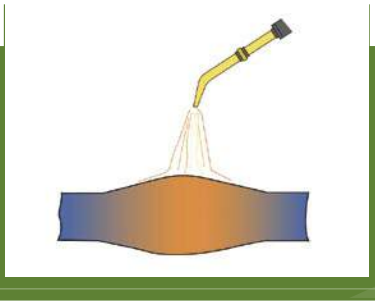

FIGURE 6

Where heat is applied, the metal expands but the cooler metal around contains the expansion causing the metal to bulge up.

FIGURE 7

This shrinking disc can be used to shrink a panel in a very controlled manner.

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