By RON MOORE

Extrication Challenges Of Advanced Steel in Vehicles – Part 1

SUBJECT: Advanced Steel

TOPIC: Extrication Challenges of Advanced Steel in Vehicles, Part 1

OBJECTIVE: Review the cutting capabilities of vehicle rescue tools including hand tools, electric cutters, air-powered cutters and hydraulic rescue system cutting tools.

TASK: Given the information contained in Part 1 of this series, the rescuers will be able to assess the capabilities of the cutting tools carried by their department for vehicle rescue work that involves vehicles built with reinforced A-pillars, B-pillars and roof rail structures.

THE SERIES...

- ✔ Part 1: More Steel
- ❑ Part 2: Advanced Steels
- ❑ Part 3: Cutting Tools
- ❑ Part 4: Power Cutters
- ❑ Part 5: New Rescue Techniques

Ron Moore

This image shows a cross section of the A-pillar of a Volvo C-70 automobile. The pillar metal is just shy of being quarter-inch-thick steel. Up until now, the typical automobile A-pillar that we encounter is approximately only one-16th-inch-thick steel.

Due to the construction of today's vehicles and the variety of ways in which people can be trapped inside a vehicle after a collision, rescuers are being called upon to perform a wide variety of extrication tasks. One common task involves working to force open and remove a jammed door. However, after opening and removing a jammed door, the B-pillar or roof may still obstruct the ability of the rescue team to efficiently remove the patient. Our most common solution to a crushed roof or a deformed B-pillar that blocks access when we want to remove the patient is to cut away the B-pillar or cut the roof off. Power cutters, electric recip saws, even an air chisel can accomplish this task.

With increasing frequency, fire departments across the country are reporting an inability to cut through structural areas such as the B-pillars of late-model vehicles. Our normal rescue cutting tools, whether hydraulic, electric or air-powered, are stalling out. That power cutter you have in your tool arsenal that has worked so well for so many years, the one that has cut through many roof posts and B-pillars successfully in the past, may finally be out-gunned by the steel found in new-model vehicles produced within the last few years. What fire departments

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These new vehicles will challenge rescuers by resisting efforts to cut vehicles apart if the occupant is trapped.

Ron Moore

This B-pillar from a Subaru Impreza vehicle has been sliced open to expose the inner layers of steel and the steel rebar welded inside. A power cutter would have to cut through at least six layers of steel plus the solid rebar if it were to be successful.

Courtesy of Rockville VFD

The 2008 Camry B-pillar crushed under the power of the hydraulic rescue cutters being used by the Rockville, MD, volunteer firefighters but did not cut through. Depending upon where you count, the cutters stalled out while trying to sever eight or as many as 14 layers of steel in the pillar. Later, a rotary saw with an abrasive blade cut the pillar.

are encountering is the newest challenge to confront extrication personnel: the challenge of structurally reinforced steel in late-model vehicles. It's almost as if a tough, crash-resistant roll cage is now being designed into the structure of our newest automobiles and SUVs.

The trigger event that has brought about the improved "crashworthiness" in late-model vehicles is the government's push to improve the side-impact and roof-crush resistance by changing federal motor vehicle safety standards. Automakers have responded to this engineering challenge in two basic ways. One solution that the vehicle design engineers came up with is to reinforce the side and roof structure areas of a vehicle with more layers or thicker layers of steel. The second engineered solution is to make areas such as B-pillars, roof rails, and rocker channels of ultra high-strength steels, otherwise known as advanced steels.

On the bright side, it must be mentioned that due to the integration of more layers of steel in a vehicle's structure or by integrating new advanced steel alloys, occupants are less likely to be injured and trapped. These new model vehicles are already proving themselves to be more crashworthy than what responders have found in the past. At the same time that more steel or use of advanced steels make for a stronger and more crashworthy structure, these new vehicles will challenge rescuers by resisting efforts to cut the vehicles apart if the occupant is trapped.

In this first installment of our five-part series, we focus on the "more steel" approach to vehicle crashworthiness. Two good examples of the "more steel" solution can be found inside Volvo and Subaru vehicles. Volvo's C-70 auto for example, has A- and B-pillars constructed with nearly 1/4-inch-thick walls of steel. With a typical vehicle using merely 1/16-inch-thick layers of steel to create a roof pillar, the Volvo vehicle will challenge rescuers working to cut the roof off, open up a crushed sidewall, or move the dash and firewall. This author's experience accomplishing extrication tasks on these Volvo vehicles confirms that the thicker steel approach to crashworthiness makes for one tough vehicle to tear apart.

An even better example of a car manufacturer using the "more steel" approach for vehicle crashworthiness is Subaru. With Subaru, it is very possible that a rescuer could encounter multiple layers of steel making up the B-pillar of certain models. To the rescuer's surprise, as they cut through the B-pillar, their tool could not only be cutting through multiple layers of sheetmetal, but may encounter one or even two steel rebar rods welded inside the hollow of the pillar.

In Maryland, firefighters from Rockville Volunteer Fire Department arrived at a serious collision involving a 2008 Toyota Camry. The vehicle was struck on the driver's side, trapping the female driver. The Toyota B-pillar, when compressed or squeezed by the blades of a hydraulic power cutter, resembled a folded wallet. The rescue team's hydraulic tools were unable to cut through the B-pillar at this extrication scene.

So many extrication incidents have occurred nationwide where firefighters were unable to cut through B-pillars on 2007 and newer vehicles that the Associated Press ran a feature story on the challenges confronting rescue personnel in March 2008.

In Part 2 of this series, we'll explain what advanced steels are and how they too influence our vehicle rescue activities at crash scenes.

TASK: Given the information contained in Part 1 of this series, the rescue team will be able to assess the capabilities of the cutting tools carried by their department for vehicle rescue work that involves vehicles built with reinforced A-pillars, B-pillars and roof rail structures.

By RON MOORE

Extrication Challenges Of Advanced Steel in Vehicles: Part 2 - Advanced Steel

SUBJECT: Advanced Steel

TOPIC: Extrication Challenges of Advanced Steel in Vehicles: Part 2

OBJECTIVE: The rescuer will understand and explain the rescue challenges presented by the introduction of advanced steels into the structure of late-model passenger vehicles.

TASK: Given the information contained in Part 2 of this series and reference to a late-model passenger vehicle, the rescuer will be able to identify potential areas of the vehicle where its structural steel is or could consist of "advanced steel."

THE SERIES...

- ❑ Part 1: More Steel
- ☑ Part 2: Advanced Steel
- ❑ Part 3: Cutting Tools
- ❑ Part 4: Power Cutters
- ❑ Part 5: New Rescue Techniques

Photo courtesy of Roger Cada, Bloomington, IL

The cut-away view of the B-pillar in this demonstration vehicle reveals that the B-pillar is not entirely Boron steel. Only the silver-colored inner layer of steel shown here is Boron. In most cases, only one layer of two or three layers will be advanced steel. In the real-world, there is no visible difference between the appearance of normal mild steel and any of the advanced steels on a vehicle.

We continue our discussion about the rescue challenges presented by the structural steel materials being used in the newest model-year vehicles. Automakers are working towards improving the side impact and rollover "crashworthiness" of their vehicles to comply with new government motor vehicle standards. In Part One of this series, we learned that there are two engineering solutions being employed; more and thicker steel or use of special alloys to create what is referred to as advanced steel. This second engineered solution – constructing areas such as B-pillars, roof rails, and rocker channels of ultra high-strength advanced steels – is the focus of this article.

To better understand what is different about these new advanced steels, we first need to understand what types of steels can be found in a passenger vehicle. Rescuers might find portions of a crash-damaged vehicle constructed of aluminum. This can include small components, a door panel or a hood for example, or possibly major structural portions of the vehicle such as the aluminum space-frame of the Audi A8.

Most often though, rescue person-

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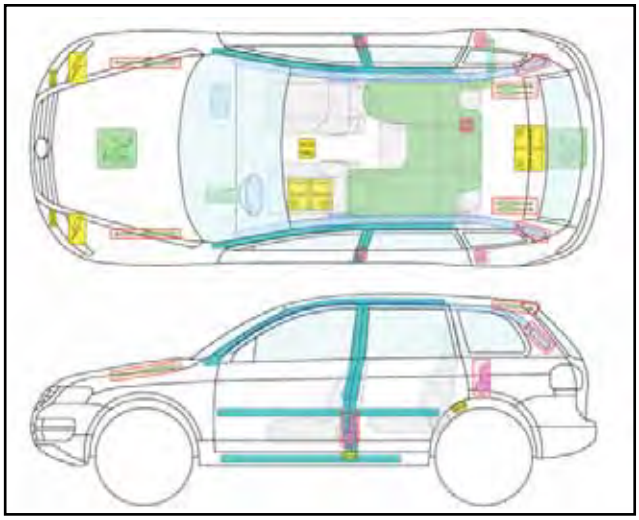

Photo courtesy of Moditech Rescue Solutions BV

This screen shot from Moditech Rescue Solutions' Crash Recovery System reveals locations where advanced steel is used on a late-model Volkswagen Touareg vehicle. The greenish areas show Boron steel in the roof rail, A- and B-pillars, rocker and door collision beams.

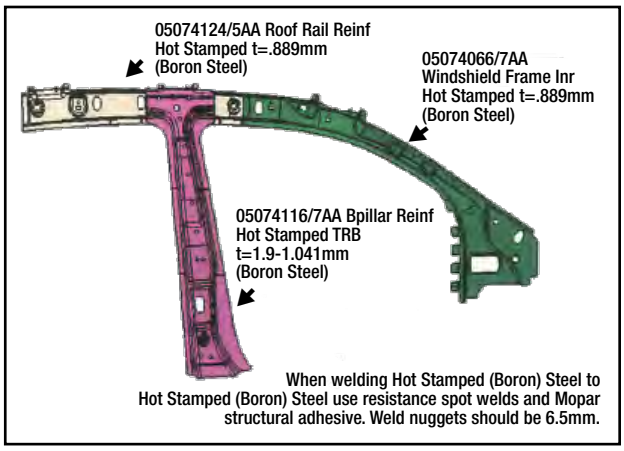

Photo courtesy of Chrysler Corporation Jeep Compass Body Repair Manual

This schematic diagram of the Boron structure of a new Jeep Compass SUV reveals not only where the Boron is located on this vehicle but even the engineered thicknesses at various points. Note that the Boron varies from less than a millimeter in thickness to almost two millimeters thick. For reference, a U.S. quarter is not quite two millimeters in thickness.

nel find that steel is what the vehicle is primarily made of. During rescue efforts, our extrication tools are able to bend, fold, or otherwise mutilate the common mild steel. Now however, with requirements for newer and more crashworthy vehicles, mild steel isn't the only type of steel we will encounter. Automakers over the past few years have introduced the use of stronger steels referred to as high-strength, low-alloy (HSLA) steels. HSLA steel is a tougher, more rescue tool cut-resistant metal. Our older hydraulic power cutters and our light-duty air chisel rescue tools will probably have difficulty working their way through HSLA metal pillars, roof rails, rockers, etc.

Just as we were getting used to high-strength steels, we are now facing the rescue reality of having vehicles built with an even stronger type of steel alloy; what the American Iron and Steel Institute refers to as Advanced Steels. Advanced steels are all Ultra High Strength (UHS) materials. There are several types of advanced steel; the most popular of which is Boron. Automotive engineers consider Boron the "most ultra" of the ultra-high-strength steels. Along with this hot stamped, Boron-alloyed steel, the family of advanced steels also includes Dual Phase steel (DP), Transformation Induced Plasticity steel (TRIP), and Martensite steel.

Why these advanced steels are becoming increasingly more common elements of a modern-day vehicle is due to the fact that advanced steels are lighter in weight than mild steels and are as much as much as eight times stronger than conventional metals. Almost every vehicle manufacturer has increased their use of advanced high-strength steels over the last two model years to improve the crash resistance of their vehicle. A typical 2009 model-year vehicle can have as much as 22 percent of its steel comprised of advanced steel.

To meet the new tougher requirements for intrusion-resistant passenger and engine compartments, vehicles built since the 2007 model year have a higher possibility of having advanced steels integrated into key structural areas. It's almost as if a race car roll cage is being built into the structure of a typical passenger vehicle without the vehicle owner ever being aware of its presence. Rescuers should anticipate that with any new vehicle they encounter at a crash scene, there is a great possibility that the door collision beams, A-pillar, B-pillar, and probably most of the roof rail will contain advanced steel. In addition, the lower rocker area from A- to C-pillar and even cross-members running beneath the floorpan or across the roof may be advanced steel.

The Challenges

For rescuers, the new application of advanced steel is both good news and a challenge. Real-world responses are showing that vehicles built with advanced steel integrated into their structural design are withstanding collision impacts with less and less injury and/or entrapment of the occupants. This is a good thing. A recent frontal collision involving a four-door Jeep Patriot vehicle, for example, resulted in the vehicle going off the road and rolling over more than a full time. Afterward, three of the four doors still could be opened by hand, the roof line had minor damage, and the rear liftgate opened normally. Without the advanced steel skeleton, the invisible roll cage, integrated into this vehicle, crush damage would be expected to have been much more significant and the chance of injury and entrapment for the occupants much greater. In this case, there was no injury to the belted driver and no entrapment.

The rescue challenges of advanced steels are many. In appearance, it is impossible to tell the difference between mild steel, high-strength steel, and the new advanced steels such as Boron. They all look the same. It will actually be our rescue tools that will tell us that we're into something tough. It will be our reciprocating saw that won't cut the roof pillar. It will be our air chisel that won't cut the rocker. And most importantly, it will be our hydraulic rescue cutter, the tool that we've had in on our rescue truck for the past ten years and that has always done what we wanted it to do, that will absolutely stall out when trying to cut through these new advanced steels. When your cutter goes to bite the B-pillar of a late-model vehicle with an advanced steel Boron B-pillar, you and the tool will quickly realize that we've been out-gunned by these new steel alloys.

TASK: Given the information contained in Part 2 of this series and reference to a late-model passenger vehicle, the rescuer will be able to identify potential areas of the vehicle where its structural steel is or could consist of "advanced steel."

By RON MOORE

Extrication Challenges of Advanced Steel In Vehicles: Part 3 – Cutting Tools

SUBJECT: Advanced Steel

TOPIC: Extrication Challenges of Advanced Steel in Vehicles: Part 3

OBJECTIVE: The rescuer will understand and explain the capabilities and limitations of various manual-, air-, and electric-powered rescue tools.

TASK: Given the information contained in Part 3 of this series and reference to a late-model passenger vehicle, the rescuer will be able to identify individual rescue tools within the department's tool inventory that can and cannot be expected to cut through advanced steel Boron structural areas.

THE SERIES...

- ❑ Part 1: More Steel
- ❑ Part 2: Advanced Steel
- ☑ Part 3: Cutting Tools
- ❑ Part 4: Power Cutters
- ❑ Part 5: New Rescue Techniques

By Ron Moore

This cross-section of the B-pillar on the driver's side of a Dodge Caliber reveals the multiple layers that make up the pillar. The outer layer and the inner-most layer are mild steel. Only the thicker middle layer is advanced steel; in this case, hot-stamped Boron.

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During this first-ever research into the challenges of advanced steels for vehicle rescue, it became very apparent that there were rescue tools out there that did not have the capability to cut through advanced steel. Essentially, our current generation of cutting tools were being out-gunned by the strength of the new alloy steels such as Boron and Martensite. In Part 3 of this series, we begin exploring exactly which tools will cut advanced steels and which won't. The time to find out is now, not at the scene of a crash with people trapped.

The research into tool capabilities began by first taking rescue tools that could potentially be used for cutting vehicles apart and organizing them into specific categories. The categories selected were air chisel tools, electric sawing-type tools, gas-powered cutting tools, hand tools and power rescue system cutters. The plan called for each family of rescue tool to be evaluated in a systematic manner on confirmed advanced steel.

Research Partners

Engineers from the American Iron & Steel Institute who participated in this field work confirmed that Daimler-Chrysler had exactly the same advanced steel structure present in its Dodge Caliber four-door sedan as well as its Jeep Patriot and Compass SUVs. The structural A-pillar, the B-pillar, and the roof rail back to the C-pillar were confirmed to be made of hot-stamped

After repeated unsuccessful attempts to cut into or through a Boron B-pillar with various air chisels, the tests were stopped. The chisel was only able to cut into the outer mild steel layer and would not cut through the inner Boron.

Boron alloy steel; that's one of the ultra-high-strength steels that are giving our rescue tools problems. Armed with that information, the Learning & Development group at the corporate offices of State Farm Insurance became involved in supporting the project. Through their network of agents, State Farm officials were able to locate eight 2007 or 2008 models of these specific vehicles, five Calibers and three Jeeps. All had suffered some sort of collision damage, were assigned as "total loss" vehicles and were scheduled for salvage auctions around the country.

Armed with knowledge of exactly what steel was present in these specific vehicles, exactly where it could be found, how thick it was and even how it was attached to the rest of the vehicle, the next step was to plan some rescue tool testing. The outcome of the research had to show what the capability of our current rescue tools are and what tools exist that have the capability of cutting through the advanced steels. The steel that was going to be consistently encountered in all these vehicles was Boron; ranging in thickness from 0.889 mm to 1.9 mm. To put things in perspective, the Boron ranged from slightly thinner than a penny to slightly thicker than a quarter. Also, in every vehicle the Boron layer was an inner layer of steel either inside the A- or B-pillars or comprising a layer of the roof rail. The B-pillar is constructed of three layers of metal – two mild steel layers and the Boron.

Air Chisel Tools

Air-powered tools, both high and low pressure, were tested first. In every case, the air chisels or airgun tools were unable to cut through the Boron B-pillars. The chisel bits cut into the outer mild steel layer but were unable to cut through the Boron layer, even the thinnest areas. In several cases, the chisel bit actually broke. Air chisels are not advanced steel cutting tools.

Sawing Tools: Recip, Circular and Rotary

Electric sawing tools were tried next including an electric-powered reciprocating saw and a special electric rotary saw. Reciprocating saw blade manufacturers from across the country were solicited to get their input into whether they had a blade that would cut Boron. A variety of demolition-quality recip saw blades were purchased for the testing. The blade that represented the best chance of being Boron-capable was the LENOX Gold blade, a product of the Lenox Co. in East Longmeadow, MA. This reinforced tooth design blade with its titanium coating is specially designed to dissipate heat and make the blade's teeth more wear resistant so they stay sharp for quicker cuts. The bi-metal LENOX Gold blade is a unique saw blade; easily identified by its white blade and gold titanium tooth edge.

Prior to the recip saw blade testing, a representative of the Walters Corp. contacted this author to offer a special product called CoolCut. Turns out it is a special gel packaged inside a caulking tube-type container. Instructions were to insert the saw blade into the CoolCut gel. With that coating on the saw blade, the manufacturer stated that it would chemically react during the cutting to keep the blade cool. A cool blade would cut through the Boron was the claim.

After basically sawing the teeth off

The electric-powered Evolution 230 Xtreme Res-Q-Saw did cut into and through the Boron B-pillar and roof rail. Sparks flew in all directions due to the hardened advanced steel, the noise level was very high and the saw blade was ruined in the testing.

Cutting through the hardened advanced steel of the B-pillar destroyed the abrasive blade of the rotary saw. As expected, significant showers of sparks were generated during use of the saw, making this an unrealistic tool for extrication operations.

every recip saw blade we had, CoolCut-coated or not, the end result was that we had only managed to scratch away the mild steel outer layer of the B-pillar but had not even scratched the Boron steel of the vehicle. In fact, the recip saw blades smoked and emitted showers of sparks as they tried to cut their way through the hard metal Boron layer. At the present time, there is essentially no reciprocating saw blade available that will cut through the advanced steels of a vehicle's structure at a crash scene.

Next, the Evolution 230 Xtreme Res-Q-Saw from the Res-Q-Jack Co. was offered for evaluation. This new tool for vehicle rescue is an electric-powered circular saw that utilizes a 1,750-watt, 15-amp motor to power a nine-inch-diameter carbide-tipped blade. The blade is specifically designed to cut mild steel, aluminum, stainless steel and wood. The saw did cut completely through the thickest 1.9-mm portion of a Boron B-pillar on a Dodge Caliber, but only after much effort on the part of the rescuers handling the saw.

Because the teeth on the saw blade were up against a hardened metal, there was a significant shower of sparks coming off the blade in all directions and damage occurred to the blade itself. Of the 48 carbide tips on the blade when we started, approximately 10 were gone by the time we completed our B-pillar cut. The noise level while the tool was working at maximum speed was almost deafening even while standing outside the vehicle. Yes, the saw cut through the 1.9-mm-thick layer of Boron steel in the B-pillar, but it isn't practical to consider this being realistically done at a real-world crash scene with a trapped patient and EMS personnel inside.

The final rescue tool in the saw category that was evaluated was a fire department gasoline-powered rotary saw. This versatile forcible entry tool was set up with an abrasive blade and tasked with cutting through the advanced steel structure of the vehicle. This saw, as one can already assume, did cut completely through the Boron B-pillar with only a typical amount of effort. That is the fact. The reality is that the blade was completely chewed up during the process, the shower of hot sparks from the Boron steel were scattered throughout the length of the vehicle, and the noise and exhaust smoke also made this tool Boron-capable, but not Boron-realistic tool for a real-world rescue scene.

Hand Tools

The next category of tools evaluated were our fire department hand tools. To balance out the reality of what we are up against with advanced steels, an entire B-pillar from a Jeep Patriot was placed on the ground. One firefighter was assigned to take sharp-pointed tools and attempt to puncture a hole in the B-pillar. He first took a pick-head axe and swung it over his head. As he came down, the pick end of his tool struck the B-pillar and simply glanced off. After repeated efforts to make a hole in the steel, the tired and frustrated researcher gave up. End result: a small ding in the pillar. Most strikes of the axe bounced off the hardened metal, leaving hardly a trace of any damage. The same results occurred when a halligan-type bar was used to attempt to puncture the pillar. We're definitely up against some tough stuff here.

Power Rescue Cutters

The performance of hydraulic-powered rescue cutters were evaluated as well as part of this overall project. Manufacturers of power rescue tools were invited to submit their power cutters for evaluation of their ability to cut through the Caliber or Jeep Boron steel structure. It became obvious that every hydraulic rescue tool manufacturer makes a power cutter that will not cut Boron.

The question as to which manufacturers have new generation cutters that can make it through the advanced steels will be addressed in Part 4 of the University of Extrication series.

By RON MOORE

Extrication Challenges of Advanced Steel In Vehicles: Part 4 – Power Cutters

SUBJECT: Advanced Steel
TOPIC: Extrication Challenges of Advanced Steel in Vehicles: Part 4
OBJECTIVE: The rescuer will understand and explain the capabilities and limitations of various hydraulic-powered rescue cutter tools
TASK: Given the information presented in Part 4 of this series, the rescuer will demonstrate the steps necessary to effectively operate a power cutter to cut through the advanced steel structural areas of a late-model passenger vehicle.

THE SERIES...

- ❑ Part 1: More Steel
- ❑ Part 2: Advanced Steel
- ❑ Part 3: Cutting Tools
- ✔ Part 4: Power Cutters
- ❑ Part 5: New Rescue Techniques

Ron Moore

The most successful tool position for cutting through a Boron B-pillar was this "parallel" position. The blades were able to close more before cutting into the metal, letting them generate a greater force than if they were loaded while fully opened.

Courtesy of Genesis Rescue Systems

One of the lessons learned thus far is that blade design can be a significant factor in whether a power rescue tool cutter will be able to cut through advanced steel. Shown are examples of combination radius/serrated, elliptical, radius and serrated blades.

As a rescuer, just having a hydraulic-powered cutter unit in your tool inventory no longer guarantees that you will be able to cut through all the structural areas of a crash-damaged passenger vehicle. There may be nothing mechanically wrong with the tool you are using; it probably worked hundreds of times before to do the same thing you are trying to do now. Your failure may simply be a matter of your cutter being outgunned by the strength of the ultra-high-strength advanced steels found in new vehicles.

In Part 4, we look at research being conducted with hydraulic-powered cutters to determine what it takes to cut the advanced steels and how cutters can best be used to complete this task. The pioneering research by this author has revealed some new and interesting information about the challenge of new vehicle extrication. Also, it has become apparent that not only the power of the cutter but other factors such as tool positioning, hose length, pump fluid flows as well as the blade design itself can mean the difference between making the cut or not.

The hydraulic rescue tool manufacturers are all acutely aware of the challenge of cutting advanced steel. All rescue tool manufacturers have cutters that will not cut through advanced steels; that is obvious. They are typically a cutter manufactured in the 1980s, '90s or the past few years. Generally, it will be a newer model cutter that is capable of cutting through the advanced steels such as Boron.

A field research project was designed

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Ron Moore

The Champion Beast with their USAR cutter blades is shown being tested on the B-pillar of a 2008 Dodge Caliber. This specific spot on our test vehicles contained the thickest 1.9mm Boron steel hidden inside the pillar.

and put into action by this author. Power rescue cutters are being assigned standardized tasks consisting of cutting through vehicle A-pillars, roof rails and B-pillars that are known to contain advanced steels. To create consistency and a level playing field, the project required lots of exactly the same type and thickness of advanced steel to cut through. The steel engineers from the American Iron & Steel Institute in Southfield, MI, provided technical data on the exact composition of the advanced steels used in our test vehicles. In a cooperative effort with officials at the Vehicle Research Center of State Farm Insurance, several crash-damaged late-model vehicles were provided from their "total loss" inventory. These vehicles all had exactly the same Boron structural steel design.

Systematically, each rescue tool manufacturer has been offered the opportunity to submit various makes and models of power cutters to be put through the testing. Each cutter is used to cut "thin" Boron; in this case, metal that was slightly thicker than a dime. The roof rails of the donated vehicles all had 0.889-millimeter-thick Boron, so that was our thin testing. For the "thick" Boron test, each cutter had to cut through the B-pillar at a point where the Boron was known to be 1.9 millimeters thick and was wrapped inside multiple layers of mild steel. This Boron was thicker than a quarter.

Lessons Learned

Results have shown cutter failures and successes. Some of the lessons learned:

• The ability of a power cutter to get through the Boron testing did not necessarily correspond with each manufacturer's published cutting forces for its tool. In other words, just having an advertised big-number cutting force rating for a specific tool did not guarantee that Boron could be cut in our tests. It seems that the ratings of power cutters are typically theoretical calculations determined through engineering formulas. Since they are not an actual cutting force measurement, advertised cutting forces may not accurately represent usable forces or what a cutter can do in the real world. There may be more to it than just these numbers.

• Blade thickness is important. In our testing, the cutters that went right through the thickest Boron B-pillars without hesitation all seemed to have specially designed thick blades. The blade thickness held the blades steady and allowed the Boron and the mild steel wrapped around it to be cut completely through.

• Blade shape or design may be another significant factor as well. The Boron testing evaluated different blade designs; radius, elliptical, serrated and a combination radius/serrated unit. There were successes and failures with each style. Many times, the common radial blade design caused the tool to crush the multiple layers of metal into a tight bundle before it was able to try to cut the B-pillar. In some cases where the power of a tool was marginal, the crushing would occur and then the tool would stall out. In cases where serrations in the cutting edges of the blades allowed the pillar or roof rail to start tearing initially as the blades closed, the cutter may make it through the Boron.

• It became apparent during our testing that power cutters are weakest when the blades are fully open and gain strength as the blades close. Their strength is also greatest at the deepest point near the pivot pin. In our real-world testing, this meant that positioning a cutter at a 90-degree angle to a B-pillar may not allow the cutter to cut through the Boron, especially if the blades are short or small in size. By simply turning the tool parallel to the side of the vehicle and getting a different bite, we were able to have the same tool successfully cut through the Boron in some cases. Don't give up if your cutter stalls out. Change your attack angle and go again.

• The newer cutters that were able to cut through the Boron seemed to have larger cylinder bodies. They also were most successful when they severed the metal in one continuous motion, almost a shocking action. Advanced steels stress first, then fracture with a sound similar to that of breaking glass. Due to the larger cylinder body size, it takes more fluid to move the piston and force the blades closed on the new cutters. A problem could occur if a department upgraded to a new-generation cutter, but hooked it up to an older power plant with a small reservoir or a low-flow pump. The cutter would move slowly, take longer to build to maximum pressure and may seem to have poorer performance than the older cutter it is replacing. Operating new cutters through existing hose reels may further diminish the performance of the tool when attacking advanced steels.

• When a cutter was out gunned by the Boron, there was a tendency for the blades to spread apart from each other as the tool stalled out. Rescue personnel should monitor the alignment of the ends of their cutter blades when cutting on late-model vehicles. Any spreading movement of the blades apart from each other is a bad sign – a red flag to stop and reposition.

• One final point is that the advanced steels vary in thickness throughout the structure of any given vehicle. There is no physical indication of whether the steel roof pillar or the area of the B-pillar you are cutting for example is or isn't advanced steel. The best advice if your cutter stalls out during what you expected to be a routine cut is to "reposition, relocate, and retry." Reposition the tool in relation to the piece being cut with a position parallel to the B-pillar being the most likely angle of attack. Relocate a few inches up or down from where you made your initial attempt to maybe get into thinner metal or even hit some mild steel soft spot. Then retry your cut and be patient in allowing your power plant to develop full pressure. Our testing criteria consisted of a hold for 10 seconds and, in some cases, the tool made it through only after a five- to eight-second delay when full pressure finally built up in the system.

By RON MOORE

Extrication Challenges of Advanced Steel In Vehicles: Part 5 – New Rescue Techniques

SUBJECT: Advanced Steel
TOPIC: Extrication Challenges of Advanced Steel in Vehicles: Part 5
OBJECTIVE: The rescuer will understand optional techniques to consider when confronted with a person trapped in a crash-damaged vehicle with an advanced steel structure and the department does not possess the ability to cut the advanced steel.
TASK: Given an acquired vehicle with a simulated advanced steel structure, the department's rescue tools, and the scenario of a broadside collision, the rescue team will perform optional techniques that could be used to free a trapped occupant that do not involve cutting into or through any of the simulated advanced-steel areas of the vehicle.

THE SERIES...

- ❑ Part 1: More Steel
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Pie Cut

If only the B-pillar contained advanced steel and not the roof rail, it might be possible to cut the roof rail on both sides of the top of the pillar in a "pie cut" fashion and lay the pillar down.

In Part 5 of the University of Extrication series on advanced steels, we present a pictorial guide to optional techniques that could be considered when a person is trapped in a late-model vehicle that has advanced steel in its structure. The scenario is that the rescue team does not have the capability of cutting the advanced steel and have decided to utilize alternative techniques. These alternative techniques include the "Pie Cut", "Lifting the B-Pillar", "Spreading the B-Pillar", "Ramming the Roof Off", and "Total Sunroof" evolutions.

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Photos by Ron Moore

Lifting the B-Pillar (1)

With this training exercise, we are simulating that most of the B-pillar and all of the roof rail consists of advanced steel that the rescue team cannot cut through. Rescuers should be trained to attempt to cut all along the roof rail, just in case there is "soft" steel somewhere within the structure. Here, efforts to cut through the pillar near the rocker channel are successful. One popular Chrysler vehicle's structural design has mild steel at the bottom of the B-pillar, spot welded to the main portion of the pillar.

Lifting the B-Pillar (2)

Once the B-pillar is cut through at the bottom, it can be lifted up and away from the simulated trapped patient. The patient doesn't care if you lay the B-pillar down or lift the B-pillar up; they just want out.

Spreading the B-Pillar

If an advanced steel B-pillar cannot be cut through, an alternative can be to ram the B-pillar away from the trapped occupants. Here, a push off the center "tunnel" moves the pillar.

A spread from B-pillar to B-pillar can also be used to move a crash-damaged pillar off of the patients trapped inside. Monitor roof movement as it may begin to lower into the vehicle as the B-pillars move outward.

Ram the Roof Off

When a rescue team cannot cut through a B-pillar or roof rail that contains advanced steel, a backup plan can be to ram the roof off the top of the B-pillar. Even though advanced steel may be present, a powerful ram may be able to push the roof rail up until it begins to tear at the spot welds.

After an initial push behind the B-pillar, a second push along the front side may be enough to completely tear the B-pillar from the roof rail. Note that cribbing will be necessary beneath the rocker to support the push of the ram.

When a team encounters a vehicle with all roof pillars, the entire roof rail and the entire rocker channel containing advanced steel, an optional technique can be the "total sunroof" evolution. First, the roof is cut from the front windshield header to the rear window. Here, a reciprocating saw is used.

Total Sunroof

A relief cut is made at the front and rear on the "hinge" side of the roof and the entire roof panel is lifted up and away from your trapped patient. A rapid extrication could be accomplished once the "total sunroof" is open.

With the "total sunroof" completed, if the side of the vehicle were still crushed in on your patient, you could push the sides away very easily now that the roof has essentially been disconnected from the side structure of the vehicle.

TASK: Given an acquired vehicle with a simulated advanced steel structure, the department's rescue tools, and the scenario of a broadside collision, the rescue team will perform the "Pie Cut", "Lifting the B-Pillar", "Spreading the B-Pillar", "Ramming the Roof Off", and "Total Sunroof" evolutions.

By RON MOORE

Extrication Challenges of Advanced Steel In Vehicles: Part 6

SUBJECT: Advanced Steel
TOPIC: Extrication Challenges of Advanced Steel in Vehicles – Part 6
OBJECTIVE: The vehicle rescue instructor/trainer will conduct effective training that simulates the presence of Advanced Steel in an older, acquired vehicle.
TASK: Given an acquired vehicle for extrication training that does not have Advanced Steels in its structure, the vehicle rescue instructor/trainer shall take steps to simulate the presence of these steels in the vehicle and then shall assign the "work-around" techniques to rescue crews.

This paint scheme mimics the advanced steel crashworthiness design used in several new General Motors vehicles. The only area on the entire side structural ring of the vehicle that is not high-strength or ultra high-strength steel is the area just above and below the rear door latch assembly.

Photos by Ron Moore

One of the most significant challenges today for vehicle rescue instructors is that we want our rescue teams to be able to handle entrapment situations involving new, late-model vehicles that have advanced steels such as Boron or Martensite integrated into their structure. Our reality as an instructor, however, is that it's next to impossible to get a new car to cut up that actually has this kind of steel in it. So, what do we do?

In Part 5 of this series on Advanced Steels, published in September of 2009, alternative rescue techniques were presented for crews that might encounter an entrapment situation involving advanced steel but not have a power rescue cutter that can cut through it. Referred to as advanced steel "work-around" techniques, it becomes very apparent that rescuers need to practice tasks such as the "Pie Cut", "Lifting the B-Pillar", "Spreading the B-Pillar", "Ramming the Roof Off", and "Total Sunroof" evolutions in training sessions.

There are two steps that an extrication instructor can take to better prepare their crews for just such a situation. The first step is to create an advanced steel simulation vehicle. The second step is assigning crews to complete "work-around" tasks on this older acquired vehicle.

To simulate the presence of advanced steel in an older, junk vehicle that is to be used for extrication training, a can of high-visibility spray paint is required. Prior to the start of your extrication training session, bright orange, yellow, green or florescent pink spray paint is applied to the side structure of a four-door vehicle. With the doors open, on the driver's side of this vehicle, paint the entire A-pillar, the entire B-pillar, and all of the rocker panel. Paint the C-pillar from the roofline down to just below the top edge of the door. Then skip the area near the door latch and finish by painting the lower portion of the C-pillar below the latch down to the rocker. This paint scheme simulates one advanced steel design used in selected General Motors vehicles.

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On the passenger's side of the advanced-steel simulation vehicle, paint the A-pillar from the roofline down to the top front door hinge. Paint the roofline from the A-pillar rearward to the connection with the C-pillar. Finally, paint the B-pillar from the roofline down to the bottom hinge of the rear door. This paint scheme simulates one style of advanced steel used in Chrysler Motors vehicles.

This paint scheme simulates advanced steel utilization in a late-model Chrysler Motors vehicle. The steel is inside the upper A-pillar, through a portion of the roofline, and inside most of the B-pillar.

Explain to your students that all painted edges of the structure on this car magically now contain advanced steel. Crews working on this car will simulate that they do not have a power rescue cutter tool that can get through this steel. They will have to accomplish "work-around" techniques that you will assign to them.

The instructor has to assign the "work-around" techniques on this vehicle in a very specific sequence. Following this order of tasks will allow the instructor to get the most value out of this one acquired vehicle.

The four-door vehicle is sitting on a level surface on its four wheels. The vehicle has been painted with high-visibility spray paint that is now dry. Participants in the class have been organized into small working teams for this training. The vehicle has to be stabilized. All four doors can actually be opened and cut off at the hinges. The instructor then follows the recommended order of tasks, assigning one task after another to the participant teams until all eight "work-around" tasks have been completed.

For more news and training on special operations, visit: http://www.firehouse.com/topic/rescue-and-special-ops.

Assignment 1 – Driver's Side: Spreading B-Pillar to B-Pillar

Begin on the driver's side and assign a team to slightly widen the B-pillars as if one had been crushed inward due to a severe side impact. This crew must spread with a tool such as a power ram from B-pillar to B-pillar to simulate moving a crash-damaged pillar off of a driver trapped inside. It is not an easy task because the seatbacks will obstruct this spreading effort and many teams have power rams but they may not extend far enough to reach from one B-pillar to the other. Monitor roof movement as it may begin to lower into the vehicle as the B-pillars move outward.

Assignment 2 – Passenger's Side: Spreading Center Tunnel To B-Pillar

The second crew must also move a B-pillar away from the interior of the vehicle as if it had been pushed inward during a side impact. This crew, however, can only work their pushing or spreading tool on their half of the vehicle; from the floorboard center tunnel area to the passenger's side B-pillar. Again, push just enough to show that it can be accomplished in a real-world situation.

Assignment 3 – Passenger's Side: Lifting B-Pillar Up

For this third training assignment, efforts to cut through the pillar near the rocker channel are successful because there is no advanced steel in this lower area of the simulation vehicle. One popular Chrysler vehicle structural design has mild steel at the bottom of the B-pillar, spot welded to the main portion of the pillar. Once the B-pillar is cut through at the bottom, have the crew lift it up and away from the simulated trapped patient. The patient doesn't care if you lay the B-pillar down or lift the B-pillar up; they just want out. Leave it attached at the roofline for now.

Assignment 4 – Passenger's Side: Pie Cut

The fourth "work-around" assignment simulates that only the B-pillar contains advanced steel and not the roof rail. This design is used in late-model vehicles from Toyota Motors. For this task, the assigned team disregards the fact that the roof rail has been painted. The simulation is that it is possible to cut the roof rail on both sides of

the top of the pillar in a "pie cut" fashion. Once the cuts are completed, the crew must lay the pillar down. (Note: At this training session, this effort removes the B-pillar from the car because it has already been cut off at the bottom by a previous crew.)

On this acquired vehicle, the crews have completed the total sunroof "work-around" assignment. For this task, only the top of the windshield needed to be cut to disconnect it from the roof. (Note: Restrictions imposed at the salvage yard required the crews to leave all tires inflated.)

Assignment 5 – Driver's Side: Ram the Roof Off

When a rescue team cannot cut through a B-pillar or roof rail that contains advanced steel, a good "work-around" technique can be to ram the roof off the top of the B-pillar. Even though advanced steel may be present, a powerful ram may be able to push the roof rail up until it begins to tear free at the spot welds.

The assigned team must place additional cribbing beneath the rocker to support the force of the ram. After an initial push on one side of the B-pillar, a second push on the opposite side may be enough to completely tear the B-pillar away from the roof rail in a real-world situation. Once separated from the roof, the crew must practice bending the pillar down without making any additional cuts. It simulates not being able to cut the bottom of the pillar in a real-world scenario.

Assignment 6 – Driver's Side: Total Sunroof

On the driver's side of the painted vehicle, the assigned team encounters a vehicle with the A- and C-pillars containing advanced steel. The team must cut the roof panel from the front windshield header all the way back to the rear window following a line along the inside of the edge of the roofline. The tool of choice is a reciprocating saw.

After the full-length cut on one side, relief cuts can be made at the front and rear on the "hinge" side of the roof. The entire roof panel can then be lifted up and away from the simulated trapped patient below. Once the "total sunroof" evolution is completed at a real-world incident, the crew could push the sides of the vehicle away now that the roof has essentially been disconnected from the side structure of the vehicle.

Assignment 7 – Driver's Side: Dash & Instrument Panel Movement

The final two "work-around" techniques address a hard-impact frontal crash where we normally would roll the dash or jack the dash. The problem, however, with our advanced-steel simulation vehicle is that the A-pillars can't be cut. On the driver's side, assign a team to push directly on the intact A-pillar, the steering column, or on the dash support pipe that runs across the instrument panel with a tool such as a ram. Remember, if a real-world crash had occurred, these components would be pushed onto your patient. You are just moving them back to their original positions anyway. Remind them to sever the dash tie-down straps along the center tunnel if they exist.

Assignment 8 – Passenger's Side: Dash & Instrument Panel Movement

The assigned team on this side also must move the dash, instrument panel, and A-pillar away from a simulated front-seat occupant. Again, the upper portion of the A-pillar cannot be cut, but on this side the advanced-steel simulation ends at the bottom door hinge. The very bottom of the A-pillar can be cut.

TASK: Given an acquired vehicle for extrication training that does not have advanced steels in its structure, the vehicle rescue instructor/trainer shall take steps to simulate the presence of these steels in the vehicle and then shall assign "work-around" techniques to rescue crews.