ARE GENERAL SECTIONING GUIDELINES STILL APPLICABLE?

It has been over twenty years since the original I-CAR research on structural sectioning.

That research resulted in a list of general sectioning guidelines for repair facilities to consider as a subjective business decision for partial replacement. Many things have changed over the years that have affected the general sectioning guidelines. However, nothing has had more of an impact as the increased use of advanced high-strength steel (AHSS) and vehicle maker design technology.

This article will address general sectioning guidelines, reinforce the necessity to follow the vehicle makers' recommendations, examine the effect AHSS and design technologies are having on the decision process, and hopefully answer the question: are general sectioning guidelines still applicable? One thing is for sure, the number of collision damage situations that would even qualify for general sectioning guidelines is getting lower and lower each and every year.

"The I-CAR sectioning guidelines explain how to determine if a part qualifies for sectioning, and where the joint should be located if it does qualify. Sectioning should be done in a uniform area that allows enough clearance to perform quality welding operations. I-CAR recommends against sectioning in or near these areas:

- suspension, engine, and drivetrain mounting locations.
- holes larger than 3 mm.
- compound shapes or structures.
- reinforcements.
- hinge locations.
- seat belt D-ring attachment points.
- locations where vertical and horizontal panels meet.
- collapse or crush zones." (crush initiators)

The first question to consider is; are there areas on late-model vehicles that would even qualify for general sectioning guidelines given all of this criteria? In other words, are there parts that have smooth and continuous areas that are not located in a collapse zone or near a mounting location, have no holes larger than 3 mm, are void of any reinforcements, and have no compound shapes or structures? The number of vehicles being built today with areas that meet all of these requirements is minimal, at best. Let's examine a few of these criteria and relate them to today's vehicles and then add some additional considerations into the mix; vehicle maker recommendations, advanced high-strength steel (AHSS), and location and design intent.

UNIFORM AREAS AND COMPOUND SHAPES OR STRUCTURES

As if general sectioning guidelines weren't subjective enough, the terms "uniform area" and "compound shapes or structures" are both open to varying degrees of interpretation. The vehicle build technologies that have allowed vehicle makers to introduce new shapes and designs not formerly available using sheet metal stamping processes have certainly increased the complexity of vehicle design and incorporated many more compound shapes and structures into vehicle architecture. The number of areas that a majority of industry professionals would consider a compound shape or structure has increased over the years. Uniform areas that are smooth and continuous have been greatly reduced. The exceptions to this may be hydroformed frame rails and unitized pillars, rocker panels, and rear rails. However, pillars and rocker panels present a different set of variables and obstacles.

REINFORCEMENTS

The number of reinforcements used on some later model vehicles has increased over the years and may be difficult to identify simply by visual inspection. Vehicle makers were challenged with greatly improving side-impact crash performance and roof crush. To meet that goal some vehicle makers increased the number of reinforcements that were used to strengthen the side of the vehicles (see Figure 1). Additionally, reinforcements were also being used in other areas, such as lower front rails. Similar to the side of the vehicle, reinforcements can be used for collision energy management. In a lower front rail, a reinforcement may be used to transfer energy around a particular area. Does this mean now that AHSS is available as a construction material fewer reinforcements are being used? Not exactly. Some of the AHSS used on today's vehicles is being used as a reinforcement, or as a collapse zone.

COLLAPSE OR CRUSH ZONES

In the past, collapse zones were fairly easy to identify and to avoid following general sectioning guidelines. Often the collapse zones appeared accordion-like and were located near the end of a rail. While there are a number of vehicles with collapse zones that can still be easily identified, new design technologies have made identification more difficult. Tailored blanks are used by a number of vehicle makers to build collision energy management into front lower rail designs (see Figure 2). Tailored blanks include multiple strengths and thicknesses of steel in a single part that is "tailored" for the design engineer's intent. The tailored blank may be used to absorb energy (a collapse zone), or to transfer energy (a type of reinforcement). Some tailored blanks are easier to identify than others. Tailor-welded blanks may have a visible laser weld seam identifying it as a tailored blank. However, tailor-rolled blanks make identification more difficult. Tailor-rolled blanks may

"SECTIONING SHOULD BE DONE IN A UNIFORM AREA THAT ALLOWS ENOUGH CLEARANCE TO PERFORM QUALITY WELDING OPERATIONS"

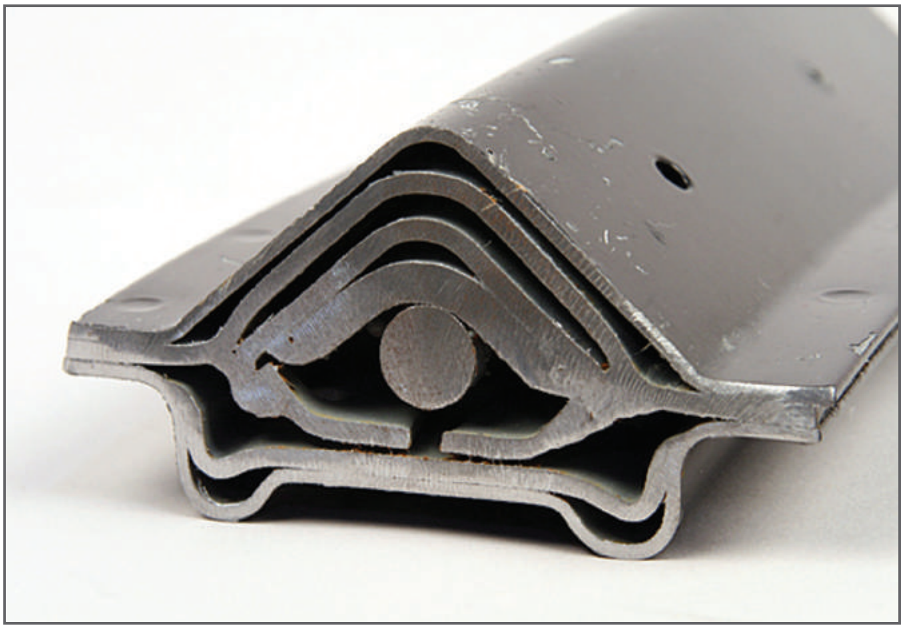


Figure 1 - A cutaway of a B-pillar from a 2000 Subaru Legacy Outback wagon shows multiple reinforcements.

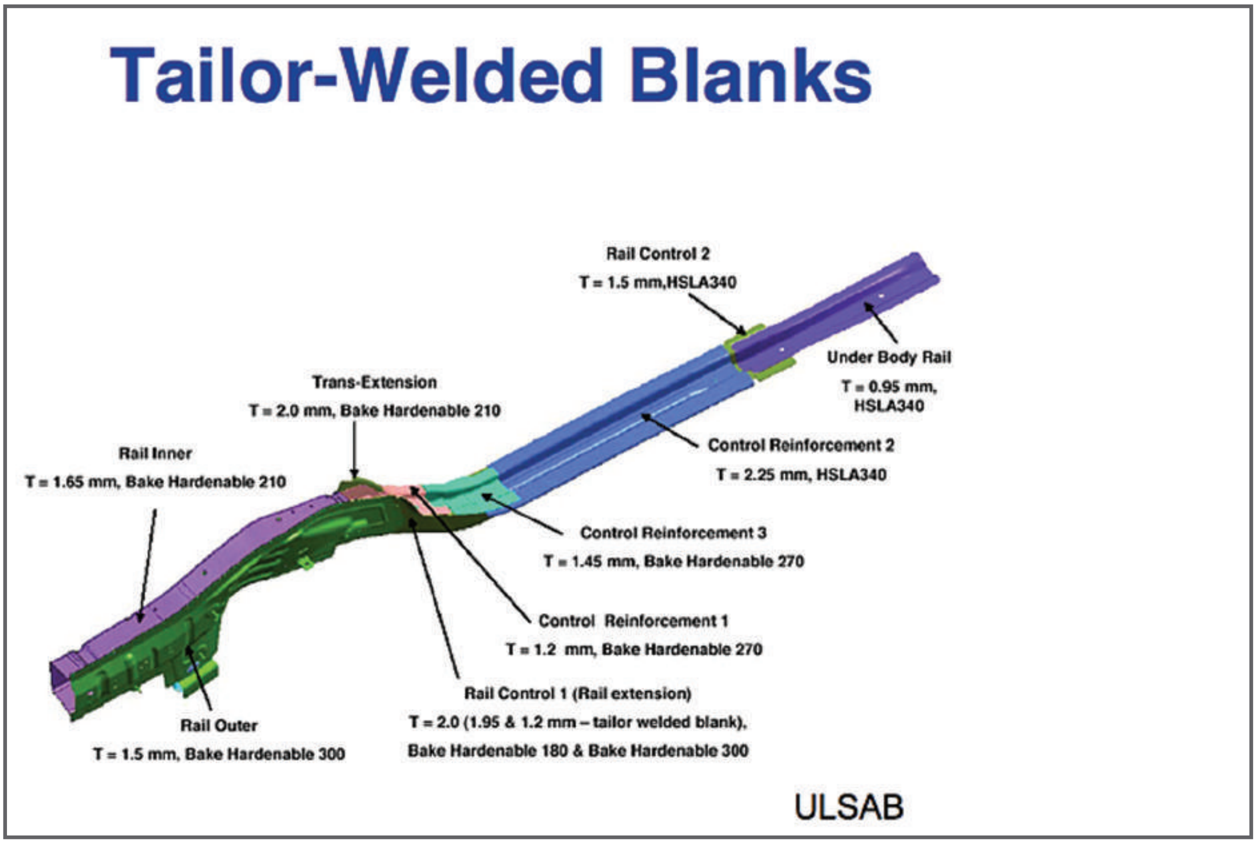


Figure 2 - Rails are often “tailor made” today with different strengths or thicknesses of steel in the same part.

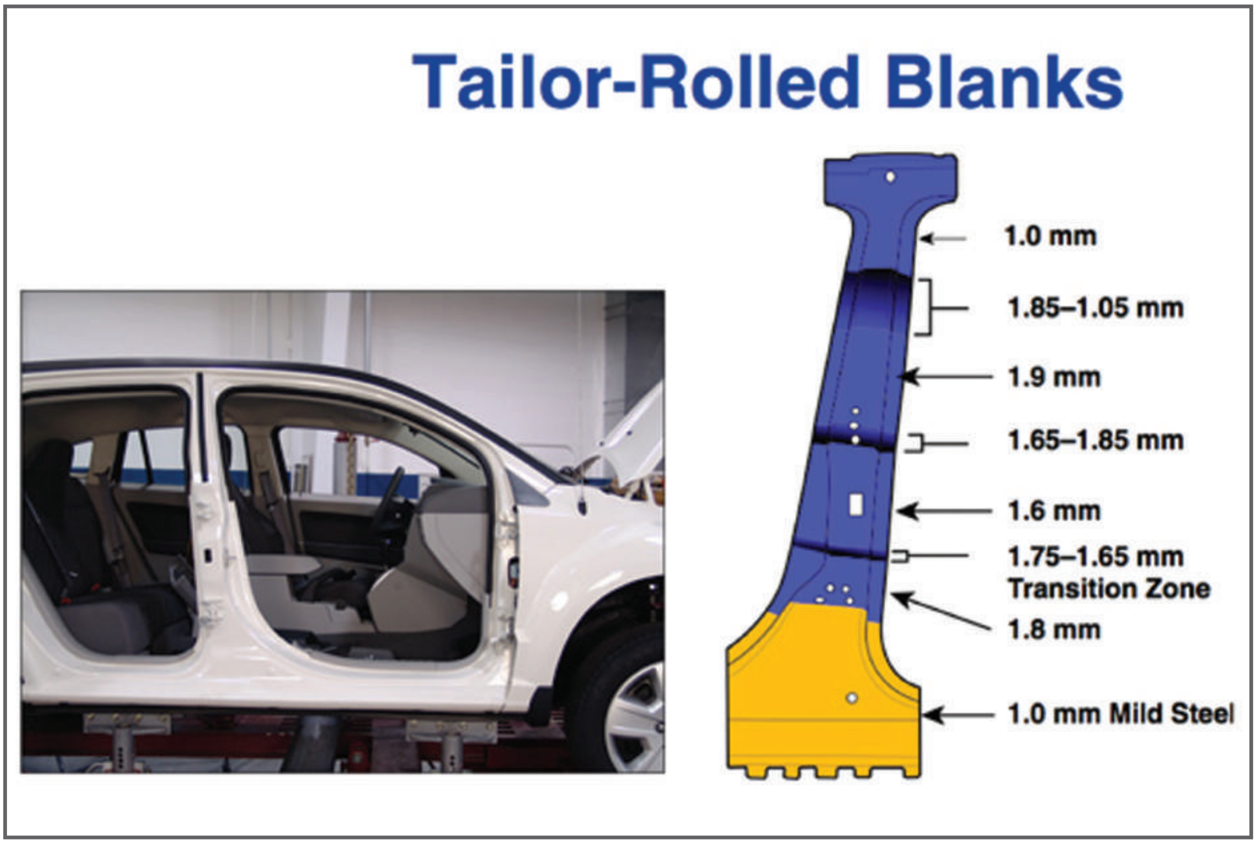


Figure 3 - There are different strengths of steel but no laser welds along the length of the Dodge Caliber B-pillar.

vary a fraction of a millimeter in a given area. The Dodge Caliber, for example, has areas on the B-pillar that are 1.00, 1.05, 1.65, 1.75, 1.85, and 1.9 mm thick on the same part. (see Figure 3).

So, how do you identify if a tailored blank is used and if it is designed to collapse or transfer collision energy? The only way to begin speculating would be to know the strength and thickness of the steel used in a given area. However, that also presents some obstacles. How would you determine the thicknesses and steel strengths of a tailored blank? If you knew the thickness and strength of different areas on a tailored blank, could you effectively conclude the design intent of that area? If you answered "yes," ponder this for a moment. Which is stronger; a 1.65 mm area of Bake Hardenable 210, or a 1.5 mm area of HSLA340?

VEHICLE MAKER RECOMMENDATIONS

Today there are more vehicle maker recommendations for partial replacement than ever before. Partial replacement recommendations may include sectioning or replacing a portion of a part at a factory seam. I-CAR has always recommended following vehicle maker recommendations when they exist; that has not changed. What has changed is the number of procedures and service parts that are available. When a partial replacement recommendation is available from the vehicle maker, the options for replacement include partial or complete replacement.

One question that is often asked is "if there is a procedure available, but there is a kink behind the recommended sectioning location, can general sectioning guidelines be used?" Generally speaking, the answer should be "no." The procedures published by the vehicle maker are tested and approved for the repair of that vehicle. That location represents the area that the design engineer has deemed the best place to do the procedure. One could conclude that areas without recommendations for sectioning don't fit the criteria established by that design engineer. Some vehicle makers, Volvo for example, have multiple sectioning locations available for a single part. Sectioning in an area behind an approved vehicle maker sectioning location would be a subjective business decision.

Some vehicle makers offer a number of sectioning procedures on a particular vehicle. If the vehicle maker allows sectioning of pillars, rocker panels, and rear rails, but not a front lower rail, you may want to consider why there isn't a procedure available. Is there a design reason why the vehicle maker doesn't offer a procedure for that area? Was testing done that resulted in not recommending a procedure? Unfortunately, the collision repair industry professional does not know the answer to these questions, thus adding more subjectivity to a decision to section without the support of a vehicle maker recommendation.

There are also a number of vehicle makers that have published bulletins that warn against sectioning if no vehicle maker recommendation exists. Honda and Chrysler are two vehicle makers who have published such statements. In fact, Honda has published this statement on multiple occasions. Ford Motor Company issued a statement in 2006 recommending that structural repairs only be completed using Ford-recommended repair procedures. Where no factory-supplied information is available, Ford recommends repairs be made at existing joints or seams using repair procedures that duplicate factory assembly processes and techniques.

In an effort to assist the collision repair industry in identifying which vehicles have sectioning procedures available, I-CAR, in association with State Farm and Tech-Cor, developed the partial replacement recommendations matrix. To determine if there is an approved partial replacement procedure available for a particular vehicle:

1. Visit www.i-car.com/partialreplacement

2. Enter the vehicle year and make from the pull down list and click the "Find Partial Replacement Recommendations" link.

3. Enter the model information and click on the "Find Partial Replacement Information" link.

4. If there are recommended procedures available from the vehicle maker for the front lower rail, pillars, rocker panel, roof rail, rear rail, or trunk floor, the results will indicate its availability. There is also a link to the vehicle maker's technical information web site on the results page.

ADVANCED HIGH-STRENGTH STEEL

The most significant change in steel vehicle construction in the past 20-plus years is the substantial increase in use of advanced high-strength steels. Many of these steels fall into the high-strength and ultra-high-strength steel categories. Before discussing what the increased use means to sectioning, let's first take a look at the reason why vehicle makers are using an increased amount of AHSS.

Vehicle makers are tasked with designing vehicles that offer an unprecedented number of creature comforts and electronic safety features. All of the computers and wiring associated with these electronic systems add a significant amount of weight to the vehicle. At the same time, vehicle makers are required to reduce overall vehicle weight, reduce emissions, and improve fuel economy. Lastly, vehicles are being designed to provide a historically high level of protection against injury and fatalities in a collision. Federal Motor Vehicle Safety Standards and Regulations (FMVSS) requirements are becoming more and more stringent and the vehicle makers are racing to meet the increased safety demands. Vehicle safety and crashworthiness are becoming primary reasons for one vehicle being selected over another by the safety-conscious consumer. All of these factors combined have resulted in the vehicle makers working with steel manufacturers to develop new, lightweight steels.

These new steels have a variety of names and characteristics. One characteristic that many of the AHSS share is their strength and vulnerability to heat. When heat, including welding, is introduced to a sectioning location that is not recommended by the vehicle maker, the integrity of that part may be significantly compromised. To emphasize the importance of not applying heat unless recommended, I-CAR performed some directional tests on boron-alloyed steel samples. The baseline boron-alloyed steel sample fractured at 4,625 psi. A similar piece that was cut and GMA (MIG) welded fractured at 2,400 psi, a decrease of nearly 52%.

LOCATION CONSIDERATIONS

An additional consideration when determining if general sectioning guidelines should be applied is the location of the part and its design intent. The front and rear of the vehicle are designed to absorb collision energy. Before choosing to section a lower front rail without the support of a vehicle maker recommendation, first consider what effect sectioning will have in that area. Consider what type of steel is used in the area where the proposed sectioning would be. Also consider which type of joint will be used and if an insert will increase the strength of the part in that area.

Pillars and rocker panels are designed to transfer collision energy around the passenger compartment in frontal collisions and to limit passenger compartment intrusion during a side-impact collision. The pillars and roof rail are also designed to withstand substantial weight in the event of a rollover. With the upcoming FMVSS roof crush requirements and the desire for "five star" side-impact ratings, the vehicle makers are using a significant percentage of HSS and UHSS in the pillars and rocker panels. While a pillar or rocker panel may offer a smooth and continuous area, there is most

NEW TOYOTA POSITION ON REINFORCEMENTS

Toyota issued a revised position on the repair of high-strength steel (HSS) and ultra-high-strength steel (UHSS) occupant cabin reinforcements. In this Collision Repair Information Bulletin (CRIB) 175, it is stated:

• Do not straighten HSS or UHSS occupant cabin reinforcements, hot or cold
• Do not section pillar reinforcements 980 Megapascals (MPa) and 590 MPa
• Only section 440 MPa parts where specified in the Toyota service information

Occupant cabin reinforcements include not only pillar, rocker panel, and roof rail reinforcements, but roof bows, floor crossmembers, door beams, and the rear bulkhead as well. Any of these parts that are HSS or stronger cannot be repaired.

In the CRIB, Toyota states, "This recommendation is based on a reduction in reinforcement strength and crash energy management revealed during research and testing conducted by Toyota Motor Corporation. Repaired and/or improperly sectioned reinforcements failed to exhibit the strength and performance ratings of genuine new original equipment service parts installed to specification. Therefore, damaged occupant cabin reinforcements must be replaced."

To identify the strength ratings of steel, particularly in newer models, refer to the model-specific Toyota Repair Manual for Collision Damage structural outline, listed in the Introduction section. This section identifies structural materials and strengths.

Some applications of 440 MPa steel (HSS) include the bottom third of many B-pillars on Toyota, Lexus, and Scion vehicles. 590 MPa steel (UHSS) is common in the upper two-thirds of the B-pillar reinforcements and rocker panel reinforcements. 980 MPa steel (UHSS) is also used on some rocker panel reinforcements.

likely a combination of reinforcements and AHSS in those areas. Additionally, many vehicle makers offer sectioning procedures for outer uniside panels. However, some vehicle makers may not allow side aperture reinforcements to be sectioned because of the steel they are made from and may recommend replacement at a factory seam. All of these factors combined limit the use of general sectioning guidelines in those areas.

Depending on the type of vehicle, rear rails may be one area that may still qualify for sectioning when applying general sectioning guidelines in cases when no vehicle maker recommendations exist for or against doing so. Additionally, complete rear rail replacement can be an extremely intrusive repair option. Applying general sectioning guidelines to a rear rail when no vehicle maker procedures exist would be a subjective business decision.

CONCLUSION

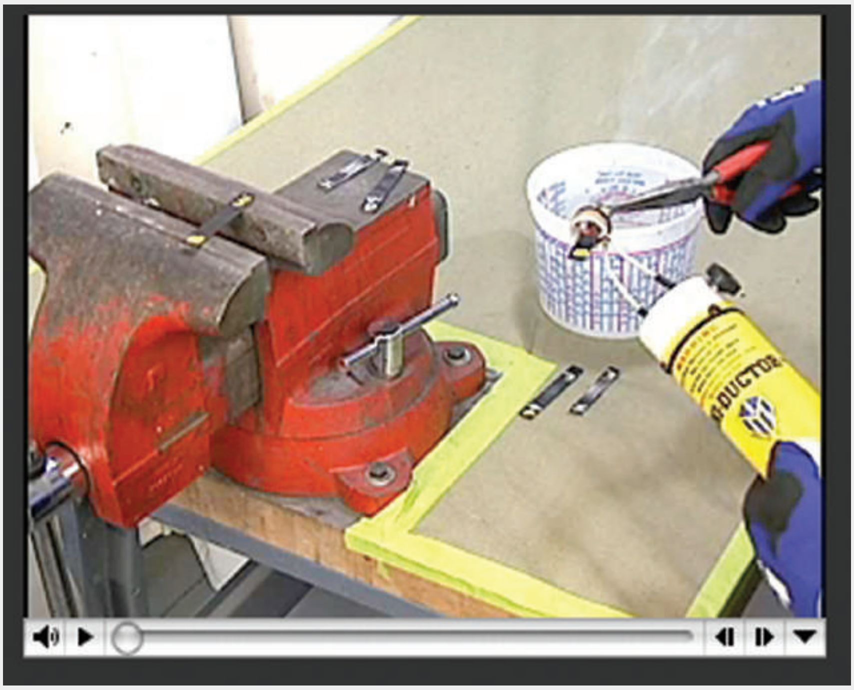
The materials and construction design technologies that are being used on today's vehicles are making it increasingly difficult, if not impossible, to apply general sectioning guidelines. In addition to the criteria that have been used for over twenty years, the collision repair industry professional is also now tasked with considering the design intent and determining the steel makeup of the part. All of this makes the decision to apply general sectioning guidelines more subjective than ever.

Fortunately, the number of vehicle makers offering partial replacement recommendations has increased significantly over the past few years. I-CAR will continue to work closely with the vehicle makers and encourage the continuation of this trend. I-CAR is also committed to continually report on the availability of partial replacement procedures. We will update the partial replacement matrix on a regular basis, report on new technology through the I-CAR Advantage Online, and develop and deliver applicable training to address new vehicle technology.

Cutting Access Windows

Several vehicle makers have developed sectioning procedures for reinforcements that include cutting and removing a portion of an outer body panel, sometimes called a "window" to allow access to an inner reinforcement for sectioning. However, some technicians have adopted the practice of cutting access "windows" in enclosed structural assemblies to access the backside of damaged panels to allow for more effective straightening of damaged structural parts.

Questions repeatedly arise about whether cutting "windows" is an acceptable collision repair practice. Cutting windows into a part to allow access for straightening may actually be more intrusive than sectioning to partially replace a structural part. This is because partial part replacement using sectioning typically only creates one sectioning joint that is closed with a continuous GMA (MIG) weld. A "window" can have as many as four cut sides creating two sets of parallel seams that must be welded shut with continuous GMA (MIG) welds, creating open butt joint seams that need to be finished to be cosmetically acceptable. This creates large heat-effect zones in the part and adjacent areas, and if the part is made from heat-sensitive steel, the part can be negatively affected from the welding heat.



A video showing the effect heat can have on AHSS can be viewed at: www.i-car.com/quicktime/advantage/120307.mov

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