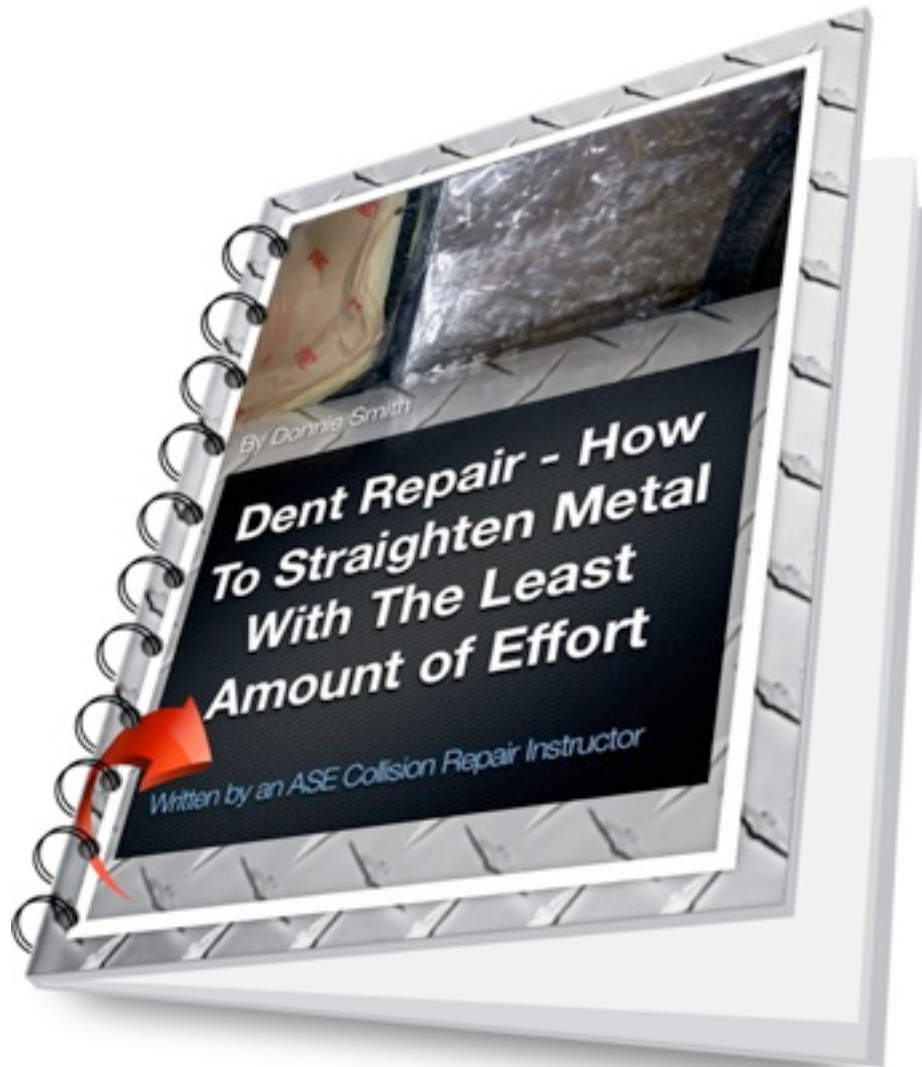


Dent Repair: How To Straighten Metal With The Least Amount of Effort



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DEDICATION

This book is dedicated to all the car enthusiast and anyone else interested to learn more about auto body repair and painting. Thanks to you all, the interest in this trade continues to thrive. Thanks for taking the initiative to learn more, which will empower you to expose this skill to upcoming generations for years to come.

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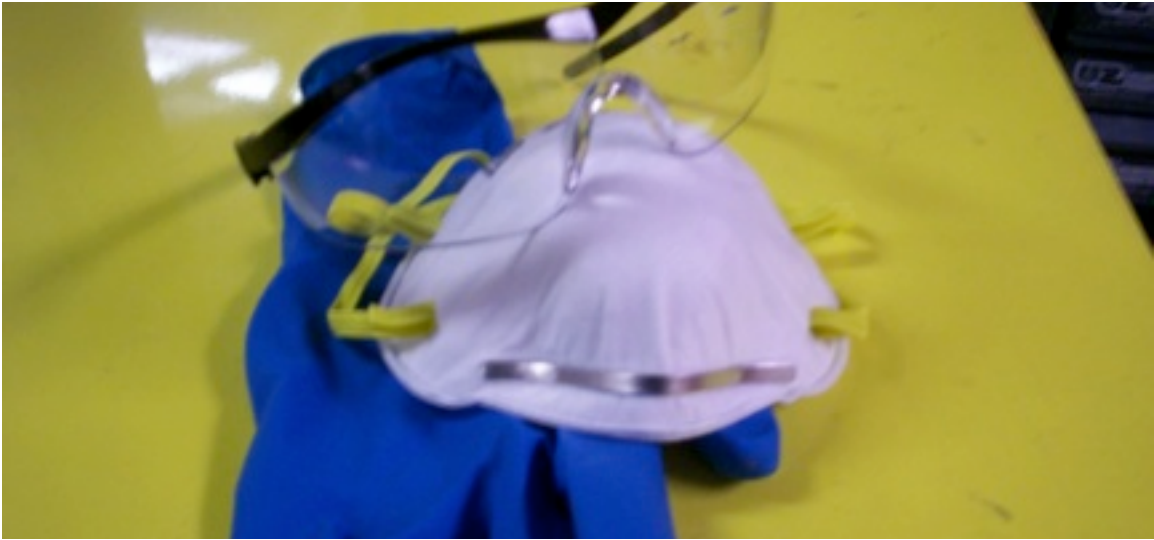
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Safety



Are You Worth One Million Dollars?

"Safety is something that happens between your ears, not something you hold in your hands" ~Jeff Cooper

In this module, you will be introduced to safety. Taking proper safety measures is a habit you must instill into your mind and work. Take the time to create productive and safe work habits.

You know it; I had to mention safety before we kick off. You always hear “safety first” at safety meetings, but many technicians think safety is a lot of hype and ignore the safety policies. So is safety really that important?

Let's Talk Cars



Photo With Chip Foose and Charley Hutton: NACE 2008

First, since we're all about cars, not safety, let's talk about restoring an awesome car. Let's say we have an unlimited budget to build a million dollar ride. You know, a car like Chip Foose at Foose Design would build. Of course, it would take hours and hours of labor and thousands of dollars to get it there, but the end result would be well worth the wait and money. Could you imagine having a ride worth one million dollars? I'm sure that you would take a lot of pride in it. I know that I would. Would you take care of it? What about storage, would you keep it in the garage or put it out back in the weather? I'm sure that you would do everything that you could to protect the car from being damaged.

Another Question



Photo Taken at SEMA 2011

If someone offered you a million dollar car like this, would you exchange it for your eyesight? What about a leg, or would you trade your life for it? I am assuming you answered no, as these things are priceless to us. I would not want to even exchange my eyesight or life for a billion dollars. While most of you would agree, we are quick to ignore safety and grab a grinder and start grinding, weld without a welding helmet, paint without a paint respirator, or many other things that could affect our health without thinking twice about it. If you're willing to take good care of a car, don't you think you should take care of yourself?

I know it can be confusing to watch some of the shows on television or even walk in to some of the body shops and see people not practicing good safety habits. However, don't buy into the "if they are not doing it, it must not be important" mentality. It's your health...take care of yourself.

Over-Exaggerating

Well, this is over-exaggerated. Or is it? There are many eye injuries and painters who have to leave the collision repair industry every year due to becoming sensitive to paint chemicals. It really happens, but the good news is that most injuries are preventable.

How To Prevent Injuries

It would take a while to explain all the PPE (Personal Protective Equipment) that needs to be used, but I will highlight a few of them.

PPE

1. Eye Protection – Most schools require eye protection to be worn at all times in the shop area, but I see many body shops that do not require eye protection. However, I would highly recommend that you get in the habit of wearing eye protection. Eyesight is too valuable to lose.

2. Dust masks – When sanding or grinding wear an approved dust mask. This will prevent you from breathing all the products being sanded and other debris that is not healthy for you.

3. Respirator – The catalyzed clears and primers that are out there should not be taken lightly. They have chemicals that will mess you up. Wear an approved respirator when spraying any coatings.

4. Gloves – Chemical resistant gloves should be worn when working with chemicals. This will prevent the chemicals from entering your body through your skin.

5. Hearing Protection – You may not need to wear hearing protection at all times, but if there is grinding, air chiseling, or other loud things going on, protect your hearing.

There are many other PPE and safety procedures to consider before working in a shop area. This just covers several of the most common PPE used in a body shop environment.

Jacks, Jack Stands and Lifts

When working under a car, steps should be taken to prevent injury. This sounds like commonsense, but there has been many people injured or killed by being pinned underneath a car. In fact, I personally knew 1 guy this happened to. He was a corvette enthusiast. After he retired from the military, he had a shop and worked on his own cars. One day, he was late coming into the house for lunch. His wife became curious why he had not come in to eat yet. She walked into the shop to find him pinned underneath a car that he was working on. He lost his life due to being underneath a car without jack stands.

He was a perfectionist at everything he did. No one knows for sure, but I am guessing he was not really working underneath the car, he probably got underneath the car chasing a bolt while the car was lifted by a jack, as working under a car without jack stand was not his nature. That is probably when he got pinned; the jack may have slipped. Regardless of what happened in his situation, my point is to use jack stands anytime you are underneath a car. No matter how big or small the job...or even if briefly to find a missing bolt.

Why Not To Trust The Jack?

Jacks are designed to raise the car, not to support it. Jacks can slip or bust all at once pinning you under a car, or hydraulic jacks can slowly leak without you noticing until it's too late. If you become trapped underneath a car, as the jack continues to leak and lower is another situation you do not want to find yourself in. Whatever reason, just secure the car with jack stands to prevent this from happening to you.

Use Wheel Chocks

When jacking a car, apply the emergency brake and use wheel chocks to prop against the tires to prevent the car from moving during the process.

Shop Lift Safety

If using a lift that lifts the car by the frame, be sure to look underneath the car to properly place the lift arms. Raise the car about 3 to 6 inches of the ground to double check the car is anchored properly and the weight is balanced properly. To do this, shake the car to assure that everything is correct. If something is going to shift or slip, this is the time you want it to happen...not when it is fully raised in the air.

Once the car is raised to the desired height, always assure the lift's safety lock is engaged. Most of the lists and frame machines I have used requires the lift to be lowered until the safety locks are locked into place.

These are just a few tips that I am familiar with. However, there are many different brands and types of lifts and frame machines out there. Always read the

equipment manual and ask questions until you fully understand how to properly operate the equipment.

Hazardous Materials

There are many hazardous materials used in a body shop. Therefore proper handling and disposal is required. When painting, you are going to have waste to deal with. My best advice to you is to check with your local fire Marshall to determine the proper way to dispose of the waste, as there are different laws in different parts of the country.

One question you may ask is, if you can store the waste in a 5 gallon bucket, with a lid. Once full, find a body shop that recycles the waste to do this for you. Now that is just something to ask about, not advice, as I do not want to get caught up in legal issues, as this is a sensitive topic. Just check with the fire Marshall in your area to be safe. I am going to leave it at that, as the laws differ in each state.

I will provide you with 6H training for you to consider. I think if you are a DIY and do less than xx number of paint jobs per year, this may not apply, but check with local laws to be certain about this.

The main thing I would like for you to know is there products that are considered hazardous waste and you should be aware of that and you should find out how to dispose of it. I have included OSHA training for you to watch to learn more about this topic. I have provided additional training regarding, OSHA, and, hazardous material on the resource page.

Air Tool Safety

There are many different pneumatic tools used in a body shop. A few of the most common tools are: grinders, cutters, sanders, and blow guns. I will list a few of the safety cautions to be aware of when operating the tools. However, you will need to read the manual or technical data sheet to each individual tool before using. Be sure to read the recommended air pressure for the air tool you are using. This will save the life of your tool and prevent an unnecessary injury.

It is also important to maintain your air tools by oiling them daily and keeping them clean.

Grinders: Grinders are used to remove coatings, grind welds, and preparing metal for body fillers. There are other uses for grinders, but the same safety procedures should be followed. Grinders produce sparks and dust. This is probably the number one cause for embedding metal into eyes in the body shop. To prevent this, safety glasses should be worn. For additional safety, a face shield should be worn as well. Due to the dust and airborne debris the grinder produces a dust mask should be worn to protect your lungs. A grinder can be loud, which requires earplugs to be worn to protect your hearing. Another thing

to keep in mind when grinding, is that the disc is turning at a high RPM. Care should be taken not to wear loose clothing, long hair, or jewelry that can get caught up in the grinder. Long hair should be tied back or tucked underneath a cap.

Buffers: This is the same thing as a grinder, but is operated at a lower rpm and a buffing pad is used, rather than a grinding disc. Therefore, all the same safety precautions should be used, as with a grinder.

Cutters: There are different types of tools used to cut metal. A cutoff wheel is a common tool used to cut metal in body shops. A cutoff wheel produces sparks, dust and debris like a grinder. Therefore, same safety precautions should be taken with cutoff wheel as with a grinder. Eye protection, a dust mask to protect lungs from dust and debris, and ear plugs to protect hearing. The cutoff wheel turns and could get caught up with loose clothing, long hair, and jewelry, so the same precautions should be used with a cutoff wheel as with a grinder.

Caution: The cutting wheel should be checked before each use for chips, cracked or broken cutting discs. If the disc is damaged, replace it. A damaged cutting disc can explode, which can cause pieces of the disc to fly and hit you or someone else in the shop causing serious injury.

Sanders: Sanders are used to remove coatings, scuff painted surfaces to provide mechanical adhesion, sand fiberglass fillers, sand body fillers, featheredge paint surfaces and many other applications in a body shop. The most common sanders is an air file and a dual action sander. Both sanders produce the same precautions. Eye protection should be worn for any tool used, but sanding also creates much dust and debris. Therefore, a dust mask should be used to protect your lungs, and hearing protection is also recommended, as sanders create loud noise.

Air Guns: This tool is used to blow an area to clean it. However, this should be used as little as possible. For example, it is not a good idea to blow body filler off a panel to clean it. This blows dust everywhere making a mess. Using a hand broom and dust pan or a vacuum is a much better tool to use for this. An air gun comes in handy to blow a car off before pulling into the paint booth to remove and dirt that may be hiding in crevices and cracks. You should also use approved air guns, which will not blow more than 30 psi.

Caution: Air guns can cause serious injury or death. You can read more about this at www.CollisionBlast.com/AirGunWarning

This is just a few of the common air tools used in a body shop. However, there are many other air tools that you may need to operate when working on cars. Always read the tool's manual. OSHA also has a pdf file you should read concerning tool safety. Visit www.CollisionBlast.com/OSHAToolSafety

Bloodborne pathogens: Defined by OSHA as, infectious microorganisms in human blood that can cause disease in humans. These pathogens include, but are not limited to, hepatitis B (HBV), hepatitis C (HCV) and human immunodeficiency virus (HIV). Needlesticks and other sharps-related injuries may expose workers to bloodborne pathogens. Workers in many occupations, including first aid team members, housekeeping personnel in some industries, nurses and other healthcare personnel may be at risk of exposure to bloodborne pathogens.

Is this a concern in a body shop? Watch the short video over bloodborne pathogens on the resource page to learn how this is a concern in any work environment. You need to attend training to learn what to do if there should be an accident. However, there is another concern in the body shop. Even though there is not an accident, there are many sharp metal edges that can cut our hands. This is something you should be concerned about and aware of. The safest way to work sheet metal is to wear work gloves to prevent yourself from getting cuts. Also be sure to bandage all open wounds to protect yourself and others from any type of contamination.

I hope when you answer the question of who is saying safety first, you think of yourself. Forget about the policies and procedures. If that is your only concern, you may only do it to please the boss. The problem with this is you may slack when the boss is away...it's all about you, keep yourself safe...as we just discussed, you're worth a million dollars.

I know that safety is not one of the most interesting subjects and I will be the first to admit that this is not my expertise topic, but it is very important. If you get hurt, you may not be able to perform this type of work for fun or as a career. Therefore, I have included additional training and several safety training resources to introduce you to safe work habits.

Safety Resources



Photo With Jessi Combs: SEMA 2011

Videos

Note: A video presentation of all three modules, safety, vehicle history, and metal straightening is available on the metal straightening resource page.

www.CollisionBlast.com/DuPont6HVideo - This is a good video overview of the 6H Ruing

Safety Training Videos

- www.collisionblast.com/introduction-to-ohsa
- www.collisionblast.com/bloodborne-pathogens-training
- www.collisionblast.com/electrical-safety
- www.collisionblast.com/industrial-ergonomics
- www.collisionblast.com/hazcom
- www.collisionblast.com/hazardous-waste-handling
- www.collisionblast.com/ppe
- www.collisionblast.com/tool-safety

Product Information

- www.CollisionBlast.com/3MRespirator
- www.CollisionBlast.com/SafetyGloves
- www.CollisionBlast.com/ShootSuit
- www.CollisionBlast.com/3MDustMask
- www.CollisionBlast.com/EarPlugs

Product Technical Data Sheet

www.CollisionBlast.com/HowToReadTDS - This is a two part video that explains how to read a technical data sheet.

Websites

www.CollisionBlast.com/6HTraining - Free training for 6H

www.CaeerSafe.com - Training website. They have a lot of free resources, but there is a charge for their safety training courses.

www.OSHA.com - This is the official website for OSHA.

www.sp2.org - Provide automotive specific safety training for a charge.

www.CollisionBlast.com/VirtualPaintShop

www.CollisionBlast.com/AutoBodyOSHA - This is a web page of OSHA, which pertains specifically to auto body shops

Safety Training Activity

Read the text, and then watch the safety videos included in the resources. I have also included several websites for you to view. There is additional training (free and paid) on each website for you to consider.

Question

Think of a time that a safety procedure or equipment protected you from injury; or a time that you were injured due to insufficient equipments or lack of policies in place.

Advice



The most important advice that I can offer is to read all product, tool, and equipment labels and manuals before using or operating any tool or equipment.

Safety Key Terms

EPA: Environmental Protection Agency

ISOCYANATES: This is the chemical in many paint products that is very unhealthy and can cause many health defects.

MSDS: Material Safety Data Sheet - This is a form that products have, which state all the chemical, ingredients, hazards, etc., regarding the specific product.

NOTE: By law, body shops must provide or have available, the MSDS sheets for the products used at the business.

OSHA: Occupational Safety Health Administration

PPE: Personal Protective Equipment

TDS: Technical Data Sheet - This is the directions of how to use a specific product. May also be referred to as the procedure pages. I believe this should be read on every product used. This will help you eliminate many common mistakes made.

VOC: Volatile Organic Compounds - This is solvents that become airborne during spraying and evaporation of paint products. VOC is what the EPA has a big concern with and developing ways to reduce VOCs.

Safety Quiz

Below are the quiz questions for safety.

1. MSDS is a document that an employer is required by law to have available for each of the products used in the workplace.

- A. True
- B. False

2. An MSDS sheet provides all the warnings and hazardous material information for a product.

- A. True
- B. False

3. According to the Introduction to OSHA video

- A. OSHA has helped cut fatalities by 60%
- B. OSHA has helped cut occupational injury and illness by 40%
- C. Both A and B
- D. Neither A or B

4. Bloodborne pathogens are not a concern in a collision repair work environment.

- A. True
- B. False

5. Safety is a lot of hype. In reality, it is not that important.

- A. True
- B. False

6. OSHA is responsible "the right to know" law. These laws include all except:

- A. receive proper training and information.
- B. reviews copies of OSHA regulations.
- C. request information from your employer on hazards, safety precautions, and procedures.
- D. reviews your customer complaints and customer service policies.

7. According to the "Electrical Safety Video" electrical safety includes locking and tagging.

- A. True
- B. False

8. Hearing protection is optional. Grinders and other loud noises are bothersome, but will not damage your hearing.

- A. True

B. False

9. According to the video "Introduction To OSHA" they

A. have authority in most countries.

B. are focused on keeping workers safe.

C. are responsible for testing and certifying equipment.

D. are only out to fine businesses for violations.

10. Industrial Ergonomics is the idea of arranging your tools and workspace to make your job easier with less strain.

A. True

B. False

Vehicle History



They Don't Make Them The Way They Used To

"Whether you think that you can, or you can't, you are usually right"

~Henry Ford

The First Cars



Photo Taken at Automobilia: Wichita, KS

The first motor cars were nothing more than a buggy and engine. (Generally repaired by blacksmiths and carpenters. These cars were very expensive, which only the wealthy could afford)

Model T was the first car mass production on an assembly line in 1908 (Ford's vision was to produce an affordable car the average person could buy)

Model T's came in black only to keep the costs down. (The price came down once the assembly line was streamlined, but in 1908, the cost for a Model T started at \$825. By 1913 the cost of the car was reduced to \$550)

Cars in the 1960s



Photo Take at SEMA 2011

Cars were made the same basic way up through the 60s.

Body Over Frame

Rear Wheel Drive (Same idea, but the cars were very big, bulky, and heavy)

Except people in the 60s wanted SPEED! They achieved this with Big Block Motors, which created much horsepower. (The Birth of Hotrods, Rat Fink, Flames, and Pin Striping.)

Cars in the 1970s



Photo Take at SEMA 2011

The government placed strict fuel economy and emissions control laws.

Customers demanded cars with increased fuel economy

New laws and customer demands started the automotive explosion of engineering ideas and changes in the automotive industry

Changes to Comply with Demands and Laws

Smaller bodied cars and smaller engines

Aerodynamics (Increase Fuel Mileage)

Lighter cars by using different materials and designs

More work-hardened areas created during formation of panel (Body Lines)

Safety

Construction of Interstate Highways + Higher Speed Limits + More High Performance Cars = Accidents and More Deaths from Auto Accidents

Federal Laws were passed to regulate safety. These laws included:

Installation of seatbelts

Safety glass windshields

Head restraints

In 1979, the first driver side airbag was introduced

Airbags are mandatory in motor cars produced after 1990

Unibody Torque Boxes: Allow controlled twisting and crushing

Crush Zones: Made to collapse during collision (To act as an absorber, absorbing the impact)

Modern Day Cars



Photo Take at SEMA 2011

Carbon Fiber Parts

Aluminum Parts

More Plastic Parts

High Strength Steel

Boron Steel

Unibody Construction

Space Frame Construction

Computer

Hybrid Cars

Now we even have cars that will tell you when you're lost, where to turn, and parallel park for you.

What Is To Come

I think with all the new technology, things are changing faster now than ever before. Good things are resulting from this, but brings new challenges to keep up with the correct repair methods. If you are reading this book to learn how to restore your ride, the fast changes may not be a big deal to you. However, if you are interested in pursuing this as a career, you will need to be willing to continuously learn new repair methods. So if you like to learn new things, this is going to be a great career pathway for you to consider.

We switched to waterborne paint last year at the school I teach at. I thought that was a big change, but that is a drop in the bucket of what is heading our way. One of the game changers is paintless cars. That's right, 3M CO has signed a five-year commercial pact with a relatively new stainless steel and aluminum distributor to create a stable of so-called disruptive products, including technology that could eliminate the need for paint on automobiles.

I knew this was coming, as I was told this summer while visiting 3M headquarters. They were talking about car manufacturers claiming their biggest problem was paint. Dealing with environmental issues is their biggest single issue with manufacturing cars. 3M was talking about designing cars with parts that would be wrapped with vinyl wraps from the factory. This recent news of 3M partnering with the new companies is a step towards that direction. Does this sound far fetched? Well, look at NASCAR, they are all wrapped with vinyl wraps. You can read the full article at: www.CollisionBlast.com/PaintlessCars

I know this would be better for the environment, but I am not sure I like the idea. I love painting! To me, the paint is the magic. This is what is in my blood and what hooked me into this industry. I can't imagine stepping back and looking at a car I just wrapped with vinyl and have the same amount of satisfaction that comes from painting a car. However, it does not really matter what I think, things are going to change with or without my opinion.

Changing The Way We Do Business

It is obvious this will change the way body shops do business. However, this is going to be a huge change to the industry, if this works out. To name a few, paint companies, abrasive companies, spray booth manufacturers, etc. It is going to be a chain of changes that is going to be a hard hit to the automotive industry...as we know it anyway. Changes will be made and we will change with it. It may be a little painful along the way, but life goes on. I guess the same way cell phones are changing home phones, online rentals changed movie rentals, computers outdated type writers, and fuel injection outdated carburetors. Things change and we'll adjust.

Conclusion

While the modern day cars appear to be made cheap and unsafe, they are designed to crush or collapse, while transferring the energy around the stronger passenger compartment to protect the passengers from injury.

There is considerably more damage to modern day cars during a collision than the older vehicles, which gives the perception "they don't make them like they used to." However, in reality the cars are taking the impact instead of the passengers. The lesson was designed to give you a little history, but to also emphasize that just a hammer, dolly, and a few wrenches are not going to repair today's cars.

I didn't want to get carried away with the history, but it is good to have a basic idea of how we got to where we are today and where we are headed tomorrow. Henry Ford was an amazing man and absolutely changed the automotive world. It amazes me to see how far we have advanced in the past 100 years, but I can't imagine the changes to come in the next ten to twenty years.

Vehicle History Resources



Photo of Jacob and Jordan with Monster Truck Driver Charles Bennis "Pitbull"

Videos

www.CollisionBlast.com/AutomotiveHistory

www.CollisionBlast.com/100YearsLater

www.CollisionBlast.com/ModernDayCars

Websites

www.CollisionBlast.com/HistoryOfTheAutomobile

Question:

What do you think has been the most significant change in the auto industry in the past 30 years?

Advice

The automotive industry is changing fast. Be open to learning and new ways to repair cars. Don't get stuck, "But this is how we've always done it" mentality. Never accept that you know it all and be open to new ideas.

Vehicle Key Terms

CRUSH ZONES: AKA Collapse or Crumple Zone is an area designed into body parts and structural parts that will collapse, crush, or twist to absorb energy produced from an accident. Usually in front or back of the passenger compartment to keep the passengers safe.

FULL FRAMES: Consists of a frame and a body, which are separate components bolted together. The motor, transmission, suspension, etc., bolt to the frame.

UNIBODY: All parts of the structural are welded together to make one component. The motor, transmission, suspension, etc, bolt to the unibody structure.

WORK HARDENING: When metal is bent and reshaped, this causes work hardening, which strengthens the metal. This may be when formed from the factory, such as body line, or can be caused during an accident, or when straightening metal.

Vehicle History Quiz

Below are the quiz questions for vehicle history.

1. In the "The Model T - 100 Years Later," how did Henry Ford increase production of model A's?
 - A. Increased the workers hours per day.
 - B. Decreased the workers hours by 1 hour per day.
 - C. He did not increase production, he just designed the assembly line.
 - D. He was hard on his worker and pushed them to work harder....people hated working for him.

2. According to module 2 text, who worked on the first motor cars?
 - A. body technicians.
 - B. everything had to be taken back to manufacture.
 - C. black smiths and carpenters.
 - D. Henry Ford

3. The model T's came in black only because that was the only automotive paint that they had available.
 - A. True
 - B. False

4. In module 2 text, the body lines on a vehicle play a role in reducing the weight of a car.
 - A. True
 - B. False

5. When was the first drivers side airbag introduced?
 - A. 1990
 - B. 1967
 - C. 1979
 - D. 1988

6. Air bags are now mandatory for cars built today.
 - A. True
 - B. False

7. What is a crush zone?
 - A. Areas designed into a car to crush and collapse.
 - B. This is the zone that strengthens the car to prevent crushing and collapsing.
 - C. There is no such think as a crush zone in automobiles.

D. This is referring to the early model frames.

8. The point of module 2 text was that modern day cars are safer than older cars. And the new cars are requiring higher trained technicians to work on

- A. True
- B. False

9. According to the article, "History of the Automobile," automobiles begins as early as:

- A. 1908
- B. 1913
- C. 1769
- D. 1885

10. In this video, "Modern Day Vehicles" the video stresses the importance of training and education in the automotive industry.

- A. True
- B. False

Metal Straightening



First In, Last Out

*Before everything else, getting ready is the secret of success.
~Henry Ford*

We've touched on safety and the history of automobiles; now let's start talking about how to repair them. In this module we are going to cover metal straightening. There are different types of steel such as mild steel, high strength steel, ultra high strength steel, boron, etc. However, this module is going to focus on mild steel, as mild steel is used on many of the body parts. If you restore older cars, probably all the steel that you work with will be mild steel. Many of the other types of steels are used on structural parts and on some of the newer cars.

First we're going to talk about the difference between older and newer cars and the repair considerations that you will need to make before repairing.

The Difference Between Repairing Early Model Cars and Cars of Today



Photo Taken at SEMA 2011

Repairing Early Model Cars

On early model vehicles the metal was thick, which had advantages and disadvantages. First, the older cars had a lot metal to work with. This allowed body men to hammer, dolly, and pick on the metal, then file the top surface, knocking the high areas down. Then they could repeat the process, working the metal and filing the surface level. This allowed the body man to metal finish much of the damage without the need of body fillers. This is called metal finishing. If there were still a few imperfections on the metal that could not be worked out, the body man would use lead to fill the lows and file the surface level and smooth.

Advantages and Disadvantages

The advantage of working on older cars was the possibility to straighten and work the metal without the use of fillers as we've mentioned. If we tried to use those metal finishing methods on many of the modern day vehicles today, we would have a hole in the part from filing through the part. If we didn't file a hole through the part, it would be very thin and weak. Another advantage of working on early model vehicles is being able to get to both sides of the panel. There was ample space making it easy to get to the back side with dollies and other tools

used to repair the damaged area. Vehicles today have limited access, which makes it hard to get behind most panels to use the hammer and dolly methods. Therefore, new tools have been developed to help us make the necessary repairs, which we will discuss in a shortly.

The disadvantage of working metal on early model cars was the strength and thickness of the steel; it was harder to move, unlock, and reshape. It took a lot more force to move the thick metal when straightening, than the thinner steel used on newer cars. The lead filler that was used also took more time and skill to fill the small imperfections. In fact, I learned how to use lead, back in the day, as my students would say. It involved a process of tinting the steel with lead, then using a torch and lead bars to soften the lead and smooth is out with wooden paddles, then using a body file to shape the lead level. I am old enough that this method was still being taught, but they had body filler as well. They taught us this method in case there should be a shop still using this method, but we used body filler for most of the repairs. I know there are some old timers out there that were very good at using lead, but for me, I like using body filler much better. It is easier, faster, and the newer body fillers are more flexible and have great adhesion to bare steel. Another disadvantage about lead is the health hazards. However, we are more educated about lead today and the health safety hazards it produces.

Repairing Vehicles of Today



Photo Taken at SEMA 2011

Today's vehicles are thinner and have very limited access. However, improved fillers, such as body filler, and tools have made the job easier. The most common tool to use for repairing dents is a stud welder gun. The cost of a stud welder gun ranges from \$200 to \$500. This tool tacks a small nail or stud to the surface. Then you get a slide hammer or t-handle to pull on the stud nail. Therefore, you tack the nails to the low areas and lightly tap on the high areas using a body hammer. It is important to do this at the same time. Let me repeat

this, at the same time. Trying to just pull out on the lows is another common mistake I have seen over the years.

Just pulling out on the low area will cause the metal to be over-pulled and stretch the metal. Just hammering in on the highs may cause the entire area to be hammered in too much. This is referred to as chasing your damage around. It is always better to have multiple forces at one time. You need to think of it as rolling the damage out, rather than hammering or beating it out. The metal wants to go back to its original shape; you just need to help persuade it to. Forcing metal will result in stretched metal. Another thing taping on the highs with a body hammer while pulling the damage will do, is allow the metal to relax, which will allow you to pull the damage with less force. I am going to discuss a method for removing dents later, but remember not to just grab the slide hammer and go to popping the dent out. I am not a fan of using the slide hammer and I will tell you why not shortly.

KISS Keep It Simple Silly



When you have access to both sides of the damage, a hammer and dolly can be used. This is probably going to be the fastest and easiest way to repair the damage. Therefore, when you are determining how you are going to repair a dent, think of electricity. Electricity moves where ever it is the easiest for it to pass through. This is called the path of least resistance. This is why a ground wire is used on homes. If lightening hits your house, it will follow that ground wire that is attached to a ground rod that is hammered in the ground, as that is the path of least resistance. When determining how to repair a dent, try to think of what would be easiest. Just because you have an expensive piece of equipment does not mean that you have to use it every time. If you can reach behind the panel and pull out on the low with one hand and push down on the high with the other hand, then simply use your hands to repair the damage. The dent may still need a little hammer and dolly work afterwards, but I have repaired many dents with nothing but my hands. Remember today's metals are thin and it does not take much to damage a part or to repair it. One word of caution, when I mention using my hands, I am only using force; I am not striking the panel with my palm or fist. Striking the panel with your hand may result in injury.

There is another lesson to be learned from using our hands. This lesson applies to a dent repair or even repairing frame damage. Imagine that you were strong enough to repair the damage with your hands. Where would you place your hands? How and from what angles would you push and pull with your hands? As you give a little thought to this, you probably have a good strategy and it's usually the correct method to repair damage. Now all you have to do is to make the tools do this for you. You will be surprised at how much of a different approach you will take if you use this strategy. Try it and see what happens.

What Ever It Takes

Whether you're working on early or late model vehicles, always remember to select the tools that will make the job easiest to make the repair. Don't over work the thin metal on late model vehicles, as the metals are thin. The use of body filler will help you repair the surface back to its original shape.

Getting Started



We're ready to jump in and get started, but there are a few more things to do first. I know, it seems like we're never going to get started. However, remember in the beginning I mentioned that I was going to help you eliminate many of the mistakes that I made in my career. These first few steps are a few of those things. So please follow each step without rushing through and pulling damage.



Paint and Body Work Is Like Going On A Hot Date – First Things First

If you have ever been on a hot date you should be able to take the first steps necessary to performing auto body and paint work. First, I will describe the dating process, and then I'll relate it to working on cars.

Preparing For The Date

I still remember when I first started dating when I was younger. When I was in high school I did a lot of outdoor labor. Hauling pipe, working outside in lumber yards, welding cow panels, and other types of work like this. At the end of the day, you could say I was quite sweaty and dirty, but I did not seem to get tired then. I wish that I still had some of the energy that I had then! Anyway, when the work was done, I would hit the shower to get ready for the night. I would shower to remove the body sweat and odors, as I did not want my date to smell B.O. Then I would get my hair just right, yes, I had a mullet, and of course I would brush my teeth extra well, as I did not want to knock my date out with my breath. I would take every necessary step to ensure that I was ready for the night out.

Dating With Confidence

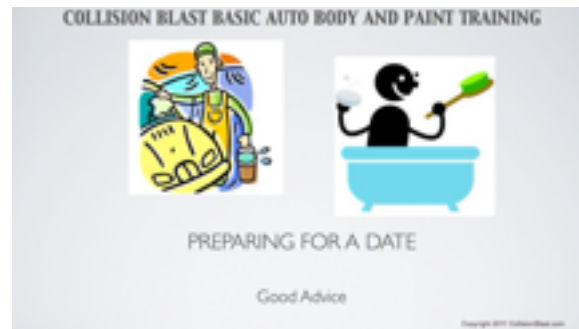
When I went on the date I would have the confidence that everything was ready to impress the date. If the chance to set next to them, talk, or even kiss; I knew that she would not be grossed out with bad breath or sweat, as I have taken all the necessary steps to eliminate these problems.

This is how I remember getting ready for a date; however, I am not saying this is how everyone prepares for a date. In fact, I know of some friends who did not do much preparation before their dates. Do you think their dates went well? They could pull every smooth line and slick trick in the book; however, if the date was turned off from the start, the date is probably not going to go well and you may not have a second chance to date them.

So What Does This Have To Do With Car Paint Jobs or Body Work?

One of the common mistakes made in auto body and paint work is improper preparation. We're so excited to get started working on the car and overlook properly cleaning it. Just like being successful on a date, the first thing you need to do before beginning the work is to wash the car with dish soap and water. Then we need to wipe the car with wax and grease remover. Once this is done, you can begin repairs with confidence. However, if you skip the cleaning procedure, the repairs are going to fight you and be difficult throughout the repair process no matter how hard you try. Then the end result may have problems like lack of adhesion or fish eyes just to name a few of them.

Good Advice



So here is my advice to you whether you are getting ready for a hot date or starting a collision repair or paint project. Thoroughly clean first!

Seriously, properly cleaning the vehicle is one of the most overlooked steps that will cause many problems down the road.

Dent Repair



Now that the car is clean, the damage will be easier to analyze and to determine which method will work best to repair the damage. Metal can be difficult to repair, but by keeping a few ideas and strategies while straightening the metal will make the process of moving the metal back to its original shape with much easier.

Repair or Replace

Let's discuss how to determine if the part should be repaired or replaced. There are several factors we must consider.

1. Can the part be repaired? This is the most obvious reason, as some parts are too damaged to repair. If the part is not repairable, the only other option is to replace it.

2. What is considered too damaged to repair? There is a general rule of thumb, but this is not set in stone. This is the kink vs bend rule. If the part has a crease, this is a sharp bend of a small radius at a 90 degree angle over a short distance, the part is kinked and should replace. If the crease is less than described, you may repair it. However, as I mentioned, this is just a general rule of thumb.

3. Is the part available? This is certainly going to help you determine if it should be repaired or replaced. As mentioned, some damage may be too severe to repair, but if you can find a replacement part, it may be worth putting in extra effort and time to repair the part, if the it can be saved.

4. Will it cost more to repair? This is also going to have a variation of answers. For example, if you're a body shop who charges \$50 per hour, it would be a better choice to replace an \$80 front fender if it has a 3 hour dent. Replacement is \$80 and the repair would cost \$150...simple math, right? However, what if you are a DIY doing this in your garage? Well, the labor is free so it may be worth your time to spend 3 to 5 hours on an \$80 fender.

Developing A Repair Plan

Now let's discuss how to develop a repair plan. You will need to analyze how to repair the dent and the method you are going to use to make the repair. We've determined that the panel is mild steel and repairing the damage would be a better choice than to replace the panel. Now we need to develop a repair plan and decide which repair method to use on the damage. This includes: removing parts, molding, and trim that may need to be removed to make the repair, protecting adjacent panels that are not going to be removed, and the method we are going to use to repair the damage.

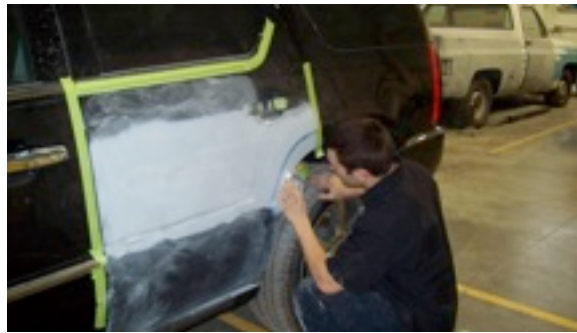
Remove It, Bag, It Have It



Remove all the parts, moldings, etc., that will need to be removed to make the repairs. For example, if the dent is close to a body side molding, it is best to remove the molding to prevent damage to it during the repair process. Any small parts, bolts, or clips that are removed, place them in a bag and label the bag. For example, parts for right front fender. This will save you much time in the long run.

Please do not forget to label the bags. I remember one time my students repaired a Ford Focus. It was a big job consisting of: frame damage, replacing the roof, and basically the entire right side of the vehicle. They did a great job of bagging all the parts; however, we did not get the job completed that school year. When I returned the next fall, a group of new students had to put the car back together. All the parts were organized and in bags, but nothing was labeled. That made the reassembly of the car difficult to say the least. It only takes a minute to bag and label hardware, but spending an hour looking for a lost screw will drive a person absolutely crazy...it does me anyway.

Protect Adjacent Panels



To protect the adjacent panels or any moldings that were not removed, apply a couple of layers of 1 ½ or 2 inch masking tape over them. For example, if you are working on the front section of the right front door, apply several layers of masking tape on the right front fender to prevent scratching while repairing or sanding. If you are grinding near glass, put a welding blanket over the glass or mask the glass with masking paper if nothing else. The sparks from the grinder can embed into the glass or leave small pits in the glass, which is something you want to avoid.

First In Last Out

When beginning repairs, the first thing that you want to determine is the direction of damage. This is important so you can reverse the damage during repairs. In collision repair we have a general rule "the first in last out rule." This means that the direct damage or point of impact is the area first hit in an accident, which makes it the first in. Therefore, this should be that last area to repair.

Direct Damage

Direct damage is the most obvious damage as it is easy to visually see. If you try to pull the direct damage first, you will stretch the metal, pull highs in the metal, and still have low areas. You are going to chase your damage around while work hardening the metal until the metal becomes too work hardened, brittle

and cracks. The first in, last out rule is golden in dent repair so be sure to make mental note of this.

Indirect Damage

Indirect damage is the damage that is caused by the direct damage. For example, as the point of impact is pushed in, it causes the surrounding metal to slightly move as well. If pushed far enough, the indirect damage can cause misaligned body gaps, cracked seam sealer, and/or popped spot welds. The indirect damage is less noticeable as it may not be visually noticeable without close observation. The indirect damage is the damage that happened last during the accident; therefore, this damage should be repaired first.

Always remember the "first in last out" rule when developing a repair plan. This will save you hours of time and frustration when it is all done.

Work Hardening



Work hardening can be caused by an accident when the metal is reshaped out of its original shape. If you remember in vehicle history, we discussed that car makers were able to use lighter weight steel by designing more body lines into the panels. When body lines are designed into a panel, it causes the metal to become work hardened. Therefore, some work hardening is designed into the part when stamped and formed from the manufacture. As mentioned, additional work hardening can be generated from an accident.

So why is work hardening important to you, the repairer? This is because work hardened metal is stiffer and harder to reshape. Not only is it stiffer, it is also more brittle. Therefore, care must be taken not to overwork the metal in work hardened areas. I grew up on a farm, but I think you can relate to this. If I needed a piece of bailing wire and did not have a pair of pliers at the time, I would bend the wire back and forth until it broke into. Have you ever done something similar to this? I did this because I saw my dad do it. I'm sure he did this because he saw his dad do it. Probably no one was thinking, I am going to take this piece of wire and bend it back and forth to its work harden state until the wire becomes brittle and breaks into...but that is what happens.

With that said, trying to get the metal perfect or trying to metal finish thin metal can result in unwanted tears and rips in the metal. Work the metal as close as you can without overworking it, and then use body filler to fill the small imperfections. Evercoat, 3M, and other companies who make body filler state that body filler can be up to ¼ inch after sanded. I try to get it a little straighter than that, but you should be able to get most dents within ¼ inch of the final contour of the panel with no problem.

Choosing a Repair Method

Once the damage is analyzed and you have determined the direction of damage, and where the direct and indirect damage is located. Now it is time to decide which repair method is the best choice for the repair. If you can get to both sides of the panel a hammer and dolly method may be the easiest repair method. If you cannot gain access to both sides of the panel a stud welder gun may be a better choice. Other considerations, such as corrosion protection and noise preventions should be considered as well.

Don't Force The Metal; Roll The Metal Back To Its Shape

Regardless of the repair method, the same principle apply. Start with the indirect damage and pull out on the lows and push in on the highs. You should roll the metal back into shape, rather than try to force it back into shape. Forcing the metal back into its shape may result in highs and stretched metal. Pulling on the lows while rolling the highs out of the metal is the key to metal straightening, regardless of repair method used.

Last Bit of Advice About A Repair Plan

Plan your work and work your plan. I'm sure that you have heard of that saying, but the saying is worth gold in this industry. This applies to metal straightening, frame/unibody repair, or just about any auto repair. So keep that little tip in mind before jumping in and started the repair.

Repair Methods

Repairing A Dent Using A Stud Nail Gun



A stud welder gun is a tool that welds a small stud to the metal surface. This stud provides something for the t-handle or slide hammer to grab on to. Force can then be applied to remove the damage. When using this method, you must remove all paint and coatings from the panel until you have bare steel, as the stud welder gun will not work on painted surfaces. The tip on the gun must make direct contact with the metal surface to produce the weld. When using this method or any method, remember the rules mentioned earlier. First in last out and roll the metal, don't just force it. Starting at the outsides (indirect damage) of the damage weld studs to the metal. Then pull the damage with a t-handle and you use a body hammer to tap lightly down on the highs. Sometimes the highs may be difficult to find, but there is usually high spots. If not, I still recommend to tap lightly around the dent while pulling on the dent to relax the molecules in the metal. This will allow the metal to be straightened with less force. Once the damage begins to pull out, start welding on additional studs and pulling towards the center of the damage (direct damage) using the same technique. I would also advise you to only use the slide hammer as a last resort. It is very easy to over stretch the metal using the slide hammer. I prefer using the t-handle and body hammer. Once you have completed the pull, you will need to remove the stud nails. This can be done by cutting the studs with a pair of dykes and grinding the surface smooth. Tip: with a little practice, you may be able to lightly tack the stud nail to the surface enough to make a light pull, but still be able to remove the stud nail by wiggling it. This will eliminate having to cut and grind the stud smooth.

Caution: Grinding Removes Metal and Heats

Keep in mind that the metal on newer cars is very thin. Therefore, you do not want to remove too much metal making it thinner and weak by over grinding. Grinding also produces heat, which is something that you want to avoid as well. Keep the grinder moving around and do not hold it in one spot too long. I have had students shave door handles without warping the panel during the welding process. Then get carried away with the grinder and warp the panel severely. To prevent these problems you may consider using a DA sander to remove the paint coatings when preparing the damaged to be pulled. However, a grinder will still need to be used to grind the studs smooth. Watch the stud welder gun video for a better understanding of how this process works. www.CollisionBlast.com/StudGun

Dent Removal System



There are several different types of dent removal systems, but they all use the same idea to removing damage. The dent repair system with the reusable electrode is similar to the stud welder gun, but the tip that welds to the metal surface is reused and does not require to be ground off. This saves time and allows you to pull a dent out much faster. However, this type of system is much more expensive and probably not going to be in the DIY's budget. I have also noticed through the years that students still favor the stud welder gun. Perhaps they feel that this system is too big and bulky. I'm not sure, but either method will produce the same results.

Other than the few differences, it is used the same way. It must be used on a metal surface to make contact, first in last out, and use a multiple repair method (pull on the lows and tap on the highs). This system also required a ground cable that must be attached to a metal surface. Here is a demonstration my students made using this system. www.CollisionBlast.com/ProSpotSystem

Hammer and Dolly



Hammer and dolly is probably the easiest repair method, but it requires that you have access to both side of the panel being repaired. However, newer cars

have many areas that do not allow you to use hammer and dolly, as there is limited access. There are two techniques when using hammer and dolly. Hammer off dolly and hammer on dolly.

Hammer, dollies, and other tools such as spoons and slapping files are used for straightening metal. They come in different shapes and sizes to fit the specific damaged panel you are working on. A large flat area needs a flat dolly and hammer. If the repair area has a crown, you will need a hammer and dolly to fit the contour of the panel. Choose tools that fit the shape of your panel.

Hammer Off Dolly

Hammer off dolly is used to remove a majority of the dent. Same rules; start with the indirect damage and move towards the direct damage. Use your dolly to push your lows and your body hammer tap down on the highs or vice-versa. Hammer off dolly should be used until the final straightening stages.

TIP: Use your dolly to strike the back side of the dent to rough out much of the damage. Then use the hammer off dolly method to continue the repair process.

Hammer On Dolly



Hammer on dolly is used in the final stages of metal straightening to level the smaller imperfections. Once you have straightened the metal using the hammer off dolly, use the hammer on dolly to level out the ripples. Hammer on dolly is also extremely effective when repairing the edges on panels. Please be careful not to use hammer on dolly too much, as this stretches the metal. If metal is over stretched, it must be shrunk. Here is a video demonstrating the hammer on dolly. There are also additional videos in the resources section, which explain how to hold and dress a body hammer. www.CollisionBlast.com/HammerOnDolly

Slapping File



This tool can be used with a dolly as well. This is similar to hammer on dolly, as you hold the dolly on the back side of the repair and strike the front side with the slapping file to straighten the metal during the final stages. This spreads your strike over a larger area and the file has small teeth on it, which reduces stretching the metal. This tool works best on older thicker steel, but I still find it useful on certain repairs on the thinner steels.

Metal Shrinking



It may be necessary to shrink the metal. The metal may become stretched in the repair process or it may have been stretched during the accident causing the damage. For whatever reason the metal is stretched, this is very easy to identify and correct. There is a term called "oil canning, which is referring to stretched metal. This is where the metal pops in and out like the top of the old style oil cans. If you are younger, you may not remember this type of oil can that I am talking about, but it is similar to a coffee can. Anyway, this is where the metal pops in and out very easy. You certainly would not want to repair a car and have

someone barely lean against the car and the fender pop in. This is caused by stretched metal or too much metal in the area. They make body hammers that have small teeth (shrinking hammer) to slightly shrink the metal. However, many times it will require heat to shrink the metal. This can be performed by using a torch or stud welder gun. Heat the highest area (stretched area) to a dime size until red. Then using a body hammer lightly tap the red spot to help spread the molecules in the metal. Lastly, cool the repair with a wet sponge or compressed air. This is the only time that you want to use air or water to cool the repair area. Normally, you want to allow the areas to cool naturally. Quenching is only used for metal shrinking. The heat will expand the metal which is the opposite of what you want to do, but when quenching it with water or compressed air, the metal will shrink more than it expanded resulting in the metal to shrink back to its original shape. This also makes the metal stiff to eliminate it from popping in and out. This process may need to be performed several times to completely correct and shrink the damaged area.

Module 3 Resources



Photo Taken at SEMA 2011

Videos

www.CollisionBlast.com/DR101Presentation - This is a presentation over safety, vehicle history, and metal straightening.

www.CollisionBlast.com/StudGun - This video demonstrates how to use a stud welder gun.

www.CollisionBlast.com/ProSpotSystem - This video demonstrates how to use a ProSpot type system.

www.CollisionBlast.com/DentRepairProcess - This is a 30 minute video covering the dent repair process.

www.CollisionBlast.com/HoldandDressHammer - This is a quick video explaining how to hold and use a body hammer and how to dress a body hammer.

www.CollisionBlast.com/HammerOnDolly - This video demonstrates a hammer-on-dolly method.

www.CollisionBlast.com/HeatShrinking - This video demonstrates heat shrinking.

Product Information

Dish Soap - Dawn, Ivory, Etc., Can get this at most stores. Just make sure the soap does not have any special ingredients to keep your hands soft, as this may not strip wax and grease as well. If you use a car soap, make sure it does not have any wax or silicone ingredients in it.

www.CollisionBlast.com/WaxandGreaseRemover - Wax and grease remover used to remove contaminants.

www.CollisionBlast.com/3inchGrinder - 3 inch grinder used to remove paint and grind metal.

www.CollisionBlast.com/3inch36Grit - 36 is a coarse sandpaper used on the 3 inch grinder.

www.CollisionBlast.com/3inch50Grit - 50 is a medium sandpaper used on a 3 inch grinder. On newer cars with thin metal, 50 grit should be used, rather than 36 to remove less metal.

www.CollisionBlast.com/StudWelderGun - This is Motor Guards new stud welder gun.

www.CollisionBlast.com/DentFixSystem - This is a dent pulling repair system.

www.CollisionBlast.com/MartinBodyHammer - Martin make very good body hammers.

www.CollisionBlast.com/SlappingFile - Slapping spoons are useful when working with older thicker steel.

Product Technical Data Sheet

www.CollisionBlast.com/WaxandGreaseRemoverTDA pdf

MSDS

www.CollisionBlast.com/WaxandGreaseRemoverMSDS

Websites

www.CollisionBlast.com

www.MotorGuard.com

Training Activity

Stop by a body shop or wrecking yard to pick up a few junk fenders. If they do not have damage already make damage by using a hammer. Then try to use the methods taught in this module to repair the damage.

Question:

First in last out...why do you think it works this way? Name a few of the problems that you may have if you do not follow this rule.

Step-By-Step

1. Wash the car with dish soap and water, not car soap. Many of car soaps are designed to leave the wax and silicone on the finish. However, you want to strip the wax off. Like one of the Dawn slogans, "Strips the grease away." That's what we want.

2. Wipe the car with wax and grease remover.

3. Remove any moldings, trim, etc., that may interfere with the repairs that need to be made.

4. Bag and label parts.

5. Protect adjacent panels.

6. If there are any dents, repair the damage by determined repair method during the repair planning process. Remember to use the easiest repair method.

7. If heat shrinking is needed, shrink the metal. Slight shrinking can be achieved using a cold method with a shrinking hammer. However, many times the heat method will need to be used. Use a torch or your stud gun with a shrinking tip, tap metal and quench.

8. Once the metal has been straightened, now prepare the metal for body filler. Body filler must be applied directly over steel; therefore, all coating must be removed. To do this grind or sand the surface with 36 to 50 grit sandpaper using a dual action sander or grinder. Care must be taken when using a grinder not to overheat or remove too much metal. Grind the coating 4 inches around the damage. This will assure that the body filler will not be applied over paint. Once ground, blow the repair area with compressed air.

Advice

Always work on quality first, speed will come with practice and time. When practicing, make certain that you are following the recommendations in this module, such as, first in, last out. Picking up bad habits are easy, but breaking a bad habit is hard.

Metal Repair Key Terms

BODY FILES: A file used to level highs and identify lows. This is useful on older model cars with thicker metal. Care must be taken if using a body file on newer thinner metal.

BODY HAMMER: A hammer used to straighten steel.

COLD SHRINKING: This is a cold method of shrinking metal using a shrinking hammer.

DA: Dual Action sander. Can be used for removing paint, feather edging, and final sanding. Does not work well for leveling body filler.

DIRECT DAMAGE: Damage that occurs to the area that is in direct contact with the damaging force of impact...Point of impact.

DOLLY: A tool used to straighten metal. Different sizes and shapes to fit the particular contour of the damage being straightened.

GRINDER: An air tool used to grind metal or remove coatings.

GUIDE COAT: Coat spray or dry powder that contrasts with the color you are sanding. This helps you identify highs and lows.

HEAT SHRINKING: The process of shrinking stretched metal back to it's original shape.

INDIRECT DAMAGE: Any damage that occurs as a result of direct damage.

METAL FINISHING: The process of picking and filing the metal to shape without the need for filler to be used.

SLAPPING FILE: A tool used to perform final leveling of steel. Works best on older cars with thicker steel.

STUD WELDER GUN: A tool that welds a small pin to a metal surface to allow pulling to remove dents.

WORK HARDENING: Process of metal being made harder by rolling or hammering the material. Can also be caused when metal is formed into parts.

Metal Straightening Quiz

Below are the quiz questions for metal straightening.

1. In module 3 text, when repairing damage you should:
 - A. repair the direct damage first.
 - B. always use a stud nail gun on newer vehicles.
 - C. think like electricity.
 - D. stop and develop a repair plan if the damage is not pulling out correctly.

2. According to the video, "How To Hold and Dress a Body Hammer" you should hold a hammer handle firm and make hard dead on hammer strikes.
 - A. True
 - B. False

3. In the "dent repair process" video, what tool(s) were used to remove a majority of the dent?
 - A. stud nail gun
 - B. suction cup
 - C. hands
 - D. PDR tools

4. In the reusable electrode video, the advantage that this system has over a stud nail gun is that it used a magnetic charge and does not heat the metal.
 - A. True
 - B. False

5. In module 3 text, the title "Paint and body work is like going on a hot date - First Things First." The main point of this story is:
 - A. prioritize what needs to be done and get the most important things done first.
 - B. wash and clean the car.
 - C. hot dates like to be picked up in a nice car.
 - D. quality repair come by practicing and with time, like relationships takes work and time.

6. In module 3 text, the hammer on dolly is a technique used in the final stages of working the metal to level the small imperfections.
 - A. True
 - B. False

7. Indirect damage can be hard to see visually.
 - A. True
 - B. False

8. In module 3 text, you should always wash the car with a quality car soap that will help protect the paint before beginning repairs.

- A. True
- B. False

9. In module 3 text, auto body fillers, new tools and equipment makes our job as a body technician much easier.

- A. True
- B. False

10. In module 3 text, the best way to use the stud welder gun technique is to:

- A. use the slide hammer that comes with the kit.
- B. start pulling from the center of the dent and move outward.
- C. as you pull the damage with a t-handle tap the high areas with a body hammer.
- D. drill holes in the damaged area to relieve stress in the metal.

11. In module 3 text, selecting a repair method depends on:

- A. if you have access to both sides of the panel.
- B. what panel is damaged.
- C. what hi-tech piece of equipment you have available to make the repairs.
- D. always use the stud nail gun system.

12. According to module 3 text, newer vehicles have limited access, which may not allow two sided repairs. This requires special tools and equipment to make the necessary repairs.

- A. True
- B. False

13. In module 3 text, care must be taken when using hammer off dolly method not to stretch the metal.

- A. True
- B. False

14. In module 3 text, new vehicles with thinner metal are much easier to metal finish than the older model vehicles with thick metal.

- A. True
- B. False

15. In module 3 text, you should always used the hi-tech tools to repair damage. Hammers and dollies are old schools and should not be used on modern day vehicles.

- A. True
- B. False

16. In the video, "Heat Shrinking" how does heat shrink the metal?

- A. when metal is heated it shrinks.
- B. if metal is stretched, it must be replaced.
- C. heat shrinking is not recommended on any metal.
- D. the metal expanding, but shrinks when quick quenched with water.

17. In module 3 text, what was one of the advantages of working on early model cars?

- A. The metal could be worked and metal finished without having to use fillers every time.
- B. The lead fillers that were used then were much easier and required less skill to perform.
- C. The metal was thick, which made it easier to unlock and shape the metal with less force.
- D. The metal was made of high strength steel, which was much better than the metals that we have today.

18. In model 3 text, what tools were commonly used to repair damage on early model cars?

- A. Stud welder guns.
- B. Everything was replaced, as there were no body men then.
- C. They did not have tools then. Everything was done by using their hands. Therefore, they were limited to the amount of repairs that could be performed.
- D. Hammers, dollies, slapping files, files and picks.

19. In module 3 test, forcing the metal may result in over stretched metal.

- A. True
- B. False

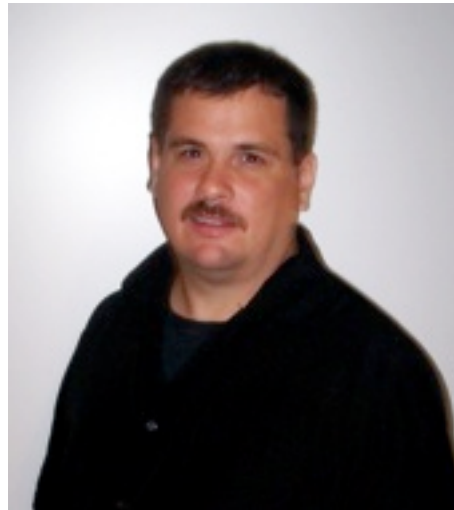
20. In module 3 text, an indication of stretched metal is when the metal pops in and out like an oil can.

- A. True
- B. False

21. In module 3 text, the first in last out rule means:

- A. the direct damage should be pulled first.
- B. the indirect damage should be pulled first.
- C. the damaged parts should be replaced after the repairs to the car have been made.
- D. it's referring to the accident to determine how many people were in the car and who the last person out was.

About The Author



My passion for working on cars started when I was a kid. I helped my dad and older brother work on cars as a hobby.

In high school I enrolled in auto shop and painted my first car. After stepping back and seeing the finished product, I knew that I was hooked for life. After graduating high school I attended the collision repair program at WyoTech. Since then I have worked for body shops and a body tech, paint tech, and an estimator. I have managed and owned a body shop. For the past 7 years I have been teaching collision repair for an NATEF Accredited school that is also a member of the I-CAR Industry Training Alliance. I stay up-to-date with the collision repair industry by attending training on a continuing basis, I am a member of ASA and the active in the collision repair industry with my website <http://CollisionBlast.com> If you are not already a member of our network, I encourage you to join us. There you will receive additional training, news and networking with other in the collision repair industry.

Here Are A Few Of My Qualifications:

- *Graduated WyoTech in 1988 and Have Years Of Experience
- * Associates Degree in Collision Repair and Management
- * Obtaining a Degree in Professional Technical Education
- * ASE Certified * PPG Certified
- * I-CAR Instructor Work Shop Certified
- * Member of ASA * Custom Paint Certificate From WyoTech
- * Custom Metal Working Certificate from UTI
- * Numerous Other Certificates in Collision Repair and Teaching
- * Attend SEMA, NACE, VISION and Many Other Events
- * Technical Educator

I am not bragging with all of my qualifications as I will be the first to admit that I do not know it all. I still learn every day in this fast-paced industry. However, I do qualify to teach and I may be able to help you out if you're interested in collision repair and painting.

I have offered my training videos free in the past and here is what motivated me to do that and to develop this training book. (1) You're interested in collision repair as a career. If so, this will allow you to test the career pathway and determine if collision repair is a fit for you. If it is, I encourage you to further your education by enrolling in a college or technical school that provides collision repair. If you need help locating a NATEF accredited school in your area let me know. I have a list of all schools accredited throughout the U.S.

(2) You're interested in this as a hobby (DIY). If so, I would like to give you a pat on the back and help you all that I can. Believe it or not, you play a crucial role in the industry.

Without the DIY folks out there, there would not be any interest in the auto industries. Remember I said that I started working on cars with my dad and older brother as a kid? Well, we were just DIY people, which resulted in a collision repair career for me.

I think there are many similar stories out there. I sincerely believe that it would improve any parent-child relationship. Your kids may not remember all the TV shows or video games they played growing up, but they will remember the times spent together working on a hobby, such as working on cars. Therefore, I want to give you all the resources you need to make that happen. In return, you are providing interest and exposure to the collision repair career. It's win/win for everyone!

Thanks again and enjoy the book.

More Books From The Author

This is part 3, metal straitening, of a series of books I plan to write. To see other books I have available visit www.CollisionBlast.com/Books

If you have read and enjoyed the book, I would appreciate it if you would provide me a rating at Amazon or from where you received the book.