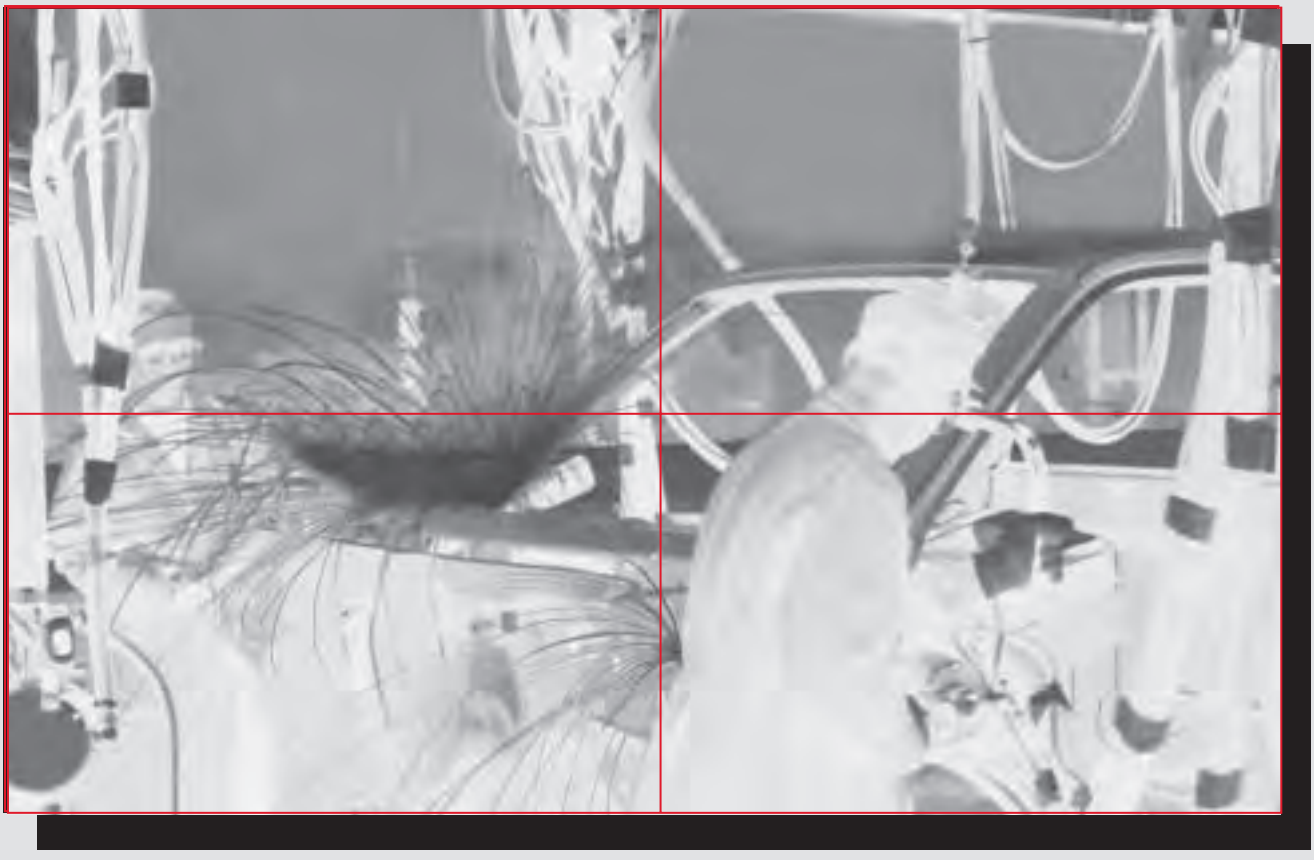
DODGE CHRYSLER Jeep

SERVICE

Welding and Weld Bonding



SAFETY NOTICE

CAUTION

ALL SERVICE AND REBUILDING INSTRUCTIONS CONTAINED HEREIN ARE APPLICABLE TO, AND FOR THE CONVENIENCE OF, THE AUTOMOTIVE TRADE ONLY. All test and repair procedures on components or assemblies in non-automotive applications should be repaired in accordance with instructions supplied by the manufacturer of the total product.

Proper service and repair is important to the safe, reliable operation of all motor vehicles, The service products recommended and described in this publication were developed for professional service personnel, and are effective methods for performing vehicle repair. Following these procedures will help ensure effective economical vehicle performance and service reliability. Some service procedures require the use of special tools designed for specific procedures. These special tools should be used as recommended throughout this publication.

Special attention should be exercised when working with spring-or tension-loaded fasteners and devices such as E-Clips, Circlips, Snap rings, etc., since careless removal may cause injury. Always wear safety goggles when working on vehicles or vehicle components.

It is important to note that this publication contains various **Caution and Warnings.** These should be read carefully in order to minimize risk of personal injury or the possibility that improper service methods may damage the vehicle or render it unsafe. It is important to note that these Cautions and Warnings cover only the situations and procedures DaimlerChrysler Corporation has encountered and recommended. DaimlerChrysler Corporation cannot possibly know, evaluate, and advise the service trade of all conceivable ways in which service may be performed, or of possible hazards of each. Consequently, DaimlerChrysler has not undertake any such broad service review. Accordingly, anyone uses a service procedure or tool that is not recommended in this publication must be certain that neither personal safety, nor vehicle safety, will be jeopardized by the service methods they select.

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Safety Precautions

Welding:

- Comply with all federal, state, and local regulations to avoid any injury due to shock, fires, fumes, sparks, liquids, and equipment must be avoided at all times.
- All flammable materials or liquids should be stored in tightly sealed labeled containers and used only in well-ventilated areas.
- No spark producing equipment should be permitted in any area where flammable materials are being handled or stored.

Adhesives:

- Adhesives must comply with all federal, state, and local regulations.
- Material Safety Data Sheets (MSDS) must be available and understood before adhesives are handled.
- All personnel should be instructed in the proper procedures to prevent skin contact with solvents, curing agents, and uncured base adhesives, which could cause allergic reactions or sensitization.

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Introduction

With the introduction of special high-strength steels and coated metals in the early 1980's, the repair technician has been required to use Gas Metal Arc Welding (GMAW), also known as Metal Inert Gas ("MIG") welding, to install or repair body panels during the repair of most unibody vehicles. While creating a strong joint with a limited heat-affected zone, MIG welding requires significant additional work to dress the welds, and there exists a concern of corrosion or recognition that a repair has been made.

This document is the second in an ongoing series. DaimlerChrysler previously published information related to Weld Bonding methods, Structural adhesive and squeeze type resistance spot welding (STRSW) as an option for the field repair rather than GMAW in areas considered as cosmetic repair locations. Squeeze type resistance spot welding (STRSW) equipment manufacturers have made significant advances that now enable repair facilities to duplicate an OEM joint utilizing the same process for repair that the OEM uses during production – both with and without structural adhesives.

Requirements of a Welding Repair

The number one requirement of any welding or weld bonding repair is to restore the vehicle to its OEM condition. Materials and technology should duplicate original OEM conditions as much as possible. To meet this requirement, the technician must ensure the following:

- Panel shingling is the same as original.
- Equivalent sealers or adhesives are utilized.
- Welds are replaced in the same size, quantity, and location.

A significant amount of structural adhesive is used at the OEM to improve joint strength. It may be difficult to determine if the material between the panels is an adhesive or a sealer, and for this reason, the following guideline should be used**: If in doubt, use a two-component, corrosion inhibiting, structural adhesive. The adhesive must meet or exceed DaimlerChrysler MS CD 507.** MIG welding is not recommended within 1-inch of an adhesive as it creates heat that will destroy the adhesive. STRSW on the other hand, can weld through the adhesive and will not destroy its properties.

DaimlerChrysler recommends the same quantity of welds as the original panel, but placement of the new weld should be within 1/4" of where the old welds were located. (Placement of new welds over an old weld location may lead to metal fatigue or poor weld quality.)

Key points to remember:

- Poor part fit-up will adversely affect weld quality and may result in early weld failure due to excessive metal stretching around the nugget.
- Clamps should be used to bring parts together and hold them in position.
- Clamps should be insulated when using STRSW to control weld current shunting. This can be accomplished with specialized clamps or by simply placing an insulating material such as cardboard between the clamp jaw and the panel.)
- Number, size, and location of welds should closely duplicate the original assembly.
- Surface of the steel parts should be clean and free of scale, rust, paint, cured adhesives/sealers and any other contaminate that could adversely affect the quality of the weld joint – This includes removal of any E-coat applied to the service parts within 1-inch of any welds. (Proper corrosion protection must be installed or restored when repairs are complete.)
- If the joint originally had structural adhesive, all E-coat must be removed where the adhesive will be reapplied
- “Weld-thru” primers are NOT recommended when STRSW or GMAW is used.

Types of Welding

STRSW (Squeeze Type Resistance Spot Welding)

- STRSW relies on the resistance of the material being welded to create heat as a current is passed through. The materials being welded are squeezed together, and as current passes through, resistance causes heat buildup. The force of the tips and the heat from the current allow the materials to fuse together. The current is removed and the force from the welding tips is held during a cool-down cycle. When the cool-down cycle is complete, the pressure is released and the next weld is positioned.
- Learning how to create weld coupons (fig. 1), and then performing a destructive test using these coupons, is the key to successfully using STRSW. DaimlerChrysler requires a physical test using test coupons and the methods outlined in this document to test welds prior to making repairs.
- Proper tip dressing is necessary to control weld quality and consistency.

GMAW (Gas Metal Arc Welding or “MIG”)

- Officially referred to as Gas Metal Arc Welding, or GMAW, is an arc welding process where the electrode wire is fed through a weld gun and is surrounded by a shielding gas. The term MIG comes from early uses on aluminum where argon was used as the shielding gas, and the process was referred to as Metal Inert Gas welding. The GMAW process is currently the most common in the unibody repair environment.

Weld Bonding

- A method of joining metals using STRSW in conjunction/combination with a structural adhesive.
- Weld bonding provides the customer with a superior repair compared to the traditional plug/puddle welding process using GMAW. Structural adhesive should not be used in a joint that original did not use adhesive.

DaimlerChrysler DOES NOT endorse or condone the use of structural adhesives alone in the replacement of body panels.

Welding Processes

While there are many methods to weld steel in the field, this document will focus strictly on STRSW, GMAW, and Weld Bonding since these are the methods of choice. Sheet Metal Arc Welding (SMAW or “Stick Welding”) is primarily used for heavy fabrication or repair to automotive castings or frames, and should never be used for sheet metal repairs.

STRSW (Squeeze Type Resistance Spot Welding)

- Applications
  - With advances in equipment technology, STRSW is not restricted to light gauge sheet metal any longer. Heavier gauges of high strength and coated steel currently used in underbody structures can now be welded in the field providing testing is performed of each combination to ensure weld quality and strength is obtained.

- Equipment Requirements
  - As stated earlier, the manufacturers of STRSW equipment have made significant advancements. These advancements now allow acceptable “STRSW spot welds” to be created in the service sector. It is expected that additional improvements will be made in the future.
  - Equipment must produce two-sided welds.
  - Equipment must have the ability to create welds that comply with the DaimlerChrysler minimum weld nugget diameters listed in the Minimum Weld Nugget Requirements chart.
- Technicians must have the appropriate sheet metal measuring equipment to ensure their welds meet the minimum weld nugget size for the actual panels being welded.
- If structural adhesive was used at OEM in a joint it must be used for the repair.

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Minimum Weld Nugget Requirements Chart

GMT*	Minimum weld nugget diameter*
0.64mm - 0.79mm	4.0mm
0.8mm - 0.99mm	4.6mm
1.0mm – 1.29mm	4.5mm
1.3mm – 1.59mm	5.8mm
1.6mm – 1.89mm	6.3mm
1.9mm – 2.29mm	6.9mm
2.3mm – 2.69mm	7.5mm
2.7mm – 4.59mm	8.0mm
4.6mm – 5.0mm	9.0mm

*GMT = Governing Metal Thickness. The minimum weld nugget diameter for two thickness welds shall be based on the thinner of the two sheets being welded. The minimum weld nugget diameter for three thickness welds shall be based on the middle gauge of the three panels being welded (not necessarily the middle panel).

Minimum nugget diameter should be measured with a vernier caliper. If the weld is not round, measure the major and minor diameter and average.

- Limitations
  - Equipment
    - Each brand/model is limited in material capacity that can be welded. The facility power supply can also impact equipment performance.
  - Access
    - Due to the existing structure of the vehicle being repaired, each weld must be evaluated for feasibility. Because of the power limitations of the equipment, tongs that are long and deep enough for certain welds may not be available, and the weld will need to be made by another method.

- Preparation
  - Prior to making repairs with STRSW, weld coupons must be created for testing. The test joint must be an exact duplicate of the original joint, including layering and sealer or adhesive application. The testing is required to ensure the repair restores the vehicle to its originally produced condition using the minimum weld nugget requirements chart.

- To correctly identify the material being welded/tested, the technician must possess an accurate material thickness gauge.
- No “improvements” to the vehicle design are allowed as this could have a negative impact on the vehicle as a whole. The repair should mirror what was used on the vehicle from the assembly plant (weld locations and quantity can be found in DaimlerChrysler Service Manuals, DaimlerChrysler Body Repair CD’s, and any other DaimlerChrysler Collision information publications).
- Note that the weld is affected by more than just the thickness or number of panels being welded.
  - Zinc based anti-corrosion coatings, (i.e. galvannealing, galvanizing), sealers, adhesives, and E-coats will affect welder performance. Any sandwich type coatings will increase weld time (and current in some types of STRSW welders) required to accomplish an acceptable weld nugget.
- When preparing an E-coated panel for STRSW, the E-coat must be removed from both sides of the mating flange within 1-inch of any welds. Corrosion protection is required any time you remove E-coat. A scuffing disc should be used to remove the E-coat without damaging other sheet metal coatings.
- If the panel originally had structural adhesive it should be reapplied prior to welding. The adhesive should have a corrosion inhibitor and cover all bare metal.
- Prior to creating weld coupons and the final body repairs, all coatings, and dirt/road debris must be removed.

- Testing
  - Weld coupons identical to the repair situation need to be made prior to performing any repair. These coupons must be tested (peel test) to determine if the weld nugget meets the minimum size outlined above in the Minimum Weld Nugget Requirement chart. Keep in mind that different material coatings, coating thickness, material thickness, and joint configurations have a direct impact on nugget size.

GMAW (Gas Metal Arc Welding or "MIG")

- Applications
  - Sheet metal repairs of DaimlerChrysler vehicles where STRSW is not available or practical, and truck frame repairs.
  - The most common usage of GMAW on uncoated or galvanneal coated steel will utilize a 75% argon – 25% CO_2 shielding gas, and AWS specification ER 70ER70S-6 wire. When welding galvanized material, flux core arc welding (FCAW) using AWS specification E71T-GS wire should be used to avoid weld porosity from the zinc in the galvanizing. DaimlerChrysler publications for specialized repair situations might specify a different wire or shielding gas.

- Equipment Requirements
  - While some 110V GMAW equipment may be adequate for thin gauge sheet metal, the preferred GMAW welder will be 220V and have a minimum output capacity of 150 amps (250 amps suggested to avoid equipment limitations).

- Limitations
  - Equipment
    - There is an abundance of high quality GMAW welding equipment available in the field. The limiting factor is the material thickness to be joined.
    - Coatings
      - GMAW equipment cannot weld through paints, sealers, or adhesives. Additionally, the zinc used in coated steels can lead to reduced weld strength due to porosity. This porosity problem on materials with heavy coatings can be dealt with by using FCAW.
      - Due to the heat-affected zone, structural adhesives cannot be applied within 1-inch of GMAW welds.
  - Testing
    - Weld coupons identical to the repair situation need to be created to help set-up the welding equipment and weld process. These coupons should then be destructively tested to ensure quality welds are being made. Refer to Figure 1 and Figure 2.
  - Post Weld Procedures
    - When welding has been completed, welds in cosmetic locations must be dressed.

- The weld will need to be smoothed down to the height of the surrounding panel without any thinning of the sheet metal. This can be accomplished using one of the many sanding or grinding products available in the aftermarket.
- Slag must always be removed prior to refinishing to restore corrosion protection or appearance.
- Corrosion protection materials need to be applied to seal the weld zone from future corrosion.

Weld Bonding

- Weld Bonding is the STRSW welding process utilizing structural adhesive between the panels that are resistance welded together. The adhesive creates a very stiff structure, while the welding eliminates concern of the adhesives' peel strength. Additionally, the adhesive acts as a sealer and provides a high level of corrosion protection.
- Sealers and Adhesives
    - Sealers are materials placed on top of a seam (or between mating flanges) to control water or air intrusion.
    - Adhesives, providing structural improvements, are found between panels welded together. Adhesives also provide the qualities of sealers when applied correctly.
- The DaimlerChrysler recommendation is to replace any suspected adhesive with a two-component, corrosion inhibiting structural adhesive when any repairs are made, providing the STRSW process is applicable. The structural adhesive must meet or exceed DaimlerChrysler MS CD507.

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- Surface Preparation and Masking (REF02)
- Refinishing Equipment and VOC Regulations (REF01)
- Restraints, Interior, Glass, Side and Rear Impact Analysis (DAM04)
- Mechanical Systems Analysis (DAM03)
- Frontal Impact Analysis (DAM02)
- Fundamentals of Collision Repair (FCR01)
- Hazardous Materials, Personnel Safety, and Refinish Safety (WKR01)
- Corrosion Protection (CPS01)

Level 3
- Squeeze-Type Resistance Spot Welding (WCS04)
- Steel Full-Frame Sectioning (SPS03)
- Adhesive Bonding (ADH01)
- Color Theory, Application, Tinting, and Blending (REF03)

Level 4
- Automotive Steel GMA (MIG) Welding Qualification Test (WCS03)
- Structural Parts Steel Qualification Test Prep (SPS04)
- Structural Parts Steel Qualification Test (SPS05)

Curriculum Skill
Area 12 – Refinishing

Level 2
- Surface Preparation and Masking (REF02)
- Refinishing Equipment and VOC Regulations (REF01)
- Fundamentals of Collision Repair (FCR01)
- Hazardous Materials, Personnel Safety, and Refinishing Safety (WKR01)
- Corrosion Protection (CPS01)

Level 3
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Figure 1

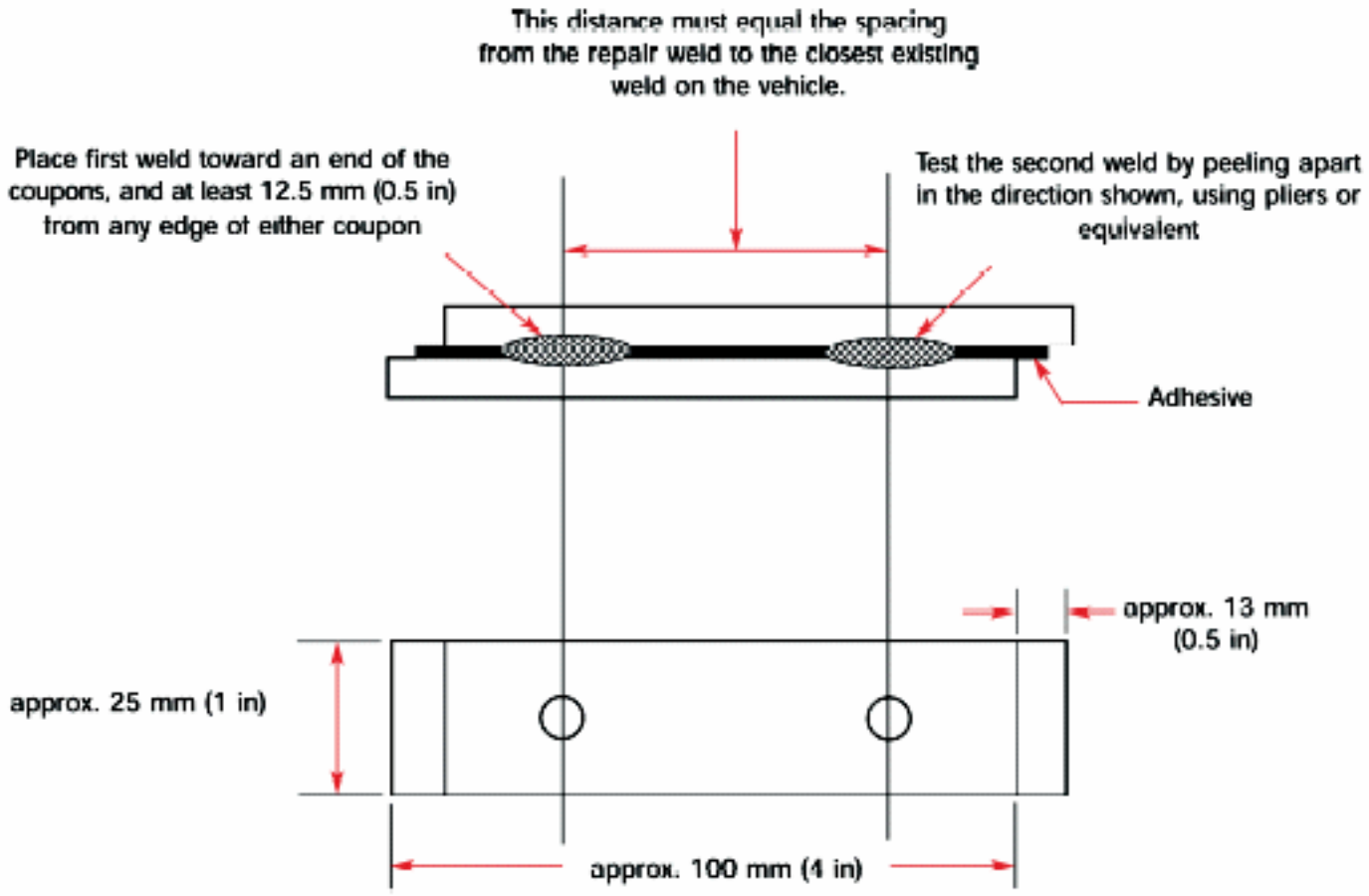
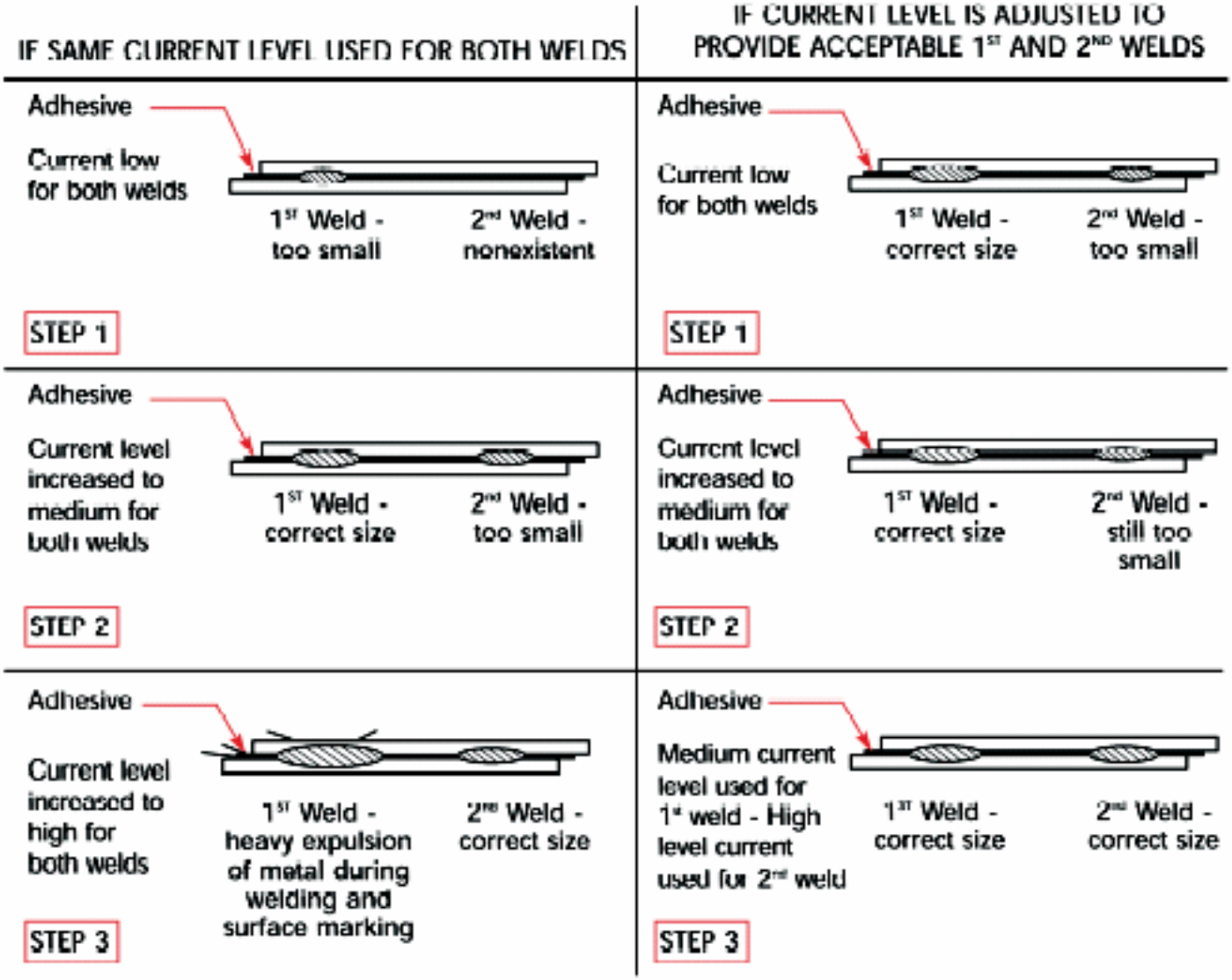

This distance must equal the spacing from the repair weld to the closest existing weld on the vehicle.
Place first weld toward an end of the coupons, and at least 12.5 mm (0.5 in) from any edge of either coupon
Test the second weld by peeling apart in the direction shown, using pliers or equivalent
Adhesive
approx. 13 mm (0.5 in)
approx. 25 mm (1 in)
approx. 100 mm (4 in)

Figure 2



Note:
Periodically check the electrode tips to determine whether the faces have been contaminated, damaged, or increased in size. If any of these conditions have occurred, replace or reface both of the welding tips.

1. Select the correct spot welder “arm” which provides the best access to the areas of the vehicle where welds are to be made.
2. Obtain metal of the same thickness and coating (i.e., bare, galvanneal, or galvanized) to be welded. This metal will be used for spot welder set-up. Damaged sheet metal taken from the vehicle being repaired may be used if it is from the area where the work is to take place. The sheet metal must be flat, and free of cracks, wrinkles, or scored metal.
3. Using the procedure outlined in figure 1, prepare test coupons.
4. Clean and prepare both mating coupons – if using adhesive, check the recommendations of the adhesive supplier. All contaminates, such as scale, rust, dirt, paint, and existing adhesives/sealers, E-coat within 1-inch of the welds, or any foreign material must be removed. Remove the sheet steel coating (i.e., galvanneal, galvanized). If the panel originally had structural adhesive, adhesive should be reapplied prior to welding. All metal that will have adhesive applied must be ground to bare metal. The adhesive should have a corrosion inhibitor and cover all bare metal.
5. Install the equipment manufacturers recommended electrode tips.
6. Adjust the welding electrode tip force, and clamp time, per the equipment manufacturer recommendations. (Note that galvanized metal will require more force.)
7. Apply adhesive/sealer to one of the coupons if present in original joint.
8. As shown in figure 1, place first weld at a position at least 12.5 mm (0.5 - inch) away from end of coupons. Then make the second weld. The weld spacing should be the same distance as the original welds or the closest existing weld, whichever is least, on the vehicle to be repaired.
9. Destructively test the **second** weld to determine the size of the resistance spot weld produced (see examples in figure 2). If the weld is insufficient, adjust the welder per the manufacture recommendations and repeat steps 7,8, and 9 until the proper size resistance weld is achieved. (If the first weld becomes too “hot” before the second weld reaches the correct size, reduce the current setting for the first weld and continue increasing the current setting for the second weld until the proper size for the second weld has been reached.
10. Shunt pliers should be used to make first weld to ensure quality first weld.

Final Weld Preparation

1. Visually verify that the mating parts are free of scale, rust, dirt, paint, cured adhesives/sealers, E-coat within 1-inch of the welds, wrinkles, cracks, or scored metal. If any of these conditions exist they will need to be corrected prior to proceeding with this procedure. Corrosion protective coating (i.e., galvanized, galvanneal) should not be removed during cleanup of the components.
2. After cleaning and preparing both mating metals, clamp the metal on the vehicle together so that no gaps exist. (Note: if adhesive is to be used, it should be applied before clamping the replacement panel in place.) The clamps used here should be insulated so as not to shunt the weld current.
3. Visually verify that the welds to be made **will not** be placed directly over an existing weld.
4. After verifying that the welder control is set to the current setting required to make the **second** weld on the test coupons, make the welds on the vehicle. (Note that if using adhesive, the welding must be completed within the time frame established by the adhesive supplier for producing strong adhesive bonds.)
5. If adhesive was used, clean up any excess squeeze out.

Training

As with any equipment, proper training is required, and in the case of welding equipment this is no exception. The goal of automobile repair facilities and technicians is to restore the vehicle to its OEM condition.

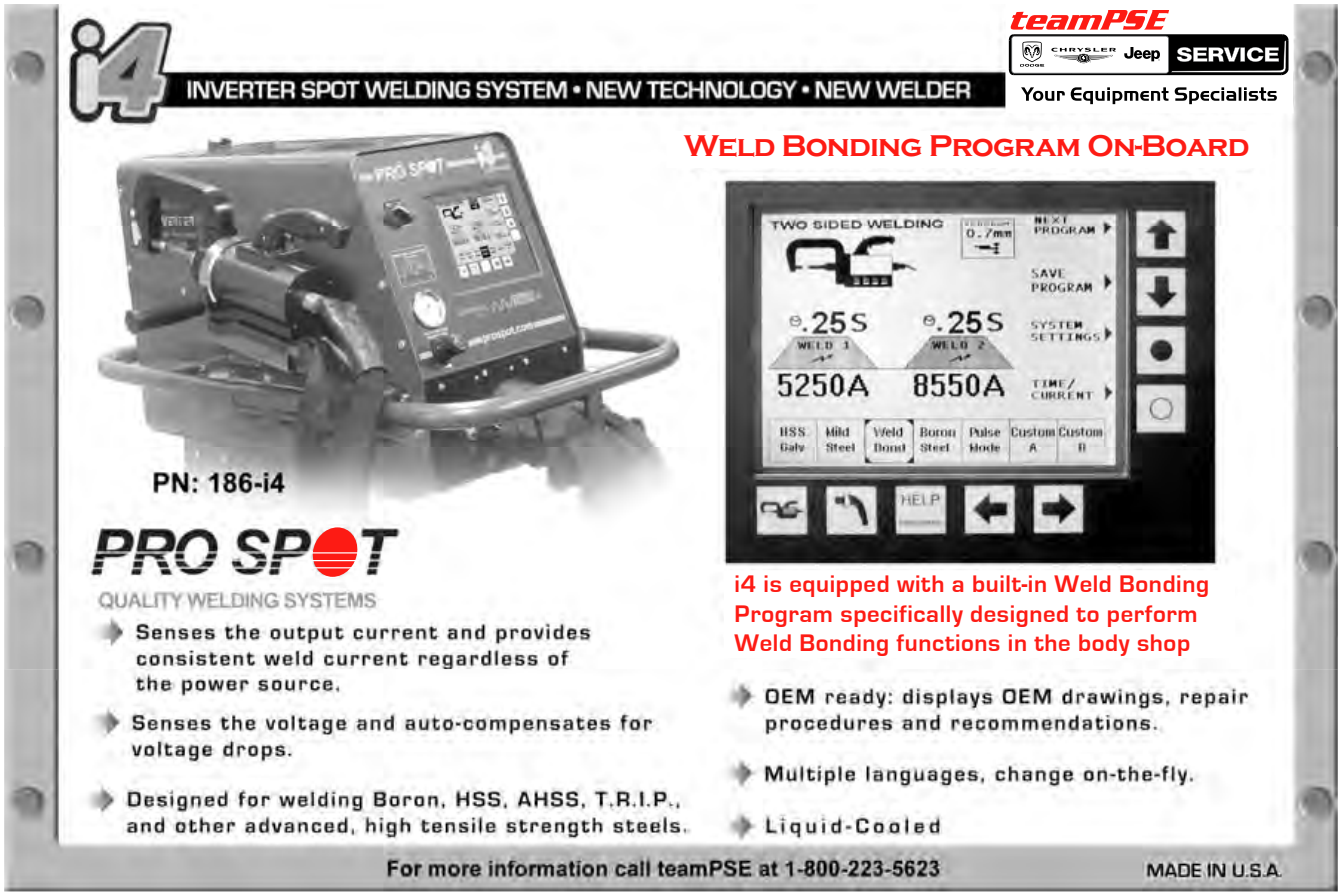
Training must be considered a two-fold process:

- The technician must be well versed in how the equipment operates, how adjustments are made and what effects those adjustments have on the weld. The technician must also clearly understand the maintenance of the equipment and the impact of poor maintenance on welds and equipment longevity.
- The second, and most important, aspect of the training is weld quality confirmation. Destructive testing of weld coupons must be performed to ensure the minimum weld nugget size is created. Physical appearance of the weld is not enough to determine the quality of the weld. Additionally, poor welds may also reduce the durability, or quality, of the repaired vehicle in time.

It is required that technicians have received training regardless of the welding equipment or method they utilize. Both training in the specific field of welding, and the particular equipment, are necessary to ensure safe, durable, quality welds are obtained.

Certification

To demonstrate welding skill, it is highly recommended that technicians obtain certification from an organization such as the American Welding Society (AWS) or Inter-Industry Conference on Auto Collision Repair (ICAR).



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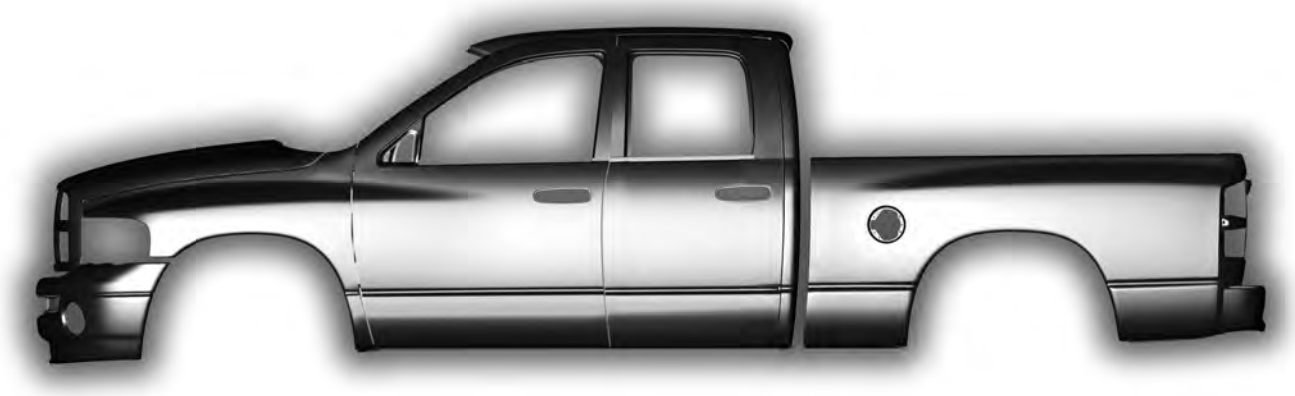

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