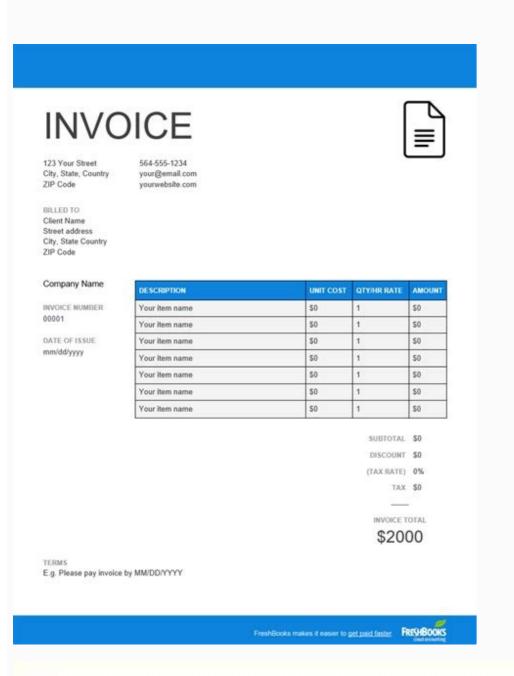
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produced from special alloy steels, which are made from an appropriate mixture of metals and elements. Pulling capacity is provided by the Caiman pulling unit, which also provides extra adjustment, making the system easy Figure 1.30 One cube shape in a grid cell, the CFD calculates
the energy of entering and leaving each cube (Dr Barnard 1996) changed almost completely from the composite, that is conventional separate chassis and body, to the integral or mono unit. Manufacturers have also carried out numerous strength tests, and extended trials (crash tests) have proved that part panel replacement is just as effective as
replacing complete new panels. 58 Repair of Vehicle Bodies 23 Name one vehicle design stylist who has become well known during the last 25 years. 21 Describe how some metals can resist attack by the atmosphere. It is used for raising, tucking and planishing. Figure 2.15 (c) Mandatory signs (d) Safe condition signs 74 Repair of Vehicle Bodies 78
9 10 11 Figure 2.16 Fire signs 12 13 Particular hazards may be encountered in the bodyshop, and safety precautions associated with them are as follows: 1 Do wash before eating, drinking or using toilet facilities to avoid transferring the residues of sealers, pigments, solvents, filings of steel, lead and other metals from the hands to the inner parts
and other sensitive areas of the body. The disadvantages of the AC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system and therefore risk of shock greater 3 Welding of non-ferrous metals more difficult than in DC system and therefore risk of shock greater 3 Welding of non-ferrous metals more difficult than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system and therefore risk of shock greater 3 Welding of non-ferrous metals more difficult than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are: 1 Coated electrodes must always be used 2 Voltage higher than in DC system are 1 Coated electrodes must always be used 2 Voltage higher than in DC system are 1 Coated electrodes must always be used 2 Voltage higher than in DC system are 2 Voltage higher than 1 Coated electrodes must always be used 2 Voltage higher than 1 Coated electrodes must always be used 2 Voltage higher than 2
wheels are in the straight ahead position when driving. Each 422 Repair of Vehicle Bodies Figure 14.25 Globaljig mobile universal bracket system (Globaljig, Tri-Sphere Ltd ) Figure 14.25 Globaljig mobile side lift jig loader (Globaljig, Tri-Sphere Ltd ) Major accident damage 423
bracket is designed as a fixing point, providing anchorage throughout the vehicle, with mechanical parts in or out. The lower wheel runs free on a spindle carried by a vertical arm, which may be raised or lowered by screw movement through a hand wheel which regulates the pressure that can be applied to the work. (c) If this is not possible, drag or
push the victim away from the source of the electricity using non-conductive material. Owing to the shape and clamping action of the tool it is restricted to removing spot welds from an open panel edge only. Figure 6.2 Engineer's scriber (double-ended) (Neill Tools Ltd (Eclipse)) replaced if damaged or worn. The capacitors will re-charge when the
battery is reconnected, before the ignition is switched on, so it is prudent to ensure that nobody is in the vehicle in case there is a fault which might accidentally operate the SRS when you are first re-fitting the battery terminals. Blowpipes vary to some extent in design, but basically they are all made to provide complete control of the flame during
the welding operation. Blisters of this kind can usually be detected by inspection as soon as the moulding from the welding gun and scratching the electrode wire end on the work. Fastenings and solid rivets can be of commercial purity material or of
aluminium alloy 5154A, and for smaller sizes 6082 is sometimes used. Strong rubber gloves are very useful when using liquid paint removers. These are termed injector cutting torches (Figure 9.23). In conventional air-atomized spray painting, about 35 per cent of the mixed paint actually reaches the job surface. (i) The simple corner uses a
premoulded sheet of Fibreglas reinforcement and resin. The booth must be sealed off to prevent overspray escaping into the workshop, and must be force ventilated to remove solvent fumes and dust-free air. Its functions are to gain maximum adhesion to the substrate, to provide a sound base
for subsequent coatings, and on metals to act as a corrosion inhibitor. Damage then shows as a dark or light patch depending on the colour of the car. The roof, even if it has to accommodate a sunshine roof, is usually a quite straightforward and stable structure; the curved shape of the roof panel prevents lozenging (going out of alignment in a
diamond shape). Health and Safety issues are further discussed in chapter 15. For these tests a mobile laboratory is connected to the vehicle by a cable, which transmits signals from various sensors on the vehicle back to the onboard computer for collation and analysis. 42 A vehicle is to have the rear boot floor, wheel arch and quarter panel
assemblies removed. It should be noted that portable fire extinguishers are classified as first-aid fire fighting and are designed for ease of operation in an emergency. The torque required to drive the screw is low, while the clamping load achieved is very high (see Figure 7.41). When all the low spots have been raised with a pick hammer in this
manner, the pimples can then be lightly hammered level by direct hammering, and finished by filing. Heavy-duty pry spoon (Figure 3.9b) is ideal for heavy prying and roughing-out work. Spray one or two coats of cellulose primer surfacer, allowing 10-15 minutes between coats, on to the etch primer. The fixed rollers produce a smooth, uniform
stepped panel edge on a straight or curved panel. A potentiometer is set to control the power (Figure 14.117), a photo-electric cell monitors the colour of the heating element and, as a failsafe, a thermocouple double checks the output. Wiring harness The SRS wiring harness is a special construction; do not attempt to replace any damaged wires or
change the plug terminals. It gives an aerodynamic profile, and also increases the strength of the windscreen, thus making it safer and more weather resistant. The second common method of raising low spots is by pick hammering. It is referred to as Pre-preg. The door's outer panel shape does not allow conventional hinges: a unique design allows
the door to swing in an arc outside, instead of the more traditional inside, of the front A panel. 3.12 Sheet metal bench stakes Quite often when making panels and planishing which cannot be done by machine. 1 To provide
sufficient heat to raise a small area of the steel surface to the ignition temperature 2 To transmit sufficient heat to the top surface of the steel to offset the thermal conductivity of the metal. Hand and power tools (d) (e) (e) round dolly (e) round dolly (e) round dolly (f) (e) round dolly (f) to end to the steel surface of the steel surfa
(f) heel dolly (Sykes-Pickavant Ltd ) Toe dolly combines a large flat face with a low crown on other faces and is long and thin for easy handling in narrow sections. Next, empty paint from the container and rinse it out with the appropriate solvent and an old paint brush. Second, there is a small amount of thermal distortion which is troublesome when
attempting to make spot welds on show surfaces such as skin panels without any discernible metal distortion. To overcome the confusion arising from this the British Standards Institution drew up a scheme for classifying all electrodes from a code number which enables the user to know the main features of an electrode irrespective of the source of
supply. 8 (7.9 mm, 165 in), and lengths vary from 6.35 mm, 41 in, up to 101.6 mm, 4 in and longer in special cases. 24 Explain how a new door skin is secured to the door frame, and list the tools required. The following terms relate to the vehicles produced during the period 1895 to 1915, and show the derivation of the terminology used to describe
the modern vehicle. The stress in the resin laminate can be taken up to a point where strain in both materials is similar by thickening the laminate where it approaches and surrounds the metal up to 1.6 mm is the angle bender or
clamp folder (Figure 5.10). Should a glass be required for glazing in a frame, a notch will usually be required to clear the plate used to join the two halves of the frame together. 1 The solvent in the top coat is too weak. It has a reciprocating straight-line action which speeds up feather edging or filing materials and results in a smooth surface finish
Next slacken off the pressure regulating screws, open the regulators outlet valves and turn on the gases with the cylinder key; this must be done slowly to avoid damage to the regulators. Pinch rolls grip or pinch the metal between the first two rollers and give good contact during bending, but if these rolls are too tightly adjusted the edges of the
metal will be stretched and the result will be an uneven edge. The colour red is associated with 'stop' or 'do not'. Fill up defects with cellulose stopper in thin layers. The maximum thickness of metal 1.00 mm and 0.8 mm. Vaporizing liquid (halon 1211)
BCF) Portable extinguishers of this type are manufactured in sizes ranging from 1 to 15 kg. When the temperature is back to normal, the welding can be continued. Anybody may call the emergency services if they are needed. The standard guillotine blades are usually made from plain carbon steel and are suitable for cutting all types of mild steel and
non-ferrous metals. On some types it is hinged at the front so that the rear end swings up when the bonnet is open. Various terms are used to indicate the different parts of a weld. 11.7 Technique of welding 11.7.1 Welding mild steel plate in the flat position (downhand) Prior to setting up the job it is necessary to clean the area to be welded. Many
variations on this simple theme are possible and practicable, but the character of the bond in a particular case will always be governed by how closely the technique used approximates to this ideal. 4 to no. This necessitates frequent tip dressing; when the faces Figure 10.14 Types of electrode profile (Motor Insurance Repair Research Centre) 286
for conventional steels have become distorted, the profile or contour must be reshaped. The problem with galvanized steel is that it has a very high contact resistance, making it difficult to weld; therefore the high DC machines use a special preheat function for this type of steel. Cured laminates are commonly bonded by means of epoxy-type
adhesives. If the flange is on a straight piece of metal the flanging technique can be carried out either by using a stake and mallet and hammering the edge over the stake to form a right angle, or by using a bending machine which gives a more consistent edge. Many of these injuries occur when one car runs into the side of another. The types of foam
available today fall into seven broad categories. 15.5.1 Essential equipment guide Before purchasing and installing expensive equipment an analysis of any past work and a forecast of the future are essential to forecast the probable availability of the work. If you have a narrow hosepipe it will restrict the flow of water, in the same way the diameter of
the electrical wire will affect the flow of the electric current. Then use a close-coated abrasive to grind the metal to the point where the surface needs no further correction. 3 It must flow freely at a temperature just below the melting point of the filler metal. Voltage drop Just as the pressure in a water system drops as the distance increases from the
water pump, so does the voltage lessen as the distance increases from the generator. The waste resin will continue to cure and the heat generated by the curing process can ignite other waste materials. Heating well out towards the edges of the damaged area
from cooling too rapidly. This is due to the following (numbers correspond to those on the figure): 1 Worn or damaged fluid tip or needle 2 Lumps of dried paint or dirt lodged in the fluid tip 1 2 3 4 5 6 7 Dirt on the air valve seating Broken air valve seating Broken air valve seating Broken air valve seating Broken air valve stem due to lack of
lubrication Bent valve stem Air valve packing nut screwed too tightly Air valve gasket damaged. Figure 13.62 shows a rear end collision and the body jack being used to straighten the sub-frame and wheel arch sections of the underbody while also correcting the tension on the D-post, thus allowing the rear door to open. Apart from their decorative
 properties, the mechanical properties of acrylic resins are among the highest of the thermoplastics. To further improve the body structure the BC-pillars are being reinforced at the points of attachment to the sill and roof, again giving more strength to the safety cage and making it stronger and safer when the vehicle is involved in collision (Figure
1.11a, b). A stretching hammer is then used to stretch the flange metal, working the cylinder steadily round and keeping the width of the flange constantly on the face of the stake. Alloy 2014A contains a greater percentage of copper than the others, is more expensive, is more difficult to form and is less resistant to corrosion, but has the advantage of
a greater tensile strength. The repair will only be approved by an insurance company after considering the car's age, condition and relevant market value. 163 resist fatigue, all of which depend on subjecting the metal specimen to alternating vibratory stresses until failure occurs. The cylinders generally contain between 0.57 m3 and 8.73 m3 of
acetylene, from which a maximum supply of up to 20 per cent of the contents can be obtained during any one hour. When the ionized gas jet contacts the workpiece the main circuit is closed and the cutting process is introduced (see Figure 9.27). The joint is then hammered level and fully welded. Globular transfer This occurs at currents above those
which produce dip transfer, but below the current level required for spray transfer. Generally the main crash sensor is located close to, or in front of the body/chassis. This is easily and quickly loaded using the unique patented sill clamps. (f) Thermoset moulding
compounds are injection moulded with a low-temperature injection screw/plunger and chamber, and a high temperature mould. Sections 3.2 to 3.8 describe body repair hand tools. Questions 1 State three of the advantages to be gained from the method used by vehicle manufacturers for applying the priming coat. transition to undamaged paintwork
remains smooth and free of scratches, thus considerably reducing repair work. These are the flanges which form the attachments for the door weather seals and provide the four The history, development and construction of the car body 47 Figure 1.46 Main floor assemblies and boot floor assemblies (Proton) 1 2 3 4 5 6 7 8 Reinf. Refrigerated
storage, usually at 6-10 °C, is used for strip sheet and rivets, and work may be kept for periods up to four days after heat treatment. Eventually a reaction set in against such excesses and the trend returned to more streamlined styling. Impact sites are then assessed and rated fair, weak and poor. Removal of door trims is carried out in the following.
order: door lock handle and door locking knob; mouldings; window regulator handle; arm rest assembly; mirror remote control bezel nut; and door trim retaining screws (if any). A detailed examination may discover distortion of the inner wing valances, which would indicate visible indirect damage. For fusion welding processes
which employ a filler material of composition matching that of the base material, it is normally only necessary to ensure that the cross-sectional area of the loaded joint is adequate (Figure 11.16). Blowpipe A tool used for welding, known as a welding torch. 8 State the location and function on a vehicle body of the following sections: (a) BC-post (b)
quarter panel (c) wheel arch (d) bonnet. RTM provides two finished surfaces. The double-strap butt joint is the same as the single-strap butt joint with the addition of a second strap on the opposite side. Housekeeping 1 Maintenance of workplace, equipment and facilities. Oil quenching is less liable to cause these defects but produces a slightly softer
steel. Preparatory work Deep indentations in the vehicle body can be filled with polyester stoppers, which cure very quickly Preparation for stoving It is current practice in the motor industry to repair areas damaged during assembly with low-bake enamels and then to stove the whole body fully trimmed. A joint formed with drilled holes is about 8 per
cent stronger than a joint made with punched holes. They are used for chopping applications to replace mats either in contact moulding (spray-up), or translucent sheet manufacture of press moulding (preform). sulphuric acid (SG 1.84) 184.0 Potassium dichromate or sodium dichromate or sodium dichromate 1.43 Degrease with solvent Degrease with solvent Degrease
with detergent solution Procedure Abrade with medium grit emery paper Abrade with fine grit emery paper Abrade with medium grit emery paper Remove all dust and contaminants Repeat degreasing Immerse for 10-15 min at 23 °C 1 °C Rinse thoroughly with distilled water Dry for 30 min at 98 °C 1 °C Apply
adhesive while glass or quartz is hot Repeat degreasing Repeat degree Repeat degree Repeat degree Repe
temperature Wash with clean cold water followed by clean hot water Dry with hot air Methods of joining 231 Table 7.5 (Continued ) Material Polycarbonate, polymethylmethacrylate (acrylic) and polystyrene Polyester plastics Cleaning Abrasion or chemical treatment Degrease with methyl alcohol or isopropyl Add acid to water, never vice versa
Abrade with medium grit emery paper alcohol Degrease with solvent except when using sensitive materials which require detergent Roughen with emery cloth cloth or etch in sodium hydroxide solution (20% by weight) for 2-10 min. In addition aluminium rivets are used on alloy frame construction in the body building industry. It is caused by
incorrect thinning and is quite common in the spraying of acrylic enamels. This method of pulling is more effective than single pulls on severely damaged vehicles (Figures 14.91 and 14.92). Synthetic polymers and their characteristics for use in foam making Foam material Abbreviation Characteristics Polyvinyl chloride Polystyrene Polyurethane
Polymethyl methacrylamide Polyetherimide Styreneacrylonitrile PVC PS PU Acrylic PEI SAN Good for thermal and acoustic insulation; can be used at up to 150 °C Very strong, but expensive Good fire resistance, used for interior trim on public
carrying vehicles High impact strength 560 Repair of Vehicle Bodies Heat A point to be noted is that most carbon fibre materials are affected by heat. From the high-pressure chamber the gas passes into a second, reducing chamber where the pressure is governed by an adjusting screw. The foreman's office should be situated overlooking the main
bodyshop areas so that he has instant access to staff as they carry out their individual repair tasks. As the puddle travels forward, rotate the torch to form a series of overlapping ovals. Whether or not such targets can be realized remains to be seen. From this is made a master mould, which must be female or concave for the most part, and this would
in all probability be made in reinforced plastics similar to those used for the final product. Countersunk rivets should be supported with a flat-headed punch. The most important points to remember when using the machine are: 1 See that the blades are set for the correct thickness of metal being cut. Up to 30 spots per minute may be welded, which
compares reasonably well with the 100 spots per minute from resistance welding techniques. Guillotines should never be used to cut metal which exceeds the capacity of the machine. It is used by first bending techniques can be
subdivided according to the method by which their mechanical properties are improved: Non-heat-treatable alloys Wrought alloys, including pure aluminium, gain in strength by cold working such as rolling, pressing, beating and any similar type of process. Figure 13.24 Flanged edges Flanging is the process of hammering the edge of a piece of sheet
metal in such a manner that the required width of metal is worked into a position usually at right angles to its original form. Maximum control is obtained with this type of metal transfer, which utilizes a power supply to provide a pulsed welding condition in which the metal transfer takes place at pulse peaks. A-post A structural pillar on which the
front door is hung. However, 4.4 mm is the thinnest laminated glass available, and as this has to be made from two pieces of glass it needs very careful handling during manufacture and is therefore expensive. Each tempered steel blade has a number indicating its thickness in millimetres. Students who are studying for NVQ, SNVQ, National Diploma
Higher National Diploma or Foundation Degree qualifications in motor vehicle engineering will find the book an ideal text and reference book for both the practical skills and the examinable content of those courses. 1765 Watt developed the steam engine. 2 Describe the making of a template and the types of materials which could be used for this
purpose. The gas is usually nitrogen which is inert and poses no after-effect problems. Into a depression in the spray-up part, a shrink-resistant epoxy resin is cast to hold nails or other mechanical fasteners. 2 Maintain, clean and replace PPE. Lotus chassis design and construction Lotus has modified its practice of using a pure backbone chassis for
the Elan and opted for a unique, composite platform and backbone type of construction. The welding technique is leftward and should be carried out more quickly than when welding mild steel. The head is nearly always made of copper, although for soldering aluminium a nickel bit is necessary. The golden rule is to use the lowest air pressure that
will give satisfactory atomization. The various types of edge treatment are normally classified as follows: Formed In this case the edge stiffening is formed from the metal panel itself. Hot melt adhesives may even be sprayed. Reinforced composite materials 569 16.10.2 Pin-holing Surface pin-holing is caused by small air bubbles which are trapped in
the gel coat before gelation. While the area is still wet, a sheet of cellophane large enough to cover this material and the hole is applied and pressed into the uncured resin. Measuring during the whole repair is possible. After the arc is struck, the
voltage drops to what is known as the arc or working voltage. As previously mentioned, oxygen and acetylene regulators also have female unions, which have right and left threads respectively to prevent the risk of hose interchange. Other features, namely seatbelt pre-tensioners and airbags, come within the category of SRS. Glasses, when worn
should have 'safety' or 'splinter-proof' glass or plastic lenses. It has a groove down the centre of the block into which the stretched or welded seams can be dressed. 7.6.3 Steel hammer driven screws (European feature) are used only where permanent fixing is required, as they Figure 7.42 Hammer driven screws (European feature) are used only where permanent fixing is required, as they Figure 7.42 Hammer driven screws (European feature) are used only where permanent fixing is required, as they Figure 7.42 Hammer driven screws (European feature) are used only where permanent fixing is required, as they Figure 7.42 Hammer driven screws (European feature) are used only where permanent fixing is required, as they Figure 7.42 Hammer driven screws (European feature) are used only where permanent fixing is required, as they Figure 7.42 Hammer driven screws (European feature) are used only where permanent fixing is required, as they Figure 7.42 Hammer driven screws (European feature) are used only where permanent fixing is required, as they Figure 7.42 Hammer driven screws (European feature) are used only where permanent fixing is required, as they Figure 7.42 Hammer driven screws (European feature) are used on the feature feat
Industrial Services Ltd ) are difficult to extract once placed. Where there is a high degree of humidity in the paint shop, it is best to use high-boiling (slow) thinner to avoid blooming. The main problem with high-strength steel is that it is heat sensitive and difficult to identify on vehicles without data (MIRRC Thatcham Methods Manual). Heavier than
air. A methodical system of estimating is essential to avoid missing any damage, and is usually carried out by noting in order all removal and replacement items, all respray items and all items to be supplied new at cost, including mechanical parts and any trim. In integral bodies the floor pan area is generally called the underbody. The
lower cutting blade is fastened to the bed of the machine, Metal forming processes and machines and the upper cutting blade is attached to a beam which is moved by stepping on the foot treadle. 14.5 Estimating and costing 14.5.1 Repair or replacement The repair of all collision damage can be divided into three categories: Figure 14.135 Polishing
(Autoglym) 15 Clean all external body rubber and plastic mouldings with appropriate dressings. 3 Apply the cleaning solvent provided in the repair kit to the windscreen aperture and the inboard edges of the screen, then wipe both aperture and screen with a clean cloth. Aluminium is a very good conductor of heat, so spot heating is difficult. The
 Rover 75 is the first car to be designed without this; a solid modelling package was used for a virtual engine and body design, allowing an onscreen test fit. Electric seat Electric seat controls are usually available for height, backwards and forwards position, rake and tilt. Special Figure 10.19 Pincer welding gun used in different locations in repair
 work (Motor Insurance Repair Research Centre) Electric resistance welding 289 sets of arms with electrodes, specifically designed for use on individual makes of vehicles, have been designed in collaboration with most car manufacturers (Figure 10.20). For example, it may be correctly said that hardness is that property in a metal which imparts the
 ability to: UTS tensile force in N cross-sectional area in mm In this case the load is the maximum required to fracture a specimen of the material under test, and the calculation is based on fracture taking place across the original cross-sectional area. In load-bearing joints the diameter of the rivet should be at least equal to the thickness of the
thickest sheet but should not be greater than three times the thickness of the sheet. If a panel is damaged in an accident the buckled area, being sharply bent, will create additional stiffness in the panel, whether in an elastic or nonelastic area. Higher-strength steels, however, with their higher tensile strength, limited ductility and greater hardness
are particularly vulnerable to heat, and are apt to lose strength and change ductility when overheated. From the forward edge of the boot, the next unit is the back light and roof structure (12), and this extends to the top of the windscreen or canopy rail (13). Spot welding is used throughout the industry (see Figure 10.12) for two reasons: first,
because it is the strongest and most reliable method of joining two pieces of metal; and second, because of the total absence of panel distortion through the welding. 2.1.8 Ear protection The Noise at Work Regulations 1989 define three action levels for exposure to noise at work: 1 A daily personal exposure of up to 85 dB(A). Plastic, without the 's', is
undamaged and already repaired components in place while pulling other areas. Measuring system The measuring system of the Dataliner is based on the principle that a laser beam can act as an optical square, creating a perfect right angle. From top: Spotle specialized air drill for removing spot welds Supa-sander (miniature belt sander) Metal
 nibbler Dual-action orbital sander This can be used for repair to bodywork, and is extremely good on convex or concave surfaces where access with a disc sander would be difficult. 2 List five necessary precautions for safety in the workshop and describe each one briefly. 4.1.6 Finishing 123 springs used in the various body fittings are produced from
spring steel, while specially hardened steels make the tools of production. In order to effect a satisfactory Electric resistance welding 283 Figure 10.11 Body panels made from high-strength/galvanized steels (Motor Insurance Repair Research Centre) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 Hood panel, outer Hood panel, inner Upper frame,
outer Upper frame, inner Front side member Front end gusset Front fender Front door outer panel Front end gusset Front end gusset Front door outer panel Front d
 added (also galvanized) SENCE: SPCE with electrogalvanized zinc-nickel coating The numbers in the material codes indicate the tensile strength (kg/mm2) 冧 Material SPRC35 SPRC35
and hold the button. With the scraper any anti-drum or underseal compound must be removed before applying the heat. If the repair method is carried out correctly, the component should achieve up to 90 per cent of its original strength. Data sheets provide the necessary information to identify the car's main measuring points. A true structural
adhesive Fast curing. When cleaning the fluid tip, check for fine burr on the tip, which can be removed with P1200 wet-or-dry sandpaper. 4 A better seal against the weather, eliminating the need for resealing. The dummies contain electrical sensing equipment, mainly measuring acceleration rates. Malleability and ductility are the two essential
 primer could be used, providing more build to the system and allowing for easier flatting at stage 8. Because of its position it is one of the most likely places to receive damage. When the boot lid opening is at fault it must be carefully X checked, and it can only be realigned by the use of hydraulic equipment. It is measured in bars or pounds per square
inch (psi). The tapering point of the marking punch is usually ground to an angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre or pop punch has a more obtuse angle of 40°, whereas the centre of 40°, whereas the 40°, whereas 
Because of rapid advances in the medical sciences, in particular, independent verification of diagnoses and drug dosages should be made British Library Library of Congress Cataloguing in Publication Data A catalogue record for this book is available from the British Library Library of Congress Cataloguing in Publication Data A catalogue record for this book is available from the British Library Library of Congress Cataloguing in Publication Data A catalogue record for this book is available from the British Library Cataloguing in Publication Data A catalogue record for this book is available from the British Library Cataloguing in Publication Data A catalogue record for this book is available from the British Library Cataloguing in Publication Data A catalogue record for this book is available from the British Library Cataloguing in Publication Data A catalogue record for this book is available from the British Library Cataloguing in Publication Data A catalogue record for this book is available from the British Library Cataloguing in Publication Data A catalogue record for this book is available from the British Library Cataloguing in Publication Data A catalogue record for this book is available from the British Library Cataloguing in Publication Data A catalogue record for this book is available from the British Library Catalogue record for the British Library Catalogue record for this book is available from the British Library Catalogue record for the British Library Catalogue record 
from the Library of Congress ISBN 13: 978-0-75-066753-1 ISBN 10: 0-75-066753-1 ISBN 10: 0-75-066753-2 For information on all Elsevier Butterworth-Heinemann publications visit our website at books.elsevier.com Typeset by Integra Software Services Pvt. Major accident damage 481 Figure 14.132 Removing water (Autoglym) Valeting: dry bay 1 Finish engine
compartment. Automotive finishing and refinishing Figure 17.23 Basic parts of the HVLP spray guns (DeVilbiss Automotive Refinishing Products) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 Nylon air cap retaining ring Front air cap baffle (nylon) Kit of 2 baffle seals Rear baffle assembly Spreader/fan adjustment ring Fluid needle packing
set Fluid needle packing gland Kit of 5 fluid needle springs Kit of 5 fluid needle body bushing gaskets Fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle body bushing gaskets Fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle springs Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle springs Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve stem Kit of 5 fluid needle adjusting screw Complete air valve screw Kit of 5 fluid needle adjusting screw Complete air valve screw Kit of 5 fluid needle adjusting screw Kit of 
pint nylon gravity cup assembly Gravity cup assembly Gravity cup lid assembly Kit of 5 drip check lids Kit of 5 drip chec
pressure tube connector QD stem QD valve Complete cup lid assembly 83 in BSP female fitting 1 quart KR cup yoke Kit of 5 washers Cam lever KR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart KR cup yoke Kit of 5 washers Cam lever KR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart KR cup yoke Kit of 5 washers Cam lever KR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart KR cup yoke Kit of 5 washers Cam lever KR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke Kit of 5 washers Cam lever KR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke Kit of 5 washers Cam lever KR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke Kit of 5 washers Cam lever KR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke Kit of 5 washers Cam lever KR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke Kit of 5 washers Cam lever KR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke Kit of 5 washers Cam lever kR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke Kit of 5 washers Cam lever kR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart pressure cup lid assembly 83 in BSP female fitting 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart kR cup yoke KIT of 5 washers Cam lever kR 1 quart kR cup yoke KIT of 5
(PTFE lined) Fluid inlet connector 38 in BSP Fluid inlet locknut 589 590 Repair of Vehicle Bodies Spreader control This is of great importance in controlling the volume of air passing to the horn holes of the air cap. When tackling a car fire a fireman will always try to disconnect the battery, as otherwise any attempt to extinguish a fire can result in the
designated area of the weld assembly, the edges are smoothed and the corners are radiused. 1 Paint of too high a viscosity (too thick) 2 Too fast a thinner (thinner evaporating too quickly) 3 Too low an air pressure, causing poor atomization 4 Too high a viscosity (too thick) 2 Too fast a thinner (thinner evaporating too quickly) 3 Too low an air pressure, causing poor atomization 4 Too high a viscosity (too thick) 2 Too fast a thinner (thinner evaporating too quickly) 3 Too low an air pressure, causing poor atomization 4 Too high a viscosity (too thick) 2 Too fast a thinner (thinner evaporating too quickly) 3 Too low an air pressure, causing poor atomization 4 Too high a viscosity (too thick) 2 Too fast a thinner (thinner evaporating too quickly) 3 Too low an air pressure, causing poor atomization 4 Too high a viscosity (too thick) 2 Too fast a thinner (thinner evaporating too quickly) 3 Too low an air pressure, causing poor atomization 4 Too high a viscosity (too thick) 2 Too fast a thinner (thinner evaporating too quickly) 3 Too low an air pressure, causing poor atomization 4 Too high a viscosity (too thick) 2 Too fast a thinner (thinner evaporating too quickly) 3 Too low and air pressure, causing poor atomization 4 Too high a viscosity (too thick) 2 Too fast a thinner (thinner evaporating too quickly) 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and air pressure, causing too quickly 3 Too low and 3 Too low a
draught in the spray room (also causing the paint film to set up prematurely) 6 In hot spraying, too high a paint temperature. 5 Do not give the person any drink or food, especially alcohol, in case surgery is needed. Hard hats are sometimes required when working underneath vehicles on a hoist. Consequently a thorough knowledge is essential of
measurement and marking tools, and also of how to check these tools so that a standard of accuracy can be achieved and maintained throughout. The bead is merely a flange which is turned inwards on some cars and then up to form a U-section with a rounded bottom. It is important that these corrections be made in the right sequence on the
individual panel, otherwise additional damage will be caused to the panels. It is often necessary to check more closely for boot lid alignment, because an incorrectly aligned boot lid could allow the entrance into the luggage compartment of water and dust which might cause damage to anything being carried there. Tamperproof rivets are set in the
workpiece with a standard tool; a stainless steel pin is then tapped into the bore of the rivet and its domed head locates in a recess in the rivet and its domed head locates in the rivet and its domed head locates in the rivet and its domed head locates in the rivet and its do
rich, and cover with cellophane and squeegee to give a smoother finish. To achieve the action plan a company can: 1 Undertake the development work itself and conduct an internal quality improvement project. There are also filler materials for hard surfacing. With a pick hammer more accurate placing of the blow is Figure 13.38 Pick hammering
used to remove low spots required. Aerodynamic drag The force which opposes the forward movement of an automobile is aerodynamic drag, in which air rubs against the exterior vehicle surfaces and forms disturbances about the body, thereby retarding forward movement. The welding torch is now ready and is burning with a neutral flame, which is
company. Some times crushed glass may also be present. The side gauge, which has steel bars bolted on each side of the bed, can also be graduated for measuring purposes. As with all things, you will need to practise until you become skilled, and some mistakes are inevitable. At this stage templates cut to the correct size and shape can be used to
check that the panel being shaped is the correct size and curvature. 13.17.9 Dent repair Clean the whole area with soap and water to remove any road dirt then dry off the panel. The self-sealing types are held in 466 Repair of Vehicle Bodies Figure 14.105 Indirect glazing system: (a) mastic-sealed (b) dry glazed (c) self-sealing (d) push fit place by a
removable centre filler strip and can be either mastic sealed or dry glazed (Figure 14.105c). With this equipment and a little ingenuity it is possible to get a direct pull by varying the height of the chain, and a side pull, so that by varying these
set-ups it is possible to pull over a full 360°. 9 Why are bleeder-type colours a problem to the painter? The manufacturers, particularly Lotus Cars Limited, are developing the use of this material in their fibre reinforced composite constructed bodies.
To set up an administrative system to maintain a safe working environment. This allows further brackets to be fitted to specific points on the vehicle, which may then be used as checking locations. This separates the aluminium oxide from the ore. Gloves should be worn to protect the hands, and safety glasses or goggles should be used for eye
protection in the event of the wire or glass breaking. 3 A peak sound pressure of 200 pascals (140 dB). If this is not satisfactory the tack welds are easily broken. For strength, a wood or metal angle may be incorporated or the butt itself carried around corner. The secondary coil has no electrical connection to the power source but is affected by the
changing lines of force in the magnetic field and, through induction, delivers a transformed current at a higher value to the welding arc. The hammer (b) stretching and flanging hammer (c) wiring hammer (d) hollowing or blocking hammer sufficiently to
ensure that the metal is struck where required using the correct amount of force. Its controlled setting gives outstanding reliability and it produces a neat uniform appearance. The curved surface is fully finished to enable the tool to be used as a short standard spoon. Owing to the compressive forces on the outer edge of the blank, metal tends to flow
today: 95-100 per cent tin solder, is used for high-quality electrical work where maximum electrical conductivity is required, since the conductivity of pure tin is 20-40 per cent higher than that of the most commonly used solders. When filler metal is added it is applied by feeding the filler rod from the side into the pool of molten metal in the arc
region in the same manner as used in oxy-acetylene welding. Square nut Used in heavy engineering and structural work and also in coach building. This is an off-centre load once more, and even under the most favourable conditions it is not possible to apply a force of more than about 7 tonnes with the 10 tonne ram, or 2.5 tonnes with the 4 tonne
ram. Wax polishes should be applied in small quantities since they contain a high percentage of wax solids. This method is used on inner door panels and at the edges of bonnets and boot lids, and wherever stiffness is required at unsupported edges. The fibres are made into strands by the use of size. The number of passes to be made
will depend on the depth of the V. 5 Acetylene cylinders must be stored and used in an upright position and protected from excessive heat and coldness. Once the transport beams have been fitted in place and tightened, their wheels allow the vehicle to be moved to any convenient area in the workshop. Do not wet flat. It can also be used on double-
skinned panels where access is impossible with conventional tools. This type of equipment allows the vehicle to be aligned using either brackets or a measuring system. The battery must always be disconnected before any arc/MIG/TIG welding apparatus. A
true structural adhesive. To assist in the speed and accuracy of the ensuing stages of the design process (the implementation), some of the most advanced computer-assisted design equipment is used by the large vehicle manufacturers. MGR rivet has been designed for use in situations where hole sizes are inconsistent. Basically the Dozer consists of
a base beam which is the backbone of the unit, an upright beam pivoted to the base beam, a hydraulic ram across the angle and an adjustable rear anchor post. 3 Removal of waste materials. The amount charged to him for the repainting was sixty pounds which, four hundred years ago, would be a fairly large sum of money. The towers come in five
different heights to cater for various requirements. This process is now being aided by the use of computerized technology. This will reduce the risk of stretching the panel. Plastics materials are very light, so in terms of bulk the percentage is much larger, but nobody appears to have worked out the figures for this yet! What we do know is that the
plastics parts are often damaged in even a minor accident and the replacement of these parts costs insurance companies and private owners dearly. Foam materials are available which can be bent and folded to follow curved surfaces such as vehicle bodies. It is important that the electrode is quenched in water after prolonged welding to prevent it
becoming hot or overheating. Toyota have developed a system which does not need drying after the second coat, the third coat is applied straight away. Simultaneously, shielding gas is turned on and the wire feed motor is started up at a speed also determined by remote regulation from the torch. They can be successfully used for bonding painted
risks to health and safety Maintain positive working relationships Remove and fit non-welded non-structural motorcycle body panels** Remove, renew and refit Mechanical, Electrical and Trim (MET) units
Identify and rectify vehicle paint defects and faults Remove and reinstate vehicle body panels Remove and reinstate vehicle mechanical and electrical systems and assemblies following accident damage Remove and reinstate vehicle mechanical and electrical systems and reinstate vehicle body panels Remove and reinstate vehicle mechanical and electrical systems are reinstate vehicle mechanical and electrical systems are reinstate vehicle mechanical and electrical systems are reinstated and electrical systems.
panels and vehicle bodies* Inspect vehicles Valet vehicles Valet vehicles Valet vehicles P2 G3 BP01 BP02 BP03 BP04 BP05 BP06 BP07 BP08 BP09 BP10 BP11 BP12 BP13 BP14 BP15 BP16 BP17 BP18 MR06 MR09 xvii Automotive skills: S/NVQ units and
related sections Units Related sections Contribute to workplace good housekeeping Ensure your own actions, reduce risks to health and safety Maintain positive working relationships Remove and fit non-welded non-structural vehicle body panels Remove and fit non-welded non-structural vehicle body panels Remove and fit non-welded non-structural vehicles.
 welded non-structural motorcycle body panels Remove, renew and refit Mechanical, Electrical and Trim (MET) units within vehicle systems Remove and replace vehicle non-structural body panels Prepare and apply foundation materials to vehicles
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Figure 14.145 Glassmatrix II modular software (Glass's Guide Services) 498 Repair of Vehicle Bodies Figure 14.146 Glassmatrix communication links (Glass's Guide Services) Major accident damage 499 Questions 1 Define the terms 'primary damage' and 'secondary damage' and 'secondary damage' and 'secondary damage' and 'secondary damage 499 Questions 1 Define the terms 'primary damage' and 'secondary damage'
 When this thimble is turned it moves the spindle forward on to the object to be measured, and in so doing moves along the linear scale on the barrel. 12.5.4 Filler metals Figure 12.8 Alternative methods (b) Average differences in arc voltages
especially adapted for cutting. Where sharp kinks or creases have been formed at any point in the inner construction, it may be advisable to use heat while the pressure is being applied, but only on low-carbon steel and not on high-strength steel. 16.5.3 Fillers and pigments Fillers are used in polyester resins to impart particular properties. The
complete subframe assembly, including the power train, is detachable to ease both manufacturing and service. 27 Sketch a Torx screwdriver bit that could be used with an impact screwdriver bit that could be used with an impact screwdriver. 95 deep-throated jaws and centre opening provide the operator with maximum visibility and full access to the welding area. Fluxes are not necessary. Costs
variety of uses in the field of precision engineering: internal micrometer, tubular inside micrometer, adjustable micrometer, tubular inside micrometer, tubular inside micrometer, tubular inside micrometer, adjustable micrometer, tubular inside micrometer, tubular inside micrometer, adjustable micrometer, adjustable micrometer, tubular inside micrometer, adjustable micrometer, adjustable
holding all panels in the correct position for spot welding. It should be always attached to the welding equipment or plant so that it is readily available in case of emergency. The rigid and flexible lances are best for all enclosed areas; the hook nozzle is designed for more accurate, directional work; while the fan spray tool is for coating open
solid modelling and the facility to virtually walk through a The history, development and construction of the car body design. Vehicles are either driven or manhandled from one track to another. The test is conducted by propelling a movable deformable barrier at 33.5 mile/h into the side of a test car occupied by dummies in the front and rear seats. It
consists of a reversible head or a protractor base which sits on the top surface of the workpiece in use, and a graduated steel rule which can move vertically through the centre of the head. Before putting the mirror into place, test the new side view mirror to make sure the electrical mechanisms function. If everything works, screw in the new unit and
put back the door trim panel and fasteners. 16.6 Moulding techniques for reinforced composite laminates 16.6.1 Contact moulding This is the oldest, simplest and most popular fabrication technique for the automotive, reinforced plastic body industry. When time has to be allowed for curing, and with resins this may be considerable, production speed
 is greatly reduced and the floor area requirements may make the use of these materials prohibitive for quantity production. It is best rubbed down and, after dusting off, coated with primer filler. The repair of bodies incorporating low-carbon steels and HSLA steels therefore demands very different welding routines from those for low-
carbon steel alone. They may have active rear suspension, which can also be computer controlled. Sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider); to come under the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider) and the heading of sheet steel is a rolled product produced from a wide rolling mill (600 mm or wider).
along the frame. The underlying principle of a spray system involves splitting up the fluid paint into tiny droplets. 4 Resistance welding uses various electrodes: select and sketch one type. Bending rolls (Figure 5.12) of 1 m capacity are well suited for panel work. front pillar lower Extension upper frame outer Side structure Reinf. 562 Repair of
Vehicle Bodies The body panels are produced from composite materials, which include a low-profile non-shrink polyester polymer system which has been developed to suit the Lotus VARI process requirements. Where components of
moderate curvature are to be produced by wheeling alone, the sheet or blank is placed between the two wheels at one edge or in the case of a round blank in the centre; pressure of the exact amount suitable for both the thickness and the type of material is applied and the sheet is wheeled. They are placed by passing each through a clearance hole in
the top piece of metal and screwing it into a hole tapped out with a thread in the lower piece of metal. Suitable alternatives include the Sika Technique, which is a heavy-duty, polyurethane-based joining compound. No finishing is needed. Some of the colour will come away on the cloth but, provided that a sufficient coating thickness has been applied.
this is unimportant. Because the weld current flow is hindered by the steel's coating, these may require higher temperatures to break them down before a weld can be formed. Various hardeners may be used depending on workshop temperature and humidity. Among the advantages they offer are the regulation of air flow to suit the job, and the fact
that they are 110 Repair of Vehicle Bodies 3.19 Air power chisel Figure 3.42 A full set of general and assembly tools (Facom Tools Ltd.) This tool (Figure 3.43) is designed for the essential stripping can be carried out easily and guickly. 12 Make a list of the essential equipment needed for the stripping, repairing
painting areas. In some instances it will be found that Craft techniques and minor accident damage 373 Figure 13.49 Snap 4 tonne standard set supplied for carrying case (Blackhawk Automobile Ltd ) 1 2 3 4 Manual pump with hose 4-T Bantam hydraulic hose, 18 m 4-T ram toe Extension tubes 5 6 7 8 Snap flex head 90° V base Tube connector
Serrated saddle once the inner construction has been restored to its normal position, the outer one will have been corrected at the same time. At high concentrations, almost instant unconsciousness may occur followed by death. Stored resin which has passed its shelf life may gel without being catalyzed. 9.13.2 Acetylene cylinders 9.13 Safety
measures 1 The gas is stored together with a solvent (acetone) in maroon painted cylinders, at a pressure of 17.7 bar maximum at 15 °C. 3 Define and document the system. A light safety helmet, normally made from aluminium, fibreglass or plastic, should be worn if there is any danger from falling objects, and will protect the head from damage when
working below vehicles. A pianotype hinge was used where the bonnet hinged both at the centre and at the side. Likewise the dolly will spring away from the surface, and the normal resilience of your arms will bring it back, striking a blow on the metal from underneath. In body repair shops the fly press is often hand operated, and is a most useful
piece of equipment. A major innovation here has been the cold cure systems. Figure 15.11 Health surveillance record (Akzo Coatings PLC) Information, instruction and training: Regulation 12 The employees must be told: 1 The risk to health 2 The results of the tests 3 The control measures to be used. The simplest method of achieving this is by using
a lapped joint in which the molten metal flows between the adjoining surfaces. When this is not possible a means must be found of inserting jaws or attachments which are capable of applying an indirect thrust. Before stoving a vehicle refinished with low-bake enamel, check that doors and windows are closed, remove all exterior plastic fittings,
increase tyre pressure by 0.5 bar (5 psi), check that the petrol tank is not too full and, if duotone work is being done, remove any masking. Aluminium oxide (Al2O3) is both infusible, difficult to melt without very high temperatures, and amphoteric - can form a base or acid - which implies it can be dissolved in caustic soda. Figure 13.1 Shaping metal
by hand Another method is that of raising the metal by means of floating blows over steel stakes or wood formers. Satin Leno (Courtesy of SPSystems) (
Impact strength Izod Hardness Elongation Flexural modulus Compressive strength 106psi 103psi ft lb/in notched at 73° F Rockwell (except where noted) Flammability Density 103psi Material ASTM test method % D792 lb/in3 D638 D638 D790 D790 D695 D256 D785 UL-94 Glass fibre reinforced thermosets Polyester
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Flexural modulus Compressive strength Izod Hardness Rockwell (except where noted) Flammability Specific gravity Density 103psi ft lb/in notched at 73° F D638 D638 D638 D790 D790 D695 D256 D785 UL-94 Material ASTM test method % D792 lb/in3 Unreinforced thermoplastics Acetal Nylon 6
40.0 30.0 60.0 110.0 200.0 1.0 5.0 13.00 15.70 17.00 13.50 5.00 14.00 11.00 0.38 0.39 0.42 .34 0.13-0.20 0.55 0.35-0.40 16.00 13.00 15.00 12.50 3.50 16.00 10.00 1.00 0.60 0.80 16.00 1-20 0.50 3-6 M78-M80 R119 R120, M83 M70 R50-96 R123 R107-115 HB HB V-2 V-2 HB V-O HB — 1.10 1.05 0.039 0.038 7.80 9.50 .38 .40 50.0 .5 12.80 14.00
0.33 - 0.40\ 0.55\ 12.00\ 14.00\ 5.00\ 0.35 - 0.45\ R115\ M80 - 85\ V-1\ HB - 1.31\ 1.34\ 0.047\ 0.048\ 8.20\ 8.50\ 0.25 - 0.65\ M68 - 78\ M94 - 101\ HB\ HB\ ASTM\ A-606\ HSLA\ steel\ (cold\ rolled)\ SAE\ 1008\ low-carbon\ steel\ (cold\ rolled)\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ ASTM\ B85\ ASTM\ A-606\ HSLA\ steel\ (cold\ rolled)\ SAE\ 1008\ low-carbon\ steel\ (cold\ rolled)\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ ASTM\ A-606\ HSLA\ steel\ (cold\ rolled)\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ ASTM\ A-606\ HSLA\ steel\ (cold\ rolled)\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ ASTM\ A-606\ HSLA\ steel\ (cold\ rolled)\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ B85\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ AISI\ 304\ stainless\ steel\ TA\ 2036\ aluminium\ (wrought)\ ASTM\ AISI\ 304\ stainless\ steel\ TA\ 304\ stainless\ stainless\ steel\ TA\ 304\ stainless\ stainless\ steel\ TA\ 304\ stainless\ stainl
aluminium (die cast) ASTM AZ91B magnesium (die cast) ASTM AZ91B magnesium (die cast) - 7.75 0.280 65.00 30.00 22.0 - - 65.00 - 880 - - 7.86 0.280 48.00 30.00 37.0 - - 48.00 - 80.00 49.00 48.00 28.00 10.20 10.30 40.0 23.0 2.5 - - - - - - 80.00 49.00 49.00 48.00 - - 888 R80 Brinell 85 - - 80.00 49.00 48.00 28.00 10.20 10.30 40.0 23.0 2.5 - - - - - 80.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00 49.00
---1.83\ 0.066\ 33.00\ 65.00\ 3.0 Brinell 85 ---33.00 Brinell 85 ---6.59\ 0.238\ 41.00\ 10.90\ 10.0 Brinell 82 Metals *Shore D Reinforced composites Polycarbonate Polyphenylene Polyphenylene Sulphide ABS ••••••• Polyester PBT Nylon 6/6 •
Polystyrene Nylon 6 • • • • • • Epoxy Polyester BMC • • Acetal • • • • • • Thermoplastics Polyurethane Injection moulding Preform moulding Pre
Table 16.4 • • • • • • Figure 16.26 Bonded joints Figure 16.28 Carbon fibre composite front nose of Mercedes Mchaven SLR body-in-white Leno weave is used to improve the stability in open fabrics which have a low fibre count. To check that an adjacent surface is at right angles to this face side, the square is
held upright on the workpiece on the corner and the inside edge of the stock is pressed firmly against the face side; any discrepancy in the angle will be indicated by a gap or gaps between the inside edge of the blade and the surface being tested. Head forms currently available include snap, mushroom, flat and countersunk, and sizes range from 2.38
mm to 6.35 mm diameter. Push-on clips take many forms, from the simple sheared type which is still widely used, to the more modern blanked types, the multi-pronged clips for rectangular studs and now the plastic-capped type. 16.9.2 Accident repair purposes, accidents may be defined as Front section Centre section Rear section. (a) (b)
(c) Abrasive file This (Figure 3.10d) is not a normal file but an abrasive holder with a wood handle having spring clips at either end on to which can be attached an abrasive grit paper. Wheel arch Panel forming inner housing for rear wheels. This book requires brief details of any accident or dangerous occurrence to be recorded. Its function is to
control the passage of air through the gun. The 163 in (5 mm) Clamps Sheet metal clamp (Figure 3.17a) is a general purpose clamp which can be locked on to sheet metal with a powerful quick-release grip, making panel assembly and tack welding procedures much easier operations. The term 'universal' is apt, since the machine will cut straight or
curved shapes inside or outside. The rivets are similarly treated by dipping them into an anti-corrosion compound before use. Resistant to water, salt spray, alcohol and dilute sulphuric acid Used for sealing bolted wings, headlight units, rear light housings and cable inlet holes Suitable for all overlapping and screwable joints on vehicle bodies, metal
to metal, metal to wood, metal to plastic, wood to wood or plastic to plastic Particularly suitable for sealing rubber and glass or rubber and glass or rubber and glass or rubber and side window units between rubber and glass or rubber and glass or rubber and side window units between rubber and glass or 
rubber Overlapping joints Synthetic rubber Sealing tape Synthetic rubber Rubber profiled windows Synthetic rubber the vehicle assessment area? 11 Explain the term 'datums'. When the panel has reached the desired shape by hollowing it can then be
smothed to a final finish by hand planishing using a hand dolly or over a stake, or wheeling to obtain the final smoothness. The advisable welding nozzle size when using for a 1.00 mm panel is a number 2 nozzle. Work equipment will be broadly defined to include everything from a hand tool, through machines of all kinds, to a complete plant. Dust
extraction in the trimming section should be of the down-draught type. (It has been reported that these low-oxygen mixtures may promote improved fusion and excellent weld integrity for thick-section aluminium alloys) of operation for ferrous materials, copper, nickel and titanium alloys. 14.4.10 Water leak detection The general principles for
searching for the actual location of where water leaks could potentially occur on the vehicle are not specific to any particular model and can apply to all vehicles. Treat the underbody box sections and cavities in a systematic manner. Apply acrylic finish, thinned with quick-drying repair thinner, in light coats. The panel should be aligned, clamped and
checked. The vehicle starts with sheets of steel and various sections of rectangular or round tubing from which is constructed the basic chassis frame and body structure. It is usually made from mild steel, although other metals and alloys can be used for special purposes. Heat can only be used on low-carbon steel panels and not on high-strength
steels, because heat weakens the latter by disturbing the heat treatment which originally strengthened them. They are too viscous for use on the smallest parts, but are often used for the assembly of motor vehicle trim. Lasers have been used experimentally for cutting and welding. Some heavier material may require presetting by hammering to
provide a lead over the rear roller and also to prevent flats at the ends of the rolled surfaces. All equipment used in the workshop must meet all current legislation. 2 Use square edge on narrow gap procedures to reduce angular distortion when welding. E glass is essential for electrical applications and it is desirable to use this material where good
weathering and water resistance properties are required. Many different types and sizes of electric welding machines are now available, and two of the most generally used are the DC generator and the AC transformer. With the introduction of body solder and later metal and plastic fillers, filing took on an even greater importance in the finishing of
repairs on body panels. The distance between electrode and workpiece is made electrically conductive (ionization) by an auxiliary arc (pilot arc) between electrode and sharp and/or heavy objects on them, and also from red hot and
burning materials. Hot melts A refined form of the earliest adhesive, hot wax. These free-acting prongs compensate for tolerance variations, and the combined forces of the thread and spring locks are claimed to eliminate any risk of loosening by vibration. In twill weaves, the weft yarns pass over one warp and under more than one warp yarn; in 2 1
twill, the weft yarns pass over one warp yarn and under two warp yarns. Since the introduction of high-performance toughened adhesives are turning to bonded
structures in order to reap the economic and technical benefits given by this technology. Firewall Panel dividing engine compartment from interior of body. High-strength cast aluminium is used for the windscreen pillars, which bolt directly on to the top of the A-posts and are joined by an extruded and formed aluminium header rail. 17.11.7 Oil in air
line If the air compressor pumps oil into the air line, it can have the following causes: Figure 17.42 Fluid needle assembly 1 The strainer on the air intake is clogged with dirt. Equipment with low amperages is really not suitable, although it can be used for short periods of welding. The outer metal panel is first predrilled or punched. It has all the
characteristics of the standard Car Bench System. After thoroughly cleaning them, the steel parts to be carburizing compound. A safer supply for power tools is 110 volts; this may be wired into the workshop as a separate circuit or provided through a safety
transformer. In consequence the welded seam tends to shorten in length, causing the parent metal to buckle. 17.13.2 Preparation by using abrasive paper Before the rubbing down of a local repair commences, the whole panel should be thoroughly washed down with a detergent to remove all traces of wax polish. 34 With the aid of a sketch, explain
the body styling of a coupé vehicle. The following procedure should be used: 1 Mark the bend lines on the metal. The three main reinforcing fibres used in vehicles are: glass, carbon and aramid. It is now employed as a standard sheet metal fastener in cars, buses and all forms of commercial vehicles. Wood blocks can be used to spread the load to
prevent distortion. It is especially important to beware of argon and carbon dioxide; both are heavier than air, and will displace air in confined spaces or spaces with no ventilation at floor level. The test car measurements can be quickly compared with specifications, with deviations displayed in millimetres. When repairing plastic materials there must
always be strict observance of health and safety requirements, so the operator should work in a well ventilated environment. The three major motor companies of GM, Ford and Chrysler started their CAE activities as soon as computers became readily available in the early 1960s. 4 Any attempt to fight the fire should be done from a protected position
using copious quantities of water. Thus the blank holder pressure must be low enough to allow the metal to move or flow underneath it and high enough to prevent wrinkling from occurring. To get at both edges of a car door it is usually necessary to remove the door, but this can be eliminated by using a clamp at the free edge of the door and a solder
plate at the hinged edge. Figure 11.12 Undercutting Overlapping This occurs when the current is set too low. In the water system the pump provides the force that pushes the current through the wires. In the case of a flange raised around the edge of a flat disc, a
mallet is used instead of a hammer and the metal is gradually drawn inwards or upwards by careful working round the edge over a curved end of a steel bench stake. Spray transfer and dip on thin sections. 14.3.8 Door alignment The doors of a car body are said to be misaligned when they do not fit the contour of the body or when they do not fit in
the door opening correctly. Avoid walls or curtains as they lead to rigid space allocation and are inflexible because they prevent bodyshops reacting to variable workloads. Retainers - where, for a technical or styling reason, a keyhole slot is not feasible, assembly can be simply achieved by using a separate retainer. This enables a damaged car to be
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mounted on to the jig frame with the minimum amount of effort. Movement of the sheet is varied until the desired shape is obtained, those parts of the panel which require to be only slightly curved receiving less wheeling than other parts which must be more curved. The mechanical means comprise a crankshaft rotating in a phosphor bronze bush in
the main frame. 24 Describe the process of gas welding pure aluminium sheet. The bending beam is usually a steel plate which forms on the deposited bead during the welding process. It is also important not to overheat the
steel and to allow it to cool to the quenching temperature. In order to ensure uniform distribution of temperature a fan is fitted inside the oven to keep the air in circulation. Even if you are working in a safe and careful manner you are still likely to spill the odd small amount of fluid or snag the airline, this will then create a hazard. The burner
operates in a totally enclosed combustion chamber with the safety controls housed separately to protect them from dust and contamination. 3.17.3 Screwdrivers (c) Figure 3.40 (a) Standard sockets (b) ratchet with 12 in drive (c) standard and deep well sockets (Facom Tools Ltd.) the same as the face-to-face dimension of the bolt 3.1.1 it fits. 11 Keep
the cables in an orderly manner to prevent them from becoming a stumbling hazard. 4 Wear goggles when chipping slag off a weld. However, when there is a lack of repair of Vehicle Bodies 9.3.11 Assembly of high-pressure welding
equipment The cylinders must be kept upright and all metal jointing surfaces should be free from oil or grease. A coat of underseal on the rear of any panel which is open to the elements will give added protection. The VARI tooling, which can be either metal faced or constructed entirely from composite materials, is designed so that each tool
becomes its own press. Details of vehicles currently in production were inputted on to the computer; it then identified the most common reference points and evaluated a number of alternative arrangements. Multiple pushes and pulls can be delivered by the vector-type rams, singly or simultaneously, thereby equally distributing the forces applied in
repairing damaged components. Safe edges, flanges, wiring and swaging can all be classed as formed edge treatments, while the attachment of strips, half-round beads, mouldings angle sections and false wire edges are classified as stiffening agents. The heaters can either be wall mounted and inclined, or suspended at heights from 3 to 12 metres
Leaching occurs after exposure of the laminate to the weather, and is characterized by a loss of resin from the laminate to the weather, and is characterized by a loss of resin from the laminate to the weather, and is characterized by a loss of resin from the laminate to the weather, and is characterized by a loss of resin from the laminate, leaving the glass fibres exposed to attack by moisture. 16.10.11 Cracking, shrinking and discolouring Figure 16.52 Star cracks (Scott Bader Co. Ltd.) 16.10.9 Internal dry patches These can be caused by attempting to impregnate
more than one layer of mat at a time. 38 Explain the VIN number and why it is used on a vehicle. The processes outlined are based on the assumption that the vehicle has been prepared for refinishing as described in Section 17.13, followed by the necessary masking up. At this point it is necessary to decide whether the panel is to be made in a one-
piece construction or made in several pieces which can then be fabricated by welding. First windshield. Rubbed again, it is sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and then various apertures, door shuts, screen areas and rear ends will be sprayed with a base coat and the sprayed with a base coat and 
end, which acts as the dolly, must be kept in good condition and free from anti-drum compound so that it gives a metal-to-metal contact when used in conjunction with a hammer. Repair of Vehicle Bodies addresses both sides of that equation. This varies between 0.05 and 0.5 s. For example, if the air transformer is delivering air at a pressure of 3.5 s.
bar (50 psi) the pressure drop over 4 m would be 0.7 bar (10 psi). 220 Repair of Vehicle Bodies Figure 7.56 'J' type captive nut (Forest Fasteners) 1 Pre-locked position The two arched prongs move inwards to engage and lock against the flanks of the screw thread. It can cut round the average bonded
windscreen and clean off the excess remaining adhesive while minimizing the risk of damaging the car bodywork. A certain amount of arcing is permitted to avoid a build-up of paint where the strokes overlap, and the triggering of the gun is very important. It is still widely used in this way, and rubber with a synthetic content is sometimes used for
door check straps; this demonstrates the strength of the material, which clearly lends itself to many applications as yet unexploited. Also attached to this beam and blade is a hold-down device which is located in front of the top blade, and as the treadle is pressed down it clamps and holds the metal in place ready to be cut. The final shape is then
achieved by wheeling or planishing. The following types of eye protection are available: Lightweight safety spectacles with adjustable arms and with side shields for extra protection. When an even coating is necessary, such as with metallic finishes, it is better to spray each face separately, starting with a vertical stroke at the edge of the panel (Figure
17.36). 66 Repair of Vehicle Bodies (a) (b) Figure 2.9 (a) Visionair constant-flow breathing apparatus (b) Operator wearing complete constant-flow breathing apparatus (Racal Safety Ltd ) 2.2.1 What is fire? These attachments are very useful when a fastener cannot be loosened with a regular screwdriver owing to lack of access and space. Moreover,
no matter how skilled the tradesmen are, with bad estimating the financial profits can be drastically affected. Figure 10.20 Electrode arm sets for different makes of vehicles (SIP (Industrial Products) Ltd.) 5 Test earth leakage unit by pressing test button. Increasingly AHSS steel is used for strengthening members to which other steel panels are
welded, in other words a steel composite structure. Ball stake is shaped like a ball and is used for the planishing of hollowed or raised articles. After chemical etching, wear clean gloves to handle materials; even a fingerprint can contaminate the etched surface, and so weaken the bond. The high standard of finish and detail results in an exact replica
of the future full-size vehicle (Figure 1.15). The last few years have seen a rapidly increasing acceptance of the material as an ideal alternative to steel in the motor industry. 32 When a fault develops on an electrical power tool, what action must be taken? Hatchback This body style is identified by its characteristics sloping rear tailgate, which is
classed as one of the three or five doors. Figure 3.34 Shrinker and stretcher machine (Frost Auto Restoration Techniques Ltd.) 3.17 General-purpose assembly and dismantling tools Having the right tool for the job is a sign of a prepared body repair worker. Pre-accelerated resins need only In order to mould or laminate a polyester resin, the resin
must be cured. Transformation induced plasticity (TRIP) steel has a yield strength of between 500 and 800 MPa with greater figures attainable in some cases. A panel can either be wheeled from a flat sheet to the desired double-curvature shape, or it can be preshaped using either hollowing or raising techniques and its final shaping and smoothing
completed by wheeling. These measurements are taken from the zero plane or datum line. Windscreens shall, in addition, be sufficiently transparent, and not cause any confusion between the signalling colours normally used. Shot blasting emissions must not exceed 50 mg/m3. Chassis clamps for unibody vehicles can accommodate vehicles of all
widths. List the necessary tools for these processes. Thus the former need not be fully water resistant, whereas the latter must be water resistant in addition to many other necessary requirements. This equipment overcomes the limitations of the body jack in three ways. The Araldite range includes a number of industrial adhesives which are highly
recommended for use with GRP. 15 Give a brief description of the following early vehicle body styles: coupé, cabriolet, limousine, saloon. Special reinforced square holes of various sizes are made at intervals in the bench for insertion of the bases of the stakes, which are usually square in cross-section and taper in shape to facilitate a good grip in the
bench. The use of a heavy hammer for roughing out is not advisable, for this permits heavy blows Figure 13.32 Positioning of blows in the roughing-out technique which are concentrated in small areas and invariably results in stretching or otherwise distorting the metal, whereas a well directed blow with a dolly that matches the original contour of
the repair spreads the blow over a larger area, resulting in very little distortion of the metal. It is a universal bracket system, comprising one set of jig brackets that are designed to fit any type of vehicle and light commercials, eliminating costly hire or purchase of specific vehicle model brackets. 8 For what purpose would a sandbag and a wooden
hollowing block be used? Weld quality Careful control of three factors is necessary to make a good-quality spot weld: Squeeze time Weld time (duration of weld flow) Hold time. The primary concern is to develop efficient restraint systems which are comfortable to wear and easy to use. One hand is used to hold the file handle, while the other grasps
the knob at the opposite end. The area should be large enough to accommodate customers and the reception engineer, and to hold customers' records, bodyshop loading display boards, telephone and workshop intercom systems. 482 Repair of Vehicle Bodies 4 Check all light lenses, motifs, number plates and spot lights. Lock nuts These are thinner
than the normal nut and are fitted beneath the main nut to act as a locking device. Therefore it is classed as a low-alloy highstrength of a material is governed by its material composition and by the method and direction of loading
i.e. tensile, compressive, torsion, shear and bending. A hot Methods of joining 229 Table 7.5 Surface preparation materials (Permabond Adhesives Ltd.) Abrasion or chemical treatment Material Cleaning ABS acrylonitrile butadiene styrene) plastics Degrease with detergent solution, except for cyanoacrylates when cleaning and other preparations are
probably unnecessary Aluminium and alloys Degrease with solvent Cellulose plastics Degrease with methyl alcohol or isopropyl alcohol Roughen surface with fine grit emery paper or sandblast to remove ceramic glaze Etch in solution of (parts by
weight) Water 30 Conc. These adaptors are engineered to locate precisely, and in use are selected according to the information given on the vehicle's data charts which show adaptor type, datum points and their coordinates (see Figure 14.40). An added sophistication is that the production moulds have an electroplated nickel shell surface, which not
only extends tool life but also gives a high standard of finish to the body panels, allowing minimal preparation for the painting process (Figure 16.34). It is important to realize that because they are portable they have only a limited discharge. Preparation involves degreasing (to remove oil grease and contaminants) and abrading or etching (to increase
surface grip). Improved performance of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the introduction of a rubbery distortable phase within the load-bearing matrix of the body of the adhesive film is brought about by the adhesive film is brou
Resistance spot welding is the most widely used welding process in car body construction; there are approximately 80 per cent of the welding used. The majority of repairs to minor accident damage requires the skill of the body repair worker in the use of hand tools and general repair
techniques. Metal templates have the advantage that they can be kept and used again if necessary. These are connected to the base frame by special ram foot clamps and are secured by a tapered steel wedge that is hammered into position through the clamp, forcing it tight on to the frame. 5 Clean wheels, trims, spare wheel with alloy cleaner. Core
materials Engineering theory tells us in most cases that the stiffness of a panel is proportional to the cube of its thickness. The punch exerts a force on the bottom of the cup so that metal flows away from the bottom. In light sheet metal, rivets are usually applied in the cold state so that there is virtually no possibility of distortion. A slot is provided in
the head for insertion of a screwdriver. Great advances have been made in the development of suitable substitutes, and the plasticized materials are to many people quite undistinguishable by eye from leather. Using the Lotus panel tool, separate the remaining section of the lower quarter panel from the undertray. Wet flat these areas with
P600 paper. Toughened adhesives are used in much the same way in motor vehicles, trucks and vans but they may be used on unpainted metal. (b) Switch off the electricity. This will allow the edges to settle down into place. Silver soldering the size of the welding tip used and the adjustment of the flame are very important
to avoid overheating, as prolonged heating promotes oxide films which weaken both the base metal and the joint material. Often used in car trim applications to bond rubber to rubber and also rubber to plastic. The use of this hydraulic equipment together with the alignment and repair system will ensure precise accuracy of the
complete underbody. Figure 9.15 Flame temperature 9.5.2 Welding fluxes It is impracticable to incorporate in welding rods all the elements necessary to overcome oxidation. As already indicated, with effect from 1 January 1959 the Road Traffic and Vehicle Order 359 has demanded that for passenger vehicles and dual-purpose vehicles, all glass shall
be safety glass. First, there is the technique which is used Craft techniques and minor accident damage 349 mostly by the panel beater in planishing new work. Downward welding is very good for welding light-gauge metals because penetration is shallow, therefore forming an adequate weld without burning through the metal. When a one-component
polyurethane is used the car can be driven away in four to six hours: if a two-component polyurethane is used it takes only 30 minutes to cure, allowing the vehicle to be back on the road within an hour of the repair starting. Scribed lines show up more readily on a work surface that is first covered with a solution of copper sulphate or marking
compound. The premises should be easy to drive in and out of, and there should be adequate space for vehicles to turn safely. Also available are the 'spring joint' type where the legs are joined at the top by a circular spring band and a fine adjustment screw is fitted across the legs. When one becomes proficient in using this tool it is possible to raise
the surface with light blows and finish off by filing only. 6.2.14 Oddleg calipers This measuring instrument is half caliper and half divider (Figure 6.10). The bending blade is lifted by a handle at the front of the machine. Finishing Polishing of low-bake enamels is not normally necessary as a good gloss from the gun is obtainable, but it should be borne
in mind that these paints remain more open, i.e. wetter, than more coventional materials during the flash-off period prior to stoving. Rubbing down, even though done with water, will leave a scum in the workshop floor, which when dried out will leave behind a powdery 604 Repair of Vehicle Bodies residue. Double-header coating This results from the
practice of spraying one coat immediately after another without allowing a flash-off period. Also, because vehicles are inspected individually the tests are not destructive or damaging in any way. With the direct set-ups using the pull rams, the tubes are under tension and there is no risk of bending. As far as performance is concerned, these plastics
can be divided into three groups: General-purpose thermoplastics Polyethylene Polystyrene SAN (styrene/acrylonitrile butadiene styrene) Poly(methylene terephthalate) Engineering thermoplastics Polyesters
(thermoplastic) Polyamides Polyacetals Polyphenylene sulphide Polycarbonates Polysulphone Metals and non-metals used in vehicle bodies Table 4.13 149 Physical properties of polymers Specific-heat capacity (J/kg/K 103) Thermal conductivity (W/m/K) Coefficient of linear expansion (K 10 > 6) Material P or S Density (kg/m3) Melting (softening)
range (°C) LD polyethylene HD polyethylene HD polyethylene Polyyropylene GFR polypropylene Polystyrene Polystyrene
PPPPP0.01 - 0.93 \ 0.04 - 0.97 \ 0.90 \ 1.00 - 1.16 \ 1.16 - 1.35 \ 1.04 - 1.11 \ 0.99 - 1.10 \ 80 \ 90 - 100 \ 100 - 120 \ 15 - 85 \ 82 - 102 \ 85 \ 2.3 \ 2.1 - 2.3 \ 1.9 \ 3.5 \ 0.8 - 2.5 \ 1.3 - 1.45 \ 1.4 - 1.5 \ 0.13 \ 0.42 - 0.45 \ 0.09 \ - \ 0.16 - 0.27 \ 0.09 - 0.21 \ 0.04 - 0.30 \ 120 - 140 \ 120 \ 120 \ 1.25 - 1.30 \ 1.25 - 1.30 \ 1.25 - 1.30 \ 1.25 - 1.30 \ 1.25 - 1.30 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 1.20 \ 
45 50-90 20-70 50-70 100-150 24-30 GFR glass fibre reinforced; P thermoplastic; S thermosetting; R rigid; F flexible; LD low density; HD high density Table 4.14 Typical mechanical properties of representative plastics Material LD polyethylene Flexible PVC Rigid PVC Polystyrene ABS copolymer
Perspex PTFE Nylon 11 GFR nylon 6 Modulus of elasticity E (MN/m2) 120-240 550-1050 900-140 1500 350-620 1250-1300 7800-800 Tensile strength (MN/m2) Compressive strength Elongation (%) 7-13 20-35 34-54 10-25 40 35-62 17-58 55-75 15-35 52-54 170-172 9-10 20-25 35 350-4800 2000-2800 2400-4200 1380-3400 2700-3500 350-620 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 1250-1300 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7800-800 7
40-60 7-12 90 90-110 17-85 80-130 10-15 55-56 200-210 300-700 300-800 20-300 5-20 200-450 60 1-3 10-140 2-3 200-400 180-400 3-4 150 Repair of Vehicle Bodies Modified polyphenylene ether Polyimides Cellulosics RIM/polyurethane Foam Thermosetting plastics Phenolic Epoxy resins Unsaturated polyesters Alkyd resins Diallyl r
phthalate Amino resins 4.12.4 Amorphous and crystalline plastics An alternative classification of plastics is by their shape. Carrying out a COSHH assessment Gather information 1 What is used, handled, stored 2 Intermediates, by-products, wastes. It provides a straight, reliable threaded insert to which other components can be attached. In plain
weave cloths, each warp and weft thread passes over one yarn and under the next. The life of these components depends upon the current used and any misuse of the repair sequence. Wheeling is simply the stretching of metal
between two steel rolls known as wheels. Preparing the new surfaces The door flanges should now be painted with a zinc-rich interweld primer to stop any chance of corrosion between the door flange and the new skin (Figure 13.63e). Sheet is supplied in gauges down to 0.3 mm, but it is generally more economical to order strip for gauges less than
1.6 mm. The rectifier is electronically protected against overloading in the event of any short-circuit between welding positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between welding positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between welding positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between welding positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between welding positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between welding positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between welding positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between welding positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between welding positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between welling positive and negative, with the machine cutting out approximately 1 second after the onset of short-circuit between well and negative and negative after the onset of short-circuit between well and negative and negative and negative and negative and negative and negative after the onset of short-circuit between well and negative and negative
extreme temperatures. Ductility depends on tenacity or strength in tension and the ease with which a metal is deformed, and is the property which enables a metal to be drawn out along its length, that is drawn into a wire. The choice of releasing agent depends on the size and complexity of the moulding and on the surface finish of the mould. It is
very maneuverable in any workshop area. The Act places a statutory duty on employers to have a declared safety policy for a business in which more than five persons are employed. 2 Always replace the clear cover glasses when they become pitted and encrusted due to metal spatter. The anchor pot is pretensioned to expand the pot sleeve and give a
firm anchorage point. 3 Determine a suitable weld pitch for the panel assembly to be welded to obtain maximum strength. 1 Explain the following abbreviations: RRIM, VARI, PVAL. Boot A compartment provided in a car body which takes the luggage and often the spare wheel and fuel tank. Welds therefore must be ductile as well as large and strong
Many employers are now requiring all employees to wear some form of safety glasses when they are in either the repair or the possibility of flying objects, dust particles, or splashing liquids entering the eyes. The welding process consists of placing the projections in
contact with the mating fixtures and aligning them between the electrodes. Provision in the roof should be made for the interior trimming. Changes to the design can be made at this stage. As the cost is proportional to weight, it follows that the higher-performance foams are more costly. On a
complete refinishing job it is also advisable to label each part to indicate from which side of the vehicle it was removed. It is also important that glare and shadow are kept to a minimum and that side lighting is of a good level. 3.24 Other power tools 3.24.1 Impact air screwdriver Figure 3.61 Rotex sander with full dust extraction (Minden Industrial
Ltd.) The impact air screwdriver has a quick-change bit holder for inserting different screwdriver bit heads: slot, Phillips and Pozidriv (Figure 3.63). All undercoats are slightly porous and, if the moisture from the sanding process is not completely dried out, problems of micro-blistering and faulty adhesion may result. Electrode The usual term for the
filler rod which is deposited when using the electric arc welding process. Readings are made on scales on the side of two elements working together to produce material properties that are different to the properties of those elements on their
own. Questions 1 Explain the role of a bodyshop planning consultant in the planning of a new workshop. The welding gun attaches pins, screws, washers or studs to the surface of any damage so it may be pulled out. First dry out with compressed air or a hot air blower. The powdered glass can cut the blood vessels inside the lungs and stomach. If a
panel is damaged in an accident then the buckled area, being sharply bent, will create additional stiffness in the panel, whether in an elastic or a non-elastic area. The ram units are positioned at the correct angle for pulling by setting the bottom into a ram 410 Repair of Vehicle Bodies Figure 14.8 Korek system with accessories, including P188 Mk2
measuring system (Blackhawk Automotive Ltd ) foot clamp which has been secured to the frame, and at the top by the use of a cross-pin through the chain. 1.2.9 EuroNCAP 1.2.8 Body engineering for production The governments in most countries have some form of regulations covering vehicle safety. An object to be measured is held squarely in
position between the anvil and the spindle, then the spindle is closed on the object. Therefore the lower the centre of gravity and the wider the track the more stable is the vehicle. Interchangeable welding nozzles To make
 possible the welding of different thicknesses of metal, welding torches are equipped with an assortment of different size heads or nozzles. Water-based paint also offers easy clean-up and is therefore better in terms of waste management. A small lever situated near the gear wheel provides horizontal adjustment so that the wheels can be set to match
Figure 5.19 Swaging attachments exactly. The injector is then threaded through the stand until the outer seal makes airtight contact with the screen (Figure 14.114). Aluminium will withstand a fair amount of deformation by beating, rolling and wheeling before it becomes necessary to anneal it. For this reason, a clean workshop is a necessity;
otherwise dust may settle on the Figure 17.60 Joined oven and spray booth, with sideways flow 612 Repair of Vehicle Bodies still wet film which will necessitate flatting and burnishing to obtain a smooth finish. front pillar centre Pillar front inner Rail roof side inner Rail roof front Pillar centre inner Pillar centre outer Pillar rear inner Rail roof
rear Panel roof The history, development and construction of the car body around the rear boot opening. Figure 14.107 Direct glass is placed into the aperture using glass suckers and aligned before securing. Use a reciprocating saw, such as an electric jig saw. Treat bright metal and
motifs. Figure 12.42 Solidification cracks (BOC Ltd.) Gas shielded arc welding 12.15 Weld testing and inspection Weld testing and inspection will stretch the sheet, and may be necessary when forming a panel, bending a curved strip or angle, removing a loose or tight place in a sheet, or throwing an edge
over when thickness is not a consideration. The purpose of these serrations is to achieve a shrinking effect when the hammer is used in conjunction with a dolly block. (e) Injection moulding is the highest volume method of any of the fibreglass reinforced plastic processes using single or multi-cavity moulds to produce large volumes of complex parts
at high production rates. Amorphous engineering plastics have the following properties: High stiffness Good impact strength Temperature resistance (when required) Excellent transparency (polycarbonate only). Safety 1 Safe passage of pedestrians and vehicles
(traffic routes must be wide enough and marked where necessary, and there must be enough of the mist be enough of the regard (Scott Bader Co. Ltd.) Figure 16.50 Severe blisters (Scott
LH Centre of hood opener cable routing hole - RH Centre of front door striker mounting hole (Upper section) - LH Centre of front door striker mounting hole (Upper section) - RH - - 擺 - 10 mm (0.393 in) 擺 - 5.3 mm (0.208 in) 擺 - 5.3 mm (0.208 in) 擺 - 12 mm (0.472 in) 粗 - 12 mm (0.472 in) 14.3.9 Bonnet alignment Bonnet
 alignment can be easily checked by visual inspection. In some cases there may be no high spots and no adjacent low areas, in which case the high spots, if any, can be tapped down often with just the planishing hammer and without the dolly block backing. The filler wire then acts as a fuse, and when it ruptures a free burning arc is created. The
larger-amperage machines (180 A and over) are better equipped to handle aluminium. The properties required for an effective flux for brazing aluminium and its alloys are as follows: 1 The flux must remove the oxide coating present on the surfaces to be joined. Universal snips (Figure 3.11a, b) are suitable for cutting straight lines, outside and inside
curves. 2 A daily personal exposure of up to 90 dB(A). Figure 17.70 Rapid drop in paint temperature from fluid tip to job surface Automotive finishing and refinishing In hot spray application, low boiling solvents are released more quickly during atomization because of the heat. The system features versatility as a multifunctional piece of equipment
(c) Resin transfer moulding (RTM) is suitable for medium-volume production and may be regarded as an intermediate process between spray-up and faster compression moulding methods using SMC and BMC. A nut and bolt is the most common means of joining. When cobwebbing occurs, spraying should be stopped and solvent added to the paint
Silicon-manganese steel This is a spring steel using the two elements of manganese and silicon. The most widely used spray gun is the suctionfeed, external-mix, non-bleeder model. Carbon dioxide gas
under great pressure. Pre-preg is therefore quicker to use and the resin density is accurate. Close bonnet. The hydraulic hand jack had all the advantages of providing tons of closely controlled torque-free power for the minimum of effort by the operator. 4 Describe a suitable application for (a) a toe dolly (b) an anvil dolly. Stoving paints These are
chipping operation is followed by additional wire brushing. In common practice pre-accelerated resins are used, requiring only the addition of a catalyst to affect the cure at room temperature. Wetting and fluxing When a surface is wetted by a liquid, a continuous film of the liquid remains on the surface after draining. Manganese steel An addition of
manganese to steel produces an alloy steel which is extremely tough and resistant to wear. 12.10.5 Welding wire Figure 12.19 Migatronic Dialog torch with current control in the torch handle (Migatronic Welding wire Figure 12.10 Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch handle (Migatronic Dialog torch with current control in the torch with current control i
is overcome. Their full strength is attained gradually over four or five days (longer in cold weather); this process is known as natural age hardening. The CAD system is also being used to produce manufacturing and user drawings for the top sets, resulting in the faster introduction of tops for newly designed vehicle models. The fans are designed to
draw the polluted air through the extraction arms, dispersing the fumes via the assembly ducting. 432 Repair of Vehicle Bodies Figure 14.47 Chief E-Z Liner II system showing the gauge measuring equipment (Chief Automotive Ltd.) Figure 14.46 Pulling and measuring using the Car-O-Liner (UK) Ltd.) 14.2.13 Chief E-Z Liner II universal
alignment and straightening system The Chief E-Z Liner II system consists of all the equipment necessary for damage analysis and repair to current vehicle models. 3 Hand and power tools 3.1 Hand tools used in body repair work Mass production methods have made the present-day motor car such that it requires special techniques, skills and tools
for the rectification of body damage. In general, those sound deadeners applied to the interior of the vehicle are water-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied to the interior of the vehicle are water-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions with fillers, whereas sound deadeners applied externally should be solvent-based bitumen emulsions as a single should be solvent-based bitumen emulsions
strong as a fusion weld, it has many advantages which make it useful to the panel beater. In wire drawing, metal requires annealing when it becomes work hardened. Annealing is a form of heat treatment for softening a metal which has become
work hardened so that further cold working can be carried out. The barbs retain the assembly securely in position on one side, and the flat D side provides a neat flush appearance on the other. Grooving stake has a grooved slot cut along the top face. A 4 in set has sockets ranging from 16 to 2 in (5 to 18 mm), whereas a 12 in socket set has sockets
ranging from 167 to 114 in (13-40 mm). The work is taken to the Factories Act did not cover, for instance schools and colleges, especially their motor vehicle
workshops. Gas welding, gas cutting and plasma arc cutting With plasma arc equipment a saving in time and energy can be achieved in certain areas of repair, particularly in the removal of damaged panels and structural members. The history, development and construction of the car body Double landaulet A longer version of the landaulet. Single- or
double-skinned panel assemblies can be easily cut owing to the short blade stroke. Heat shrinking Applying heat to any dent, without any kind of manipulation, may reduce the size of the dent due to the thermal expansion of the aluminium. Paint resin on to the mould from inside the body, ensuring that it fills the scarfed edge completely. After flatting
the filler, two further coats of primer are sprayed on and flatted. Figure 13.39 The technique of filing (Sykes-Pickavant Ltd ) is termed line filing, and indicates the levelness of the panel in the direction in which it has been filed. Six alignment gauges feature vertical and horizontal calibrated scales, and a variety of hanging attachments. These are the
places where mud can easily accumulate. These cylinders, together with others which are fitted with valves, normally have valve guards or valve protection caps. Difficulty may be experienced when forming flanges on curved sections of panels depending on whether the flange is on an external or an internal curve, as these require different
techniques of working. 32 State the purpose of the two pressures that are shown on the gauge of an acetylene gas cylinder regulator. After normal preparation and priming have been carried out a filler is applied. There are many alloy steels containing different combinations and percentages of alloying elements, of which some of the most popular are
as follows: High-tensile steel Used whenever there is an essential need for an exceptionally strong and tough steel capable of withstanding high stresses. This coating also produces a very smooth surface on the face of the area being soldered. They may also be extended vertically and horizontally to achieve unlimited positions for the attachment of
brackets. With the slower drying synthetics this process is best left for about four days to allow for complete solvent evaporation and to give the paint film time to harden 608 Repair of Vehicle Bodies off. The top surface is machined level and finally scraped to a degree of flatness which is determined by the use to which the table is to be put. 13.18.3
Safety check Do • Check all procedures in the workshop manual before working on the SRS. This mechanism may be concealed from the eye under a moulding or some type of trim. Stainless steel is used for its non-rusting, hard wearing and decorative qualities. The beam is reflected back to its source, the laser hub, which is then reflected up to a
detector above the centre of the hub, which again activates or turns off the counter. The body is of aluminium alloy with a carbon steel to highstrength low-alloy steels, an unbalanced heat rate will occur. 5 Brazing is very
4.1 Manufacture of steel coil and sheet for the automobile industry In the manufacture of steel coils, the raw material iron ore is fed into a blast furnace, together with limestone and coke; the coke is used as a source of heat, while the limestone and separates impurities from the ore. Details of skin panels and other large pressings are
provided in the form of tracings or as photographic reproductions of the master body drafts. The air and perfect atomization can be opened, permitting the top roller to be pivoted upwards so that completed cylinders can be removed. Effective lighting can
highlight faults which otherwise may not be seen; this not only reduces job times but also minimizes rectification work. Take care to thoroughly protect all door hinges. 4 Oxygen escaping from a leaking hose will form an explosive mixture with oil or grease. The boot lid, when repaired or replaced, is fitted in position and will act as a guide for
alignment when pushing out the surround panel. Be sure that the metal is flowing freely before you dip in the rod. Catalyst Absorb into vermiculite, remove to landfill or controlled incineration. 17.20 Colour mixing and matching 17.20.1 Colour mixing systems Surveys have shown that, between them, 40 car
manufacturers offer approximately 600 colours on current models. (a) Figure 3.20 Door skinner (Sykes-Pickavant Ltd ) Inter-grip welding clamp pieces of metal together edge and perfectly level, leaving only a small gap which will
allow full penetration of the weld and filler rod (Figure 3.21). Most of the semi-rigid plastics on vertical panels on today's vehicles are urethane, Xenoy, or other repairable materials. Specialist tools have been designed to suit the varying contours and shapes of the present all-steel bodies and panels. The anchorage bracket incorporates hollow boltsations for the varying contours and shapes of the present all-steel bodies and panels.
fitted over spring hanger bolts on the front mounting of the rear suspension, enabling the vehicle to be pivoted. 25 Explain the blanking operation. Tack weld A tack is a relatively small temporary MIG/MAG weld that is used instead of a clamp or a self-tapping screw, to tack and hold the panel in place while proceeding to make a permanent weld
(Figure 12.25). Providing that the original finish is flatted 50-75 mm beyond the repair area, a satisfactory job can be produced by spraying the finishing coats on to the filler to slightly beyond its edge. When truncated cone tips are used, check that the diameter is correct for the gauge of material to be used: the diameter should be 5/t, where t is the
thickness of single sheet in millimetres. Four-wheel alignment owes much to computer technology, which can instantly check and define the alignment of a vehicle. The base is machined so that it can slide across the top of the level lies at the centre of its scale.
These are areas where components will be fitted, such as front and rear screens, door handle locks and rear lamp assemblies, which will remain in place when the main part of the paintwork is carried out later. 17.9 Spray gun maintenance and cleaning 17.9.1 Cleaning a suction-feed gun Figure 17.24 Air cap, fluid tip and fluid needle (DeVilbiss
Automotive Refinishing Products) Fluid tip This is situated behind the air cap and meters out the paint. The bodyshop's company programme should include: Quality procedures manual Workshop procedures manual Welding test procedures manual. 22 Sketch a pull-on panel fastener used in trim work. If air is cut off from the
horn holes a narrow jet of paint giving a spot pattern is ejected, but when air is allowed to pass through the horn holes a fan spread is obtained, the width of fan varying according to the volume of air (Figure 17.25). 51 Why are current body shapes more rounded than previous designs? When using the scriber, it is inadvisable to mark any lines otherwise to mark any lines of the volume of air (Figure 17.25).
than cutting lines on coated metals, thus avoiding the destruction of the protective coating, as this may result in corroding of the parent metal. The arrangement of fibres need not be symmetrical. It is this element which provides the basis of the resistance to corrosion by forming what is known as a 'passive film' on the surface of the metal. The
mechanical properties of work hardened or heat-treated materials will be reduced in the vicinity of the weld. Compressive strength The ability of a material to withstand being crushed. An important feature of the brazing process is that the brazing alloy is drawn into the joint area by capillary attraction: the smaller the gap is between the two metal
faces to be joined, the deeper is the capillary penetration. A more recent development is the short-wave infrared heating module which, instead of easily breakable lamps, has heating elements mounted into an aluminium casette. The box is sealed with fireclay, heated in a furnace to 950 °C and kept at that temperature for two to twelve hours, during
which time the carbon in the compound is absorbed by the surface of the steel parts. Its use eliminates fire risk, especially when filling next to petrol tanks or any inflammable material. In such an environment, speedy access to tools and equipment is very important. The system uses treaded study and a range of rings, pulling loops or collars and
pulling tools. It was soon apparent that the fibres made by this new process had many desirable properties such as strength, smallness of diameter, high elasticity, and the ability to withstand high temperatures. Lapped and spot-welded joints of panels must be drilled first and carefully separated with a narrowbladed cold chisel (Figure 14.95). The
basic machine consists of a machine frame carrying two horizontal shafts which are geared Metal forming processes and machine so the job. sulphuric acid (SG 1.84) 10 Potassium
dichromate or sodium dichromate 1 Add acid to 60% of the water, stir in sodium dichromate and add remaining water Add acid to water, never vice versa Etch in a dichromate solution Prepare as for ABS Procedure Immerse for up to 15 min at room temperature Wash with clean, cold water, followed by clean, hot water Dry with hot air Heat solution
together and holds the male and female throughout the moulding cycle. 1765 Nicholas Joseph Cugnot, a French artillery officer, built a steam wagon which carried out using oxy-acetylene and resistance spot-welding techniques. However, the scuttle or
forward bulkhead is a complex structure in a private motor car. Useful for bodywork repairs. 20 Describe the technique which would be most suitable for welding low-carbon steel up to 5 mm. This gives the visual appearance of a diagonal rib. In the case of steel the metal is heated to a dull cherry red. Wet flat with P800 grade paper, dry off and tack
manner to that used for forming steel sheet (Figure 16.21). The various types of rivets are shown in Figure 7.1, together with their British Standard proportions. 30 Explain the reason why the face of a planishing hammer should be maintained in perfect condition. (b) Spray-up is a low-to-medium volume moulding method similar to hand lay-up in itself.
suitability for making boats, tanks, tub/showers and other medium to large size shapes. 9 Lift the screen using the suction cups and offer it up to the vehicle, top edge leading. • Store all SRS components in a locked safety approved area. Remember that the nature of these processes will affect a change to the properties of the steel, and that the
energy of the impact will have had the same effect on the panel. Once the curing process is complete the repair area is not only optically clear but also structurally sound; in fact it is stronger than the glass it replaces (Figure 14.115). • Ensure that nobody is in the vehicle when re-connecting the battery. The best method is to apply a single coat
followed by wet on wet (double-header) coats. This raising process can be speeded up considerably by 'taking in' or making tucks at the edges of the metal. Slight imperfections should be levelled with cellulose stopper, which must be over-coated with surfacer. Figure 17.31 shows the method of overlapping with the panel being sprayed in separate
sections, each section overlapping the previous one by about 100 mm. When the trigger is released the motor decelerates, and after a short time lag the gas flow and welding voltage are interrupted. Correct bonnet alignment with the wings and front grille preserves the streamlined contours of the front end of a car. Set screws are used either to fix
two pieces of metal together or to adjust the distance of one piece relative to the other. Both machines are used to advantage in body work as they are capable of bending to shape many articles suitable for both new and reapir work. Floor pan Main floor of the passenger compartment of an underbody assembly. As far as possible, no job should be
accepted into the workshop until the parts have been obtained to complete the repair without holding up the flow of the work. 14.3.5 Vehicle alignment on any part of a vehicle body. The damage will eventually spread
further as the temperature changes and the vehicle flexes in normal use (Figure 14.112). Normal car painting procedure is then carried out (Figure 16.42). The body worker 354 Repair of Vehicle Bodies frequently has to increase the strength and rigidity of the edges of large unsupported metal panels, to stop movement and vibration when the vehicle
is in motion and to create resistance against buckling and twisting. The best solution is an efficient extraction system or extraction tools. When the rod is not in the puddle, keep the tip just inside the outer envelope of the flame. Precaution must be taken when welding vehicle panels in case there are flammable materials attached to the other side of
the panel which could ignite and burst into flames. Cleaning agents, fillers, stoppers, primers, gunwash and many other products in the refinishing of motor vehicles all contribute to this figure. The number of pins which need to be welded on to the panel will vary in accordance with the depth and extent of the damage, starting at the deepest section
function of the trigger is to operate the air valve and also the fluid needle. To prevent the interchange Figure 9.3 A typical oxy-fuel gas welding and cutting system (Murex Welding Products Limited ) of fittings between cylinder valve has a
right-hand thread (see Figure 9.4). With the aid of the triangular grinding plate you can reach into any corner or inside the narrowest of openings, for ideal sanding of edges and profiles. The bottom roller is adjustable to accept varying gauges of material up to 1.2 mm (18 gauge) mild steel. 3.5 Body files Flexible panel file This tool (Figure 3.10a) is
This type of change in shape of the metal, with little structural change, is known as metal movement (Figure 5.22). Remove any one of these and the first stroke, raise the file and, without dragging it over the metal, bring it back to the starting position and
make a second stroke. Never lay it on the bench while the machine is running. Solvent should only be used in the cleaning bath for which it is designed. Therefore, one revolution of the thimble moves it along the barrel for 0.5 mm. This is 607 because the metallic flakes have a tendency to lie parallel to the surface when a dry coating is applied. They
(Figure 13.22) and is passed over to the sales section. 276 Repair of Vehicle Bodies 12 Describe the reasons for both leftward and rightward welding methods, and state any benefits derived from these methods. Only experience in body repair work will give the ability to estimate the time required to do a particular job. The high temperature necessary
to create the plasma is achieved, in the case of plasma cutting, by a standing electric arc. As side and cross members are usually formed from lowcarbon steel, heat may be used to relieve stresses in badly creased areas. Thus components such as safety harness attachments, door hinges, jacking points, spring shackles, steering column brackets and
seat frame guides are attached using the dip transfer technique, which enables welds of this type to be made on thin shell panels with no distortion of the panel and deep penetration into the thicker workpiece. Alternatively use hot pressure washer with appropriate detergent (Figure 14.127). The lighting level required for the preparation area is
between 750 and 1000 lux on both vertical and horizontal surfaces. As it is pulled through tiny holes, that liquid mass is transformed into fibres smaller in diameter than a human hair. Before pushing them into the ECU. 2 The joint can be
made quickly and neatly, requiring very little cleaning up. Cut the damaged section out of the bumper, a round or oval shape will prevent further cracking. The pressure washer or steam jenny should only be used with the recommended detergent. Joint fittings made of copper should not be used under any circumstances. Some of Britain's largest
organizations now include BS EN ISO 9001-2002, or other acceptable quality management systems, as a contractual requirement for their suppliers. Any small particles of paint which the sander will not tin the surface unless it is precleaning is very important, as the tinning paste will not tin the surface unless it is precleaning is very important, as the tinning paste will not ten to their suppliers.
perfectly clean and free from paint. MIG: high-current spray, aluminium TIG: Aluminium, copper, stainless steel. 9 Gas welding are cutting 9.1 Development of gas welding are cutting 9.1 Development of gas welding are cutting 9.1 Development of gas welding.
the properties of welded joints are as follows. 5 If the accessibility for the use of hand tools is difficult owing to the presence of brackets behind the panel or double-skinned sections, rough out the damaged area either by cutting out the back and using spoons to lever the damage out, or by using a panel puller on the front of the damaged section to
pull out the damage. One data sheet is usually required for each vehicle, giving published dimensions from manufacturer's drawings. Major accident damage 435 Figure 14.51 Computer measuring screen (Chief Automotive Ltd.) The body scanner automatically reads all
reference points simultaneously, from strategically placed targets positioned on the vehicle underbody. 4.1.4 Annealing Coils used for the manufacture of a car body must not only have a bright smooth surface but must also be soft enough for bending, rolling, shaping and pressing operations, and so the hardness of cold rolled coils to be used for car
bodies must be reduced by annealing. The high-pressure system is used in all fields of engineering, and especially in the body repair trade. Too much current causes burned welds. The ramifications of the EPA and COSHH legislation are far reaching for all bodyshops. Today's chassisless bodies hold engine, suspension and steering in the right
and are designed to absorb the impact of crashes by crumpling, thus shielding the passenger compartment (and its passengers) from shock and deformation. For goods vehicles, windscreens and all windows in front of, or at the side of, the driver's seat shall be safety glass. It should be kept clean, tidy and uncluttered at all times. An overhead
conveyor carries the body shells from the pre-cleaning area to the dip tank. At 30 per cent the typical characteristics of an oxygen-fed fire are apparent. Porosity Porosity results when bubbles of gas are nucleated in the weld pool and trapped during solidification. This nut is threaded in such a way that it tightens as the machine rotates, thus avoiding
the risk of a disc coming loose. A powerful lamp held on the reverse side of the panel helps. To obtain the necessary consistency for spray application and good flow-out, thinners are normally used. Door aperture seals and weather strips should be renewed if damaged or suffering from deterioration. 4 Take the spacer blocks from the repair kit,
remove the adhesive backing, and fit them in the original position on the windscreen aperture. % PPE pt 
PVA PVC 
Ibl lb ft lbf/in2 part number percentage Personal Protection Equipment (Regulations) pint (imperial) plus (tolerance) plus or minus polyvinyl acetate polyvinyl acetate polyvinyl chloride positive (electrical) pound force pound (mass) pound force
foot (torque) pound force per square inch r ref. The hydraulic platform provides easier and speedier loading of a vehicle and allows the operator to set the bench at any suitable working height to a maximum of 700 mm. On the car's re-entry into the paint shop, the bodywork is masked up and then flatted by hand, as with every part of
this operation. Pulse arc transfer In this mode the droplets are transferred by a high current which is periodically applied to the arc. Pull back the spring clip holding the connector plug into the ECU then pull the wired out of the connector. Kinetic energy The energy of
motion. The coveralls must withstand continuous exposure to a variety of chemicals and must be suitable for protection when using isocyanate- based two-pack paints; they also prevent the environment being contaminated by particles from the operator's clothing and hair. In body work the machine is used in the stiffening and strengthening of
panels; for decoration in the form of beading or swaging; for the edge preparation of panels, such as wiring; and for making joints between panels as in lap and joggle joints. When the flame is directed towards the completed weld, this is termed rightward, backward or backhand welding. These cylinders contain a porous filling which acts as an
absorbent for the acetone used to dissolve the acetylene. The calipers are then carefully withdrawn from the workpiece and the distance between the two points is measured. 7 Use a sketch to explain the principle of the Mitek system. The body of the machine is usually fabricated, and this construction is to be preferred. 2 Find the colour identification
plate on the vehicle (the positioning of this varies from one vehicle manufacturer to another) and note the colour coding. Brazing is accomplished by heating the pieces to be joined to a temperature higher than the melting point of the brazing alloy (brass). Both are obtainable as either compressed air operated or electrically driven machines (Figures
17.44 and 17.45). 13.13.2 Basic equipment A body jack consists of three basic units (Figure 13.51): a pump, a flexible hose connecting pump to ram, and the ram unit. Electric sunroofs operate in a similar way to electric sunroof specific sunroof specific sunroof specific sunroof specific sunroofs.
conditions are less than ideal a certain amount of lifting of the surfacer could be experienced. This ensures ease of access to the most difficult repair job even in a limited space. Early models used a jointed type of bonnet which was held in place by bolts through the centre section of the bonnet into the body of the cowl and into the radiator
Acrylic-based, epoxy, and single-part epoxy adhesives can be toughened in this way. A bend test machine consists of a roller or former connected to a ram and operated hydraulically. The rigid areas are such assemblies as door posts, sill members, roof cantrails and flanges around wing edges and bonnets. Check reverse of interior mirror. The other
two important regulations affecting bodyshops are the Control of Substances Hazardous to Health (COSHH) Regulations 1988 and the Environmental Protection Act (EPA) 1990. Better economy is also a feature of plasmaarc cutting as compared with oxy-fuel methods. 24 Show, with the aid of a sketch, the principle of twin-spot welding. Caution: if a
leak or leaks are detected, apply sealer to the area and retest. These panels are spot welded along their flanged edges to form a single unit in the same manner as an ordinary door. Angle of welding torch 40°-50°. Countersunk, round, cheese and pan heads are available, with either slotted or star recesses (Figure 7.48). Some seats have memory
settings available for different drivers, referred to as setting 1, 2 and 3 and so on. Good fusion characteristics and shielding efficiency, but stability and spatter levels poor. The abrasive is fixed on a backing which is either of paper, cloth or a combination of the two. The cause of this defect is incorrect parameter selection, in particular the use of high
current or slow travel speed. This leads to extreme control over the weld penetration and weld appearance. To ensure gas-tight connections between cylinder valves and finally tighten the nuts properly, but without the
use of excessive force. Synthetic resins have similar properties and are normally converted to solids by ploymerization. Figure 13.23 Folded edges (a) single fold (b) folded and creased edge (c) double folded edges (a) single fold (b) folded and creased edge (c) double folded edges (a) single fold (b) folded and creased edge (c) double folded edges (a) single fold (b) folded and creased edge (c) double folded edges (a) single fold (b) folded edges (b) folded edges (b) folded edges (b) folded edges (c) f
that it may be used in conjunction with the Car Bench measuring system and mini bracket system using the base modular blocks as starter packs. Active gases such as carbon dioxide (CO2), oxygen (O2) and hydrogen (H2) may be added to the shielding gas to control one or other of the functions stated, but the gas chosen must be compatible with the
material being welded (Table 12.1). In surface fusion the depth of penetration of the molten solder into the surfaces to be joined is so shallow that it forms an intermetallic layer which bonds the surfaces to be joined is so shallow that it forms an intermetallic layer which bonds the surfaces to be joined is so shallow that it forms an intermetallic layer which bonds the surfaces to be joined is so shallow that it forms an intermetallic layer which bonds the surfaces to be joined is so shallow that it forms an intermetallic layer which bonds the surfaces to be joined in the surface to be joined in the surface
formed in any way the material should be used in the annealed condition and then heat treated after the shaping operations have all been carried out. Or, where this is not acceptable, the CA Taptite can be used; this has a gimlet point capable of self-extruding in thin sheet sections. 2 Select the tip for the type and dimension of wire being used and
fitted to the equipment. 3 Heavy centre pattern (see Figure 17.41d) 17.11.2 Faulty spray patterns caused by: The normal spray pattern produced by a correctly (a) Too low a setting of the spreader adjusted spray patterns can develop from the fol(b) Atomizing air pressure
which is too low lowing causes: or paint which is too thick (c) With pressure feed, too high a fluid pres1 Top or bottom heavy pattern (Figure 17.41b) sure or a flow of paint which exceeds the caused by: normal capacity of the air cap partially blocked. If the zone is more than about 15 metres wide, then additional rows of
heaters may be required. Oscillating means that the grinding plate - here a triangle rather than a disc shape - does not rotate, but moves to and fro through only 2 minutes of angle at a frequency of 20 000 oscillations per minute. On heavier plates of 6 mm or more, vertical upward welding is more practical since deep penetration can be obtained
The heat value of the flame must be adjusted by changing the tip and not by unduly increasing or decreasing the pressure and volume of gases used. The receipt and issue of parts, the stock held and the costs are therefore very important to any bodyshop. A variety of vehicle body parts, accessories and related parts all utilize common bolt and nut
fasteners as well as a range of special fasteners. 9 Wash interior. The cutting tip has an orifice in the centre for the oxygen flow, surrounded by several smaller holes for a preheating flame which generally uses acetylene, propane or hydrogen. Grooved rivet has been developed for use in thick sections of soft or brittle materials such as hard board,
plywood, glass fibre, asbestos board, con- crete and brick. The hinge pillar or A-post extends forward to meet the dash panel and front bulkhead to provide strength at this point. Pluid needle This seats in the fluid tip, its function being to start and stop the flow of paint. 2 Do not use kerosene, thinners or solvents to wash the skin. The cowl extends
upwards The passenger-carrying compartment of a car is called the body, and to it is attached all the doors, wings and such parts required to form a complete body shell assembly (Figure 5.14) has two rollers of equal diameter mounted side by side which rotate in the same direction. Typical
thermoplastics are polythene and PVC. 13.15 Care and maintenance of body jack Figure 13.60 Repairs to a door opening using aperture restraint (Blackhawk Automotive Ltd.) As with all hydraulic equipment, little trouble is experienced with the working of the jack provided the unit is kept free from oil leaks. Before striking the arc the operator
should have his head shield or face screen in position and observe the arc through the glass filter. 3 Water can leak into the interior of the body through any body panel holes made by screws, bolts and clips unless they are securely sealed. Though the glass filter. 3 Water can leak into the interior of the body through any body panel holes made by screws, bolts and clips unless they are securely sealed.
synthetic, slower drying types of spraying synthetics, and, most widely used nowadays, two pack synthetics. The parts are then returned to the forge and kept at a bright red heat for a short period to allow the carbon in the compound to penetrate the surfaces to which they
are applied, and must not harden or crumble in service. In operation, the dust created by sanding is drawn through the holes and deposited in the collecting unit or bag. The following paint systems are typical of those carried out in refinishing shops. To ensure satisfactory leak location and testing, it is recommended not to use a leak detector on a wet
vehicle, which should be blown dry prior to the test. As a body repairer you are obliged to follow these regulations for the protection of yourself and your colleagues. A roof panel or car door is a typical example of this. 4 Repair doors, fit glass, and body trim to doors and check for ease of operation and alignment of the door in the opening in the body
shell. In addition this equipment can be used for vector pulling and pushing and upward or downward pulls. This will provide a secure, attractive attachment with no evidence of fastener location. Several proprietary brands are available to the refinisher: Gravimetric This system involves the use of a set
of scales. It can be installed in the workshop either by concreting it into a suitable position in the floor or by siting it on a level area of the floor. They are first reduced to the thickness of plate, and then to sheet if this is required. assy backbone Bracket A-Frame RH Pan front floor Crossmember assy front floor front RH
Crossmember assy front floor rear RH 9 10 11 12 13 14 15 Crossmember assy front floor front LH Reinf. 456 Repair of Vehicle Bodies Pulling by anchoring it to the under-body members using special bolt-on clamps or chain attachments and pulling the damaged
section back into line. Most destructive tests require the use of sophisticated Electric resistance welding equipment which most body shops do not possess. Tallow is a popular flux with plumbers for the purpose of wiping joints in lead pipes. The equipment consists of frame and body straighteners to pull the damaged body shell back into alignment.
When this plasma is directed at a conductive material the arc is transferred through the plasma (transferred through the plasma (transferred through the material. It is as well to mark hole positions lightly at first, check them for accuracy, and then increase their depth by heavier hammer blows, holding the work on a firm foundation such as an anvil. 14 Name the four
categories of safety signs used in the workshop. The bottom blade is fixed to the machine frame, while the top cutting blade is fixed to a moving member which is pivoted in the fact that the craftsman has to merge, by careful hammer blows or
wheel action, all these stretched blows into one to create a continuous smooth surface. Self-etching primer and then coating over with surfacer or filler. Silicone rubbers Used, amongst other applications, for sealants and flexible mould compounds. The main advantages
gained by using this system of alignment check are the speed at which it can be set up to diagnose distortion, and the convenience it offers in making regular checks during repair procedure. 2 Over-atomization, due to using too high an atomizing air pressure for the volume of paint flowing. The panic was over. The most obvious limitation of a paint
based solely on a drying oil is slow drying. A number of large repair organizations have adopted flowline systems: these can only be successful if allowance is made for several lines accommodating various speeds of work, but must still retain the facility to move a vehicle easily out of the line in the event of unexpected hold-ups. Polyester primer filler
can be used with 580 Repair of Vehicle Bodies most car refinishing processes and is very useful when used with low-bake enamels. 11.5 Arc welding operations Arc welding operator will vary considerably depending on the position of the joint,
which may be flat or downhand, horizontal, vertical or overhead (Figure 11.7). 5 Do refer to the manufacturer's instructions for specific adhesives. There are too many variables involved to make it possible to lay down a hard and fast system in obtaining a perfect match on repair work. 3 Check windscreen wiper arms and blades, air grilles. However,
because of the high level of crimp of the fibres the mechanical properties are low compared 552 Repair of Vehicle Bodies Reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials 553 (Facing page) Figure 16.24 Design consideration for reinforced composite materials for reinfor
and replace it with a small quantity of solvent. Mudguards on earth-moving equipment meet conditions in service to which the wired edge lends itself most admirably, and repairs can be readily made, if necessary, with the aid of welding equipment. 6 Use self-adhesive tape to cover the cut-out area from the outside of the body. 10.8.1 Factors affecting
weld quality The following factors can have a large influence on the final outcome of the spot weld: 1 The type of metal being welded (for example, coated metals) 2 Joint configuration 3 Current and timing settings 4 The type of welding equipment being used 5 Electrode maintenance. 7 Immerse a cartridge of sealer in water at a temperature of 60 °C
for approximately 30 minutes. The correct gun action is acquired by keeping the wrist flexible (Figure 17.27). Allow to dry hard. The higher-strength steels have been made specifically for motor car manufacturers to produce body
shells from thinner but stronger steel sheet. The Japanese, in particular, and the European industries have moved to the use of HSLA steels in further attempts to reduce body weight. The ramp system enables the vehicle to be secured to the bench quickly. 20 In integral construction, what section of the body possesses the greatest amount of
strength? Other adhesive types may be too viscous, or lack the appropriate grades of strength. Valve guards should not be removed. 6 Describe the process of contact moulding. Figure 16.34 Final inspection of the completed Lotus Elan (Lotus Engineering) 16.9 Repair of reinforced composite bodies The repair of reinforced composite bodies and
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component panels is not difficult, and unless major damage has been sustained it can quite readily be carried out by a competent body repair shop. Lighter body weight reduces the load on the car engine and therefore has a direct influence on petrol consumption. This position not only permits perfect control over the machine at all times, but it will

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also produce less fatigue over longer periods. Absorb spillage into sand or chalk. The engineering definition of heat (heat being the essence of all welding) is (energy) time. The use of arc welding depended naturally upon the development of electricity, and dynamos or generators were not developed until 1880. The other is based around ECE (United
Nations) Regulations and provides for approval of vehicle systems and separate components, but not whole vehicles. The weld specimen may be placed in the jaws of the tensile test machine and struck with a hammer when tensioned. The advantages and disadvantages of glass fibre
reinforcement materials are indicated in Table 16.2. 16.4.8 Carbon fibre This is another reinforcing material. It is compatible with all plastics, fibre-glass and metal surfaces. For horizontal welding, hold the electrode so that it points 5-10° and slants approximately 20° away from the depositing weld. 9 Provide temporary workers with some particular
health and safety information to meet special needs. The presence of internal dry patches can be readily confirmed by tapping the surface with a coin (Figure 16.53). Allow to dry for 1 hour. Godfrey, Pickles Godfrey Design Partnership) Parts department for trade and retail This could include parts manager's office, parts store area, and storemen.
Deposited metal Filler metal from a welding rod or electrode which has been melted by a welding process and applied in the metal and then run the metal through the wheels. 4 Define the following abbreviations: COSHH, HASAWA, EPA. The machines can be
either electric or driven by compressed air. Figure 17.52 Spray booth combined with low-bake oven is shown in Figure 17.60, in which the vehicle being painted is moved sideways on rails and bogies. The combination of design and material permits the recommended screw to form its own thread by displacement, resulting in high torque load and
good anti-vibration characteristics. The application of the release agent to the mould is followed by brush or spray application of a gel coat of resin. They are shaped like a cone and fit in the chuck of a standard power drill. Butyl rubber, however, is 'dead' to handle and contains no wax, and so whilst neoprene is costly its use is essential for some
parts. An even coating of paint is thus applied, even on thin metal edges. On the satisfactory completion of the road test, the vehicle can be made ready for its second entry into the paint shop, but not before its body panelling has been thoroughly inspected for small marks or minor imperfections. This is relatively easy to achieve where simple tensile
or compressive forces are involved, but the effect of shear loading must also be considered in the case of lap joints. Some years earlier a French chemist, Edouard Benedictus, had accidentally knocked down a flask which held a solution of celluloid. 1910 1920 1930 1940 1950 1.2.6 Prototype production 0.95 0.82 0.56 0.45 0.42 1960 1970 1980 1990
1993 0.40 0.36 0.30 0.22 0.20 During the wind tunnel test all four wheels of the car rest on floating scales connected to a floor balance, which has a concrete foundation below the main floor area. Heat-treatable alloys These are strengthened by controlled heating and cooling followed by ageing at either room temperature or at 100-200 °C. 3 Examine
the closed lenses in the helmet. Metal corded wires can be obtained with additions of alloying elements to meet special requirements (HS low-alloy steels). The information which is required to be recorded in the accident book is: Name and address of injured person Date, time and place of accident/dangerous occurrence Name of person making the
report and date of entry Brief account of accident and details of any equipment/substances which were involved. The applications range from body component assembly to fixing electronic control panels (see Figure 7.20). The hot dip product (available as plain zinc, or iron-zinc alloy) is generally used for underbody parts. Over 2000 car colours are
available in this material, and so colour matching does not present too many problems. It is a two-piece fastener consisting of a zinc-plated carbon steel pin with a nylon seal and a collar which is pulled tight from the other side of the workpiece, thus causing no damage to the material during installation. The condition where the gauge bars are not
parallel (Figure 14.60a) indicates that the underbody has moved up or down at some point along its length. The usual plastic identification codes are as follows: ABS ABS/PC PA PBT PC PE PP PP/EPDM PUR PVC GRP/SMC acrylonitrile butadiene styrene polymer alloy of ABS polyamide (nylon) polybutylene terephthalate (POCAN) polycarbonate
polyethylene polypropylene polypropylene polypropylene polypropylene/ethylenediene rubber polyurethane (not all PUR is weldable) Equipment for plastic welding guns (see Figure 14.116). This includes most types of protective clothing and equipment such
as eye, foot and head protection, safety harnesses, life jackets and high-visibility clothing. Methodically check all edges, valances, glasses, lights, grilles. (a) 97 3.8 Recommended basic toolkits for panel beaters The pride of the craftsman is the set of tools he possesses. Integral A necessary part to complete a whole unit. 13.11 Body soldering Body
soldering (or loading, filling or wiping, as it is sometimes termed) has become a general practice where owing to the all-steel body, the use of normal panel beating methods of repair using hand tools is not possible. When welding structural components and chassis members the material tends to be thicker, up to 3 mm or even
more, and so it is necessary to use a hot arc in order to penetrate the material. Several coats were applied, each being rubbed down smooth prior to the application of the next coat. The same dimensions can also be projected on the screen of a graphic station; this is a sophisticated computer-controlled video system showing three-dimensional
illustrations, allowing design engineers either to smooth the lines or to make detail alterations. 27 List the applications where toughened adhesives would be used. Hold the grinder so that only 40-65 mm of the outer edge of the disc is in contact with the surface being ground. 622 Repair of Vehicle Bodies 17.19 Common spray painting defects
17.19.1 Blistering Blisters are hemispherical projections on the painted surface, which will contain either air or water. Therefore, when carrying out repair, the type of resin and gel mixes used will depend on the original materials used in manufacture.
environment and anything contained in it. In good practice the brazing alloy is melted by the torch flame. Since then a large variety of plastics has been developed commercially, particularly in the last twenty-five years. Hose fittings are shown in Figure 9.11. To have some direct influence on these costs
it was recognized that motor insurers required a means of researching the cost of repairing accident damaged cars and light commercial vehicles. Basics of Replacing the Entire UnitYou may need a full side view mirror repair. The art of wheeling lies in the operator's ability to handle the panel successfully in the wheeling machine (Figure 13.10). The
included angle or vertex angle (Figure 12.10) is usually smaller for low-current DC applications. Silicon Used as a deoxidizing agent, and has the slight effect of improving hardness. When repairing it is essential to know the nature or properties of the sheet metal used in body panels. The point where the welding is to be done has one or more
projections which have been formed by embossing, stamping or machining. Caution: do not switch off the machine until the air has stopped flowing, otherwise the torch. When introduced into Britain it was viewed with a certain amount of distrust, as the claims made for it (primer, stopper,
surfacer rolled into one) appeared too good to be true. It is held against the circumference of the round bar so that one blade lies across the surface, giving a diameter line which is then scribed. Cast iron welding rod should be used, together with a cast iron welding flux. 6 Maintain
certification by reviewing the system at predetermined intervals, conducting system audits, and maintaining a disciplined approach to quality assurance. 16.9.6 Replacing part of a components are shown in Figures 16.43 and 16.44. Re-fitting is the reverse
procedure. Wood formers or jigs, upon which the beaten shape can be tried in order to obtain uniformity of shape for each workpiece, are used for many jobs. Rear-end damage is the result of an impact direct or slightly angled, to the rear end of a vehicle and 406 Repair of Vehicle Bodies causing substantial damage to bumper, rear panel, boot lid,
boot floor panel and quarter panels. Cutters are available to suit most profiles and tip diameters. Near side The left-hand side of the vehicle as viewed from the driver's seat. 27 Describe how to safely store paint. Wider tapes of sheet Sheet,
strip and circle blanks are sold in hard and soft tempers possessing different degrees of ductility and tensile strength. Class C fires: gases Not many cars run on liquid propane gas (LPG), but welding gases or propane space heaters not only burn but can be
checked for any minor defects after the repair process is completed. They will include not only lifting of loads, but also lowering, pushing, pulling, carrying, or moving them, whether by hand or other bodily force. A polyester resin adhesive films are thick enough to avoid problems of
undercure. Figure 14.102 Application of Cold Front heat barrier material (Gray-Campling Ltd ) 14.4.8 Door hanging requires particular care, as the fitting of doors is one of the most essential features of crash repair work. Position of filler rod Follows the welding torch. After shaping, the surface of the finished panel has to be smoothed
by the technique of planishing, using a steel bench stake, or by wheeling. An alternative torch movement is the semicircular motion. They are also used to monitor and control prolonged engine testing to establish reliability characteristics. On sites lacking these services it could prove costly to have them installed. It has a soft-top folding roof (hood)
and wind-up windows, together with fully enclosed or open bodywork (Figure 1.6e). The measuring system is dual purpose as it fits directly to any Celette bench or jig lift, and there is a choice of using brackets or measurement. The actual spraying of these has a great influence on the finished appearance as regards colour. 504 Repair of Vehicle
Bodies Figure 15.1 Bodyshop layout (ICI Autocolor, Ernest W. 16 What are the important factors to be considered when spot welding high-strength steel. The result was Thatcham, named after the small Berkshire town where it is situated, and the only centre of its type in the UK. The repairer must be able to determine what, if any, damage exists
before attempting a repair. This permits the metal to return to its original shape with little danger of cracking. This protective design depends on the ductility of the metal, and the welds too have to be ductile. They are cold cured and the material is dispensed on to the glass through a specially formed nozzle out on the end of a cartridge. Friction Theorem
resistance to motion that a body meets when moving over another. This can be further improved upon by having entrance/exit doors at each end of the unit which would provide a flow-line system of painting and stoving (Figure 17.54), thus reducing time wastage on vehicle movement. There are many manufacturers and suppliers of valeting and
cleaning chemicals. The lower the value indicated, the more brittle the specimen; conversely, the higher the reading, the greater the toughness. 14 Always turn off the welding machine when not in use. Moreover, it has long been a disadvantage that, despite filters and regulators, peneumatic tools can still blow oil, rust, dust and other impurities into
the atmosphere and on to the work being treated. The acetylene and oxygen are fed independently to the mixing chamber, and then flow through the tip. If necessary it can be burnished and polished after overnight drying, though this can be done after 4 to 6 hours if the enamel is force dried. 18 State the reasons why GRP has not replaced low-
carbon steel as the material used to manufacture vehicle bodies. It had two permanent seats plus two occasional seats in the rear and a driving position in front. This action assists spreading and the feeding of brazing alloy to the production of well filled joints. Overspray the repair with a mixture of 75 per cent thinner,
25 per cent colour, carrying the spraying beyond the edge of the repair to obtain a soft blend. Snapsacs provide increased retention and sealing for trim panel fasteners, and their smooth surface eases assembly and removal. The Glassmatrix software is supplied on a CD ROM, which is regularly updated - usually once a month. The activator contains
phosphoric acid which etches the surface, thereby ensuring good adhesion. The most useful set of Pozidriv screwdrivers ranges from number 1 to number 4. When the centre line does not pass within 3 mm to these intersecting points, measurements must be taken to establish which member is distorted. 17 Check all wheels. However, all the following points, measurements must be taken to establish which member is distorted. 17 Check all wheels.
give satisfactory results: abrasive discs, belts, and cloths; medium-grit emery paper; and wire brushes. A suitable lighting level for this type of area would be between 300 and 500 lux (Figure 15.3). It can be installed at any stage without damaging the work-piece finish, even after painting. Learn where to get the replacement parts and how to handle
the installation. Guide coat A thin coating applied as evenly as possible over a surface to be rubbed down. As the paper is pulled out of the machine, a strip of the tape is automatically attached to one of the edges (Figure 17.4). When the metal is Craft techniques and minor accident damage 357 formed to make the body panel it is bent beyond its
elastic limit. This must meet all the requirements of the EPA in relation to the throughput of air and the placement of the exhaust stack. In a crash, the wheel deforms at the hub and the metal legs align the wheel parallel to the chest of the driver to help spread the impact and reduce chest, abdomen and facial injuries. Door trim The interior lining of a
door. Specialist repair area or jig area This is designed for major accident damage where the vehicle must be repaired on a jig system. This makes them ideal for applications such as inspection covers and service access. • Attach any other wires to the SRS circuit. Ring spanners are available in 6, 8 or 12 points. Figure 16.16 Application of gel coat
covering (Scott Bader Co. Ltd ) 1 The master mould must be spotlessly clean. The initial spreading is done with the flat end of the hammer and the head is finished with the flat end of the hammer. the strength of a sheet, as can be demonstrated by forming a right-angled bend in a thin sheet of metal and then trying to bend the metal across the point
of the bend. Do not mix radial-ply and bias-ply tyres. A small child was trapped in the vehicle; it was a very hot day at a local car boot sale. 1.3.2 Integral (mono or unity) construction employs the same principles of design that have been used for years in the aircraft industry. Warping Parts fixed under tension; poor site
preparation. Therefore, surface preparation can safely be omitted, or restricted to simple degreasing, on a wide range of jobs. To take advantage of a great amount of the natural support provided by the crown of the metal, the force of the hammer blow is spread over a larger area. The rivet is available with two alternative mandrels: one, called 'short
break' (Figures 7.8 and 7.9), fractures immediately under the mandrel head which is retained in the blind end of the set rivet; and the second, known as the 'long break' type, fractures at a point outside the rivet and can be finished off to result in a flush finish. A solution of coloured dye is sprayed on to the weld and parent metal and allowed to soak.
Runabout An open sporting type of vehicle with simple bodywork and two seats only. 2 Does the vehicle appear level or is there any sagging? Whenever possible, fasten the cables overhead to permit free passage. It is so called because a threaded nut is held securely in position by an annular rivet, the head of which is hammered flat around the hole
to form a secure anchorage (Figure 7.51). It is usually a two-piece construction comprising the wheel arch and the quarter panel, which are welded together (Figure 1.46). Coupé cabriolet or double cabriolet A long vehicle having the window seats tightly in
this channel, effectively sealing out the weather. 6 High speed may reveal steering wear and odd noises, indicating loose or damaged parts. If the pressure is too low at the start of the drawing, wrinkles will occur before the pressure in the joint. Working
environment 1 2 3 4 5 Temperature in indoor workplaces. All rights reserved The rights of A. In addition it can be used to check the critical suspension points before, during and after repair (Figure 14.64). 13.4.1 Folding Folding is the simplest form of edge treatment (Figure 13.23) and is satisfactory when neatness and speed are the main factors.
From this it is possible to determine the mix of bays, such as paint shop or panel shop; add to this an estimating bay and the plan takes shape. If the voltage becomes too great in relation to the wire speed, large drops will form on the end of the wire. Some manufacturers use external hinges, while others use concealed hinges
attached to the inner panel only. 1.2.4 Engine performance and testing Development engineers prepare to test an engine in a computer-linked test cell to establish the optimum settings for best performance, economy and emission levels. When a flat sheet of metal is bent to a wide radius it will regain its former shape when released; in other words
the metal is flexible. The glass reinforcement used for vehicle components is made to suit the application and can vary between the woven cloth like material which is sandwiched in layers in a bumper assembly and the finely powdered glass particles which are used to strengthen a lamp cluster. Remove the filler plug from the end of the pump and
release the valve. The classic Rolls-Royce radiator was one of the first examples of the use of stainless steel. Materials included in this group are: acrylic and polyerethane primer undercoats and finishes; and polyerethane primer undercoats and finishes, including base-coat-and-clear finishes; epoxy resin primers and finishes; and polyerethane primer undercoats and finishes, including base-coat-and-clear finishes; epoxy resin primers and finishes; and polyerethane primer undercoats and finishes, including base-coat-and-clear finishes; epoxy resin primers and finishes; and polyerethane primer undercoats and finishes, including base-coat-and-clear finishes; epoxy resin primers and finishes; and polyerethane primer undercoats and finishes, including base-coat-and-clear finishes; epoxy resin primers and finishes; and polyerethane primer undercoats and finishes; epoxy resin primers and finishes; epoxy resin primer
well as being used in vehicle repair, this process is also used in vehicle production on some assembly lines as it offers increased speed and a smooth flat bead requiring little dressing after brazing. The US reference is exactly opposite to that used in this country. They present special health hazards, and the user should be equipped with an air-fed
mask and face visor to prevent inhalation of the vapours when spraying (Figure 17.3). 12.10.3 Feed unit The consumable electrode for welding ferrous and non-ferrous materials is supplied as a continuous length of wire on a spool or reel, and the wire varies from 0.6 to 0.8 mm diameter. This preparation is a key factor to good-quality spot welding. In the consumable electrode for welding ferrous and non-ferrous materials is supplied as a continuous length of wire on a spool or reel, and the wire varies from 0.6 to 0.8 mm diameter. This preparation is a key factor to good-quality spot welding.
1969, motor insurance company members of the British Insurance Association and motor syndicates at Lloyd's joined in a scheme to create a research centre. When chopped strand mat is used, its random fibre arrangement can be expected to give roughly equal mechanical properties in all planes; however, maximum strength will in practice be
parallel to the plane of the laminate. Paint has to adhere to the metal on which it is placed. 18 Describe a method by which a surface can be checked to ensure that it is vertical. 3 Reduce the risk of injury as far as reasonably practicable. The bought-in 352 Repair of Vehicle Bodies panels include those for front and rear wings (each in two parts) and
the roof, leaving the boot lids, bonnets and doors to be made on site as before. The artillery wheel gave way to the wire-spoked wheel, and this in turn to the modern disc wheel with tubeless tyres. Reduce or increase the acetylene supply by the welding torch
control valve until the white inner cone is sharply defined, and check working pressures again. 3.10.2 Mallets Mallets (Figure 3.27) come in two shapes. Hence acetylene for welding purposes is dissolved in a liquid chemical known as acetone, which is capable of absorbing up to 25 times its own volume without changing the nature of the gas itself,
and then stored in steel cylinders. 4 The torch should be kept free of slag at all times to ensure a free passage of air. The EuroNCAP tests are designed to encourage vehicle manufacturers to consider safety standards above and beyond those required by the government regulations. A range of self-tightening clamps and accessories is available (Figure
14.6) designed to clamp on to or be fixed to the wide variety of sections which may require to be pulled. This assessment must state the hazards of using the materials and how to deal with accidents arising from misuse. If this is done correctly it will produce a satisfactory weld. Lighting is only one of the many factors that will be taken into account
when choosing a spray booth. Explain how this process will be carried out. It is thinned 4:1 giving a viscosity of 26-30 seconds. This relates to net profit achieved against an asset, which would be the work being produced in the workshop. Lead, on the other hand, may be beaten into almost any shape without annealing and without undue risk of
fracture. Rubber hose Use only hose in good condition, fitted with the special hose connections attached by permanent ferrules. This system avoids the dimpling effect on the outer surface of the bonnet skin which occurs in spot welding. Weld time is an important factor, because the strength of a weld nugget depends upon the correct depth of fusion
An extremely thin coating gives best results. Scissor-action lift The scissor-action lift is quite unique in that once the frame has been lowered to rest on its wheels, the base unit can be automatically raised from the floor so that it retracts directly into the frame. This is done by bisecting the lines joining the front and rear pairs of points and using the
chalked cord to mark the centre line. The small percentage of antimony both improves the chemical properties of the Personal Protective Equipment (PPE) at Work Regulations 1992. Concurrent with these
developments, vehicle manufacturers were concentrating on particular aspects of car design. 23 By means of a sketch, draw one type of swage which could be produced on a flat piece of sheet metal. This is because in addition to distributing the gas it also acts as an insulator, and is of vital importance to the service life of the swan neck of the torch
11.7.4 Welding aluminium and its alloys The equipment used is standard DC welding equipment. Welding goggles with appropriate shaded lens to BS regulations. 22 What practical factors limit the width of sheet metal which may be formed on a wheeling machine? The front wings (or the fender assembly) are usually 49 attached to
the wing valance of the front end assembly (see Figure 1.45) by means of a flange the length of the wing, which is turned inwards from the outer surface and secured by either welding or bolts. For cutting higher-tensile steels such as stainless steel, alloy steel blades are necessary. If the latter method of installation is used, approach ramps are
provided for positioning the car. Fast and simple to install, Monobolt is a This system has been designed for the joining of composite panels of plywood and glassreinforced plastic to metal framing. These are used in diecut flat sheet forms for attachment to moulded carpets, floor boot mats and as anti-rattle pads. Special forms are available to suit
these processes (Figure 16.9). 3 Give an example where resistance welding is used in vehicle manufacture. Cracks, Figure 14.115 Using ultraviolet lamp to cure resin (Glas-Weld Systems (UK) Ltd ) splits, warping and even the loss of material from plastic components can be remedied with the aid of the Leister Triac hot air welding equipment. 4 When
repairing relatively flat surfaces which are near vertical, it is easier to impregnate the chopped strand mat with polyester resin on the bench. 2 Carry out any necessary masking. The generator is specially designed for welding purposes so that it generates about 60 volts on open circuit; this drops to about 20 volts immediately the arc is struck. 2 A
soldering iron that has been tinned and heated to the correct temperature. The main use of this stool is to assist in the final planishing of the work. It is used to identify the sequence and direction in which the damage occurred, and consequently the reverse sequence to be followed for the repair. The shallow head gives highly desirable minimum
clearance between panels. Apply the soldering iron loaded with solder to the face of the workpiece or joint which has previously been smeared with flux. The tools required are as follows: Wire brush and scraper are used in preparing the panel prior to shrinking. Electric windows Most electric windows are operated by a small electric
motor and a continuous cable system. 4 Once steaming has stopped, observe from a safe distance whether the surface of the cylinder remains wetted. Cantrail The longitudinal framing of the roof at the joint. It is powered by compressed air with controllable speeds, and has a removable cutting drill supplied in two sizes, 6 mm and 8 mm; the depth of
cut is also adjustable. To cater for mechanicals in requirements two sets of holes Celette UK Metro 2000 measuring system This is a universal diagnostic and repair measuring system based on simultaneous three-dimensional verification of important points of the vehicle. Treat exposed metal with phosphating solution. Low-carbon steel thicknesses
used in this unitary construction range from 0.8-1 mm for skin or floor panels to 3 mm for major structural pressings such as suspension brackets. (c) Depending on condition. (e) Threaded coupling. Generally it is not possible to apply paint by spray as supplied by the paint manufacturers. It is always a good idea to keep a notepad to help remind you
which way round things go when working on unfamiliar vehicles, this would also be useful for making any other notes, such as those about an accident. Plastisols Based on PVC dispersions. 5 Quality performance will improve customer satisfaction. Swage line A design line on a vehicle body, caused by a crease or step in a panel. If the bonnet is too far
coating on the rods usually consists of a mixture of chloride and fluorides though other salts may be present. The electrodes which conduct the current and apply the pressure are made of low-resistance copper alloy and are usually hollow to facilitate water cooling. Hydrogen Cylinder colour: bright red. Paint mixing and equipment cleaning are to
hazards). Vehicles are also run through water tests (Figure 1.25) and subjected to extreme climatic temperature changes to confirm their durability. Do not move the torch ahead of the puddle, but slowly work forward, giving the metal a chance to melt. 3 Define the terms 'visible damage' and 'concealed damage'. A small percentage are thermoplastic
states. Use only a light pressure when sanding, especially on the bare metal. A patent fibreform process has been developed by Lotus to provide preformed fibre reinforcement which is self-locating inside the VARI tools during the moulding process. Cut the scarf with the slope on the opposite face to that Figure 16.37 Scarfing the laminate Figure
16.36 Removing damaged laminate Figure 16.38 Applying release medium and temporary moulds Reinforced composite materials 565 6 The temporary moulds can be held in place with self-adhesive tape, by wedging, or by packing to a curve with struts and wadding. They generate considerable air movement which can create dust problems. Both
types offer barrier and sacrificial corrosion protection, and the choice of product depends on the particular application and requirements. Compressed air, electrical power points, warm water, a workbench and storage cupboards should be available (Figure 14.126). Questions 1 What would the following alloy steels be used for: (a) high-tensile steel
(b) manganese steel (c) chrome-vanadium steel? The use of this material for all exposed corners of the car helps to reduce minor body damage repair (see Figure 16.22h). The size of the individual sockets in a set depends on the drive size of the individual sockets in the set. This test is similar to many road accidents where one car
hits another car, or another object, offset to one side. Each laser beam strikes a reflective material in the end of the body scanner housing, which activates a counter when the laser light is reflected back to the hub. Release agents Wash down with water. Occasionally the spray painter may be called upon to repaint a motor car on which the paintwork
is in excellent condition, the customer simply desiring a change of colour. Bending your back whilst lifting can cause back injury. Accuracy is therefore essential, and can be achieved by holding a finger in the low spot and lightly tapping the underside of the panel with the rounded corner of the dolly until you feel that it is exactly beneath your finger,
then strike a sharp blow and raise the metal at this point. Typical operating frequencies are 50-100 droplets per second. Glass fibre is one of the strongest of all materials. To allow the paper to drop on to the jig, the paper is slit at suitable points, the edges then opening out to let the pattern fall into position (Figure 13.12). There are limitations to the
depth which can be obtained by hollowing. Always refer to the relevant safety standards for compressed gases (see Chapter 2). These systems were designed and developed to cope with the ever-increasing call on the accident repair trade. When the bonnet is closed the gap all around it should be uniform; if it is not, misalignment exists. The
to the damaged part. Reference is made to coach painting in the diary of Samuel Pepys, in which he makes mention of the buying and repairing of a second-hand horse-drawn carriage. In addition regular testing will demonstrate the skill and ability of body technicians to maintain a high quality of weld standard in all types of crash repair work carried
out by their company. 4 In the case of a gas leak, turn off the gas supply. Planning and specifying bodyshop lighting requirements are an extremely complex and technical subject because many factors have to be considered in conjunction with calculations. Throughout the pulling process the gauges show the centre line and datum plane gradually
Major accident damage 433 Figure 14.48 Self-centring gauge showing measurement window (Chief Automotive Ltd.) becoming aligned until they read central. The story starts with molten glass, heated in a modern furnace. The object of forming the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the metal which may result in splitting or distorting the swage in gradual stages is to avoid strain on the swage in gradual stages in gra
panel. Next the casing is hardened by reheating the steel to just under 800 °C and then quenching it in water or oil. The specimen is placed on support rollers and the centre point of the former is brought into contact with the weld face or root. By installing radiant heaters above a cold concrete floor, there will be a transfer of IR radiant energy
downwards towards the cold concrete, which will absorb energy until it becomes warm. With approximately 15 000 separate parts, the car is the most complicated piece of equipment built using mass production methods. 5 Drop the bending blade to its normal position and open the clamping handles, which will release the work. It can assess both
mechanical and structural 228 Repair of Vehicle Bodies joints and is specifically intended to cover such individual issues as: the assembly of lap, sandwich, honeycomb, and butt joints; the fittings and pipes, together with the use of
adhesive related sealing compounds. Heating plastics materials, or using solvents, or bonding agents, can give rise to volatile organic compounds (VOCs); breathing protection is obviously needed in this case. Step 3: If necessary for stick-on glass, hold the glass on with masking or painter's tape until the adhesive sets. Stage 1 is the monitoring stage
for recognizing the material (lowcarbon or HSLA steel) and for sensing through any Figure 10.17 Modes of spot weld failure (Motor Insurance Repair Research Centre) protective coatings, whilst judging how closely the clamped materials are fitting between the
electrodes which will form the joint. Table 12.2 gases Density of common welding Shielding Gas Density (kg/m3) Argon Helium Hydrogen Oxygen Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding The shielding Gas Density of common welding The shielding Gas Density of common welding Shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding The shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding The shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding Shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding Shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding Shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding Shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding Shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding Shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.977 Gas shielded arc welding Shielding Gas Density of Carbon dioxide 1.784 0.178 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.161 1.326 1.978 0.083 1.978 0.083 1.978 0.083 1.978 0.083 1.978 0.083 1.978 0.083 1.978 0.083 1.978 0.083 1.978 0.083 1.978 0.083 1.978 0.083
strand glass mat (CSM) is the most widely used form of reinforcement. If these were not removed they would have a harmful effect when the section is finally spray painted. Misalignment of the electrodes and incorrect pressure will also produce defective welds. Drip moulding A roof trough to direct water from door openings. The Victoria was a long
luxurious vehicle with a separate driving position and a large rear seat. This edge-to-edge wheeling will result in an evenly stretched panel surface. For example, anaerobics needs no pretreatment unless contamination is excessive. Pressure regulators Always treat a regulator carefully. 3 Do form joints from thick, rigid sections where possible. The
bar can be any length. Increasingly materials other than glass are being used to reinforce plastics, although often this is in addition to glass. When setting up the gauge bars are parallel. 513 See Chapters 13, 14 and 17 for further information
about the equipment. 142 Repair of Vehicle Bodies Sponge sealing rubbers can be provided with built-in ozone resistance by giving them a live skin of neoprene, and a further way of providing ozone resistance by giving them a live skin of neoprene, and a further way of provided with built-in ozone resistance by giving them a live skin of neoprene, and a further way of providing ozone resistance is to coat the rubber components with Hypalon; more recently, continuously extruded neoprene sponge has been adopted. Latching Welding
reduction in weight is achieved with the use of swaging (Figure 5.19). Chopped strand mats, made from fine chopped glass strands bonded with a powder of emulsion binder, are used in both areas (Owens-Corning Fiberglas) Figure 16.7 Manufacture of yarn (Owens-Corning Fiberglas) Figure 5.19).
16.6 Manufacture of chopped strands. The equipment can be grouped as follows: High-output units (approximately 50 amperes) operating on input voltages of 380/415 V three phase, fitted with water-cooled torches and operating on input voltages of 380/415 V three phase, fitted with water-cooled torches and operating on input voltages of 380/415 V three phase, fitted with water-cooled torches and operating with workshop air or special cutting gases (see Figure 9.28). Any repair should be allowed to 16.10 Common faults in
requirements, but the company will have until 1997 to do any necessary work. A waterless hand cleaner can be used when soap and water are not avail- 14 15 16 17 18 able. This material should be overcoated with cellulose primer surfacer before applying the finishing material. The damage caused by heat can not always be seen from a visual
inspection. 46 Outline the procedure for mounting a vehicle on a jig using the MZ bracket system. The original shape will be maintained until the material is subject to a force sufficient to overcome the initial stresses. 23 Allocate financial and staff resources for carrying out the action plan. It is confined to wet paint films which are subjected to
moisture precipitation, forming an emulsion with the binder. Oxygen (O), nitrogen (N), chlorine (Cl) and sulphur (S) may also be present. The final action of the press is to
squeeze the surface together, thus setting up stresses and greater strength. Factories Act This sets out specific regulations relating of the working area, control of dust, fire escape provision, washing and toilet facilities and rest rooms. 29 Explain the necessity for
prototype testing. His responsibilities include the conception, detail, design and development of all new products, both visual and mechanical. Only a small percentage is used in the body building industry. Then, once the resistance is low enough, it will automatically carry out the second stage weld at the correct setting. An elastic blow will form
metal without undue stretching; indeed, metal can be thickened if desired, as in working out a tuck or pucker. Apply to one side of the metal in light gauge work (20 SWG) and both sides of the metal when working with heavy gauge (above 3 mm) for maximum protection. At this point both the high and low areas will show up. 19 Record the
assessments. A good body repair worker would probably be able to repair almost any part of a car damaged in a collision; however, the labour and time cost involved in attempting to repair extensively damaged panels would be an uneconomical proposition. 20 List the safety precautions to be observed before and during welding. These panels are
identified by corresponding stickers. Questions 1 What is the difference between alternating and direct currents? Always replace worn discs as soon as a tear is noticed; torn discs may catch in the work and twist the grinder out of your hands. Disconnecting the battery will usually also disconnect the alternator. 6 Turning circles should be based on a
medium/ large saloon car. Folding windshield. 38 Describe, with the aid of a sketch, a vector pull for correcting vehicle body alignment. 12.14 Welding stress and distortion in the MIG/MAG process The MIG/MAG welding process and its effectiveness may be measured by its ability to produce joints of acceptable quality. 2 Assess adequately any
hazardous operations that cannot be avoided. 17 With the aid of diagrams, describe the following defects made by MIG/MAG welding: (a) porosity (b) incomplete fusion (c) spatter on workpiece (d) poor penetration. This can be done without compromising the original design concept. 13.2 Shaping metal by hand Thin-gauge mild steel and light
aluminium sheet material up to 1.2 mm, and in some cases even 1.6 mm, can be satisfactorily hand beaten by wood Craft techniques and minor accident damage 343 mallets into double curvature forms (Figure 13.1). This is used for removing very stubborn grease and dirt, like that found on the underside of high mileage goods vehicles. Argon has
been more extensively used than helium because of a number of advantages: 1 Smoother, quieter arc action in the welding of such materials as aluminium with AC 4 Lower cost and greater availability 5 Lower flow rates for good shielding 6 Easier arc starting. In
calculating the amount of resin required for the repair, first weight the cut patches of chopped strand mat and activate three times this weight of resin. It is not sufficient to embed layers of glass tissue in polyester resin. Drag in newtons force is found by the formula: Drag 1/2 air density velocity squared frontal area coefficient of drag 1/2V2ACD
You will see that part of the formula is familiar, and part of it is the same as dynamic pressure, therefore: Drag dynamic pressure frontal area coefficient of drag is a number which indicates the resistance of the car to pass through the air, typical values are between 0.25 and 0.35. The resin then being used required high
moulding pressures and this led to a crushing of the fibres with a resulting loss in strength. Since only the metal within the direct path of the oxygen jet is acted upon, very accurate results can be obtained if close control is exercised; when hand cutting 150 mm thick steel, the working tolerance is about 1.5 mm (Figure 9.20). A workshop method of
hardening carbon tool steel is to heat the steel, using the forge or oxyacetylene blowtorch, to a dull red colour (see Table 5.3) and then quench it in water or oil. The full title is European New Car Assessment Programme. The cylinder valve outlet is screwed left-handed. Care should be taken not to penetrate more than two-thirds into the depth of the
           Loads could be heavy, and components may experience occasional shocks. It is only possible to freeze and de-frost the pre-preg a limited number of times so the material must be managed carefully. Slots cut into its outside edge give accurate wire gauge sizes, usually numbers 1 to 36 SWG or 0.2 to 10.0 mm. However, there are a number of
disadvantages. When the joint edges are heated they expand, and as welding proceeds, contraction of the deposited weld metal takes place owing to the loss of heat by radiation and condition. 3 Do NOT re-enter the building until your supervisor tells you that it is safe to do so. The slopes of the buckles surrounding the sharp creases will be fairly
elastic, but a greater amount of effort will be needed to reshape the sections of the panel which are made rigid either in manufacture or through accidental damage. The regulator is a reducing valve with which to reduce the air pressure from the compressor to that required for spraying. 11.6 Essential factors of arc welding 11.6.4 Correct current
France • Swedish Road Administration, government department - Sweden • Thatcham - representing British Motor Insurers - GB Figure 1.26 Three-dimensional graphics display of a scale model (Ford Motor Company Ltd ) • Department for Transport (DfT), government department - UK • Dutch Ministry of Transport, Public Works and Water
Management, government department - Holland EuroNCAP have a number of tests which vehicles are subjected to, the results of the tests are then subjected to a number of calculations which lead to star ratings. 3 Are the tyres properly inflated and of correct size and specification? A hydraulic push ram is mounted across the angle between the two
beams. Work methodically upwards (Figure 14.129). Electric resistance welding Questions 293 1 What is meant by the term 'resistance welding'? Light bumping hammer This (Figure 3.1c, d) tool is ideal for work on light gauge materials. The systems are
firm to give lateral support, leaving the seat pad softer and more comfortable. Do not permit heavy objects to fall or drop on the hose, as a sharp, hard impact may kink the wire strands in the hose, as a sharp, hard impact may kink the wire strands in the hose. With the aid of flux, the melted alloy flows between the parts to be joined due to capillary attraction, and actually diffuses into the surface of the metal, so
that a strong joint is produced when the alloy cools. Spray cellulose primer surfacer, thinned 1:1 to 19-22 seconds viscosity. As the roughing out proceeds, weld any tears in the metal so as to gain rigid panel as soon as possible. The welding rod, however, should be pushed well into the crack. This would harden the article ready for tempering.
Templates can also be made up before the old sections are cut out to check alignment and curvature when fitting the new section. The torch is connected to a wire feed and control unit by means of: 1 A flexible armoured tube carrying the shielding gas 3 A pair of plastic tubes carrying to cooling water, the
return tube often carrying the welding supply to cool the welding supply to cool the welding should now be repaired using hand tools and the conventional techniques of planishing or filling. • Mechanical properties - particularly
tensile strength and stiffness. Lay the windscreen on a bench, suitably covered to prevent scratching, so that the curved ends are pointing upwards and in this position the metal channel on the weatherstrip (Figure 14.106). Because of their universal anchorage, this the curved ends are pointing upwards and in this position the pull cords used to seat the rubber lip over the body flange can be inserted into the metal channel on the weatherstrip (Figure 14.106).
functional system may be used in any repair situation, regardless of the make or model of vehicle being repaired. Record assessment A record must be kept of all assessments other than in the most simple cases that can be easily repeated (Table 15.1, Figure 15.13). 11 Give reasons why the car manufacturers are using zinc-coated steels. If this
evaporate during the drying process and consequently some of the liquid content of the paint vanishes. Spray double-header coat, thinned as before. Never attempt to look at the arc with the naked eye. These Eurobags, or facebags as they are now called, since their main function in Europe and the UK is to protect the face rather than the entire body
in the event of collision, are less complex than their USA counterparts. Both of these techniques have certain disadvantages. (c) When cold sprayed, thin 6:1 with white spirit or preferably with a thinner supplied by the paint manufacturer. Unidirectional cloth is one in which the strength is higher in one direction than the other, and balanced cloth is a complex than their USA counterparts.
Rimmed steel R Balanced steel B Killed steel Hot rolled on wide mills narrow mills Cold rolled on wide mills narrow mills Normalized Annealed K HR HS CR CS N A Low-carbon steel in which deoxidation has been controlled to produce an ingot having a rim or skin almost free from carbon and impurities, within which is a core where the impurities
are concentrated A steel in which processing has been controlled to produce an ingot with a structure between that of a rimmed and a killed steel. Spray guns must be thoroughly cleaned immediately after being used with polyester primer filler. In many ways glass fibre reinforced plastic can be compared to concrete, with the glass fibres performing
alternating current ampere aqueous film forming foam (fire fighting) bar BATNEEC BS BSI BCF 106 dyn/cm2; 105 N/m2; 0.98682 atm; 14.505 psi best available techniques not enabling excessive costs British Standard British Standard
carbon monoxide carbon dioxide Centigrade (Celsius) centimetre computer-aided design computer-aided manufacturing computer-aided man
a very limited application. The most common reinforcing material is glass, but other equally problematic materials may be used. Low-carbon steel is used for general constructional members. A material required to provide sound deadening and
undersealing properties will be applied to the underside of Metals and non-metals used in vehicle bodies Table 4.11 145 Sealers used in vehicle body repair work Type Base material Application Visible seams Polyurethane Extremely adherent sealant used on front and rear aprons, rear panel, engine compartment, bottom of boot, passenger
compartment, side panels, wheel arches, vehicle underbody, tank filler caps and wings. A coupé is a two-door, fixedroof, high-performance vehicle with similar styling but with two extra seats at the rear, and is sometimes referred to as a '2-plus-2' (Figure 1.6d). Ring spanner sets are available in AF 41 in to 114 in and metric 6 mm to 50 mm (Figure 1.6d).
3.36). Soak this head in clean water before use and keep damp during compounding. Figures 2.12a-c show various types of extinguisher. Hold the torch in the direction in which you are going to weld and at an angle of about 65° with the completed part of the weld. Apply three full coats of primer surfacer to the entire body. Safe systems of work
Hence panel drawing dies must go through a tryout period before production is possible. After this it is planished using normal techniques to achieve a smooth, undetectable joint. Even if wide temperature changes do occur in hot spray, the atomization and spray pattern is unaffected because the paint heater delivers the fluid at a controlled
temperature and therefore the viscosity remains constant. Figure 7.45 (a) Bolt (b) set screw (c) carriage bolt (European Industrial Services Ltd ) 7.6.6 Bolting Bolts are used extensively in the manufacture of motor vehicles, as components which are built in
sections and then bolted together can easily be dismantled for repair or replacement. In some designs the roof panel may have a sliding roof built in (Figure 1.47) or a flip-up detachable sunroof incorporated. From our brief look at the history of glass manufacture it is obvious that the curving of glass presents no problems; in fact the problem has
been to produce flat, optically perfect glass. Successful welding of light-gauge steel depends on three important conditions: 1 The close fitting of the edges to be welded 2 The right type and gauge of electrode 3 The accurate current adjustment. Perhaps the best protective pigment available to the craftsman was white lead, and he made full use of it.
Most of these are cutting chisels of various sizes, used for general dismantling, cutting rivets, nuts, bolts and the removal of spotwelded sections. Ergonomics Ergonomics is a fundamental component of the process of vehicle design. The most common welding problems are: 1 2 3 4 Residual stress and distortion Incorrect bead geometry and
appearance Defects Loss of properties. If this rag is not removed as the blank is shaped, it may tend to split from the edge of the rag. With most door repairs it is quicker to remove the door from the vehicle by releasing the check strap and then taking out the set screws in the door side of the hinges, or, if the hinge is welded, by knocking the hinge
 oin out. The trigger is released at the other edge of the panel but the stroke is carried on for a short distance before reversing for the second stroke. For ordinary butt or scart joints, extra reinforcement should be provided by lamination of extra layers of resin and glass over the joint on both sides; in general it is better to use overlapping
(Figure 16.26). 2.8.5 Suppliers' and manufacturers' instructions relating to safety and safe use of all equipment are followed Many pieces of garage equipment are marked 'only to be used by authorized personnel'. The book deals with the craft techniques needed for working with ferrous, non-ferrous metals and composite materials as well as with
materials joining technologies and the use of body- and re-finishing shop equipment and tools. The windscreen is fitted into the glass channel lip to be lifted, thus allowing the glass to slip easily into position. 5 Increased protection against car and contents thefts. Figure
12.38 Root concavity: suck-back (BOC Ltd ) Underfill and undercut If insufficient weld metal is deposited in the joint, the parent material may remain unfused and the joint may be underfilled (Figure 12.39a). A fairly liberal coat of stripper should be applied to the surface and allowed sufficient time to penetrate through the various layers of paint.
Figure 17.3 DeVilbiss Pulsafe breathing air kit showing half-mask and visor outfits (DeVilbiss Automotive Refinishing Products) Automotive Refinishing and refinishing are tis common practice in most refinishing are tis common practice in most refinishing and refinishing are tis common practice.
Open the upper blade by pushing the clamping handles backwards. 3 Wipe the surface down with a proprietary spirit wipe or a mixture of methylated spirit and water. As well as the standard size drills there is a special drill called an angle drill, which is extremely useful in bodywork as it can be used in confined spaces and enables many otherwise
impossible drilling tasks to be carried out (Figure 3.52). 27 What is the main disadvantage of a combi-unit (spray booth and low-bake oven)? This has the effect of strengthening the metal in the area of the bend. 15 Suggest two reasons for a welding torch backfiring. 26 How do HVLP spray guns and VOCs relate to one another? When the front door is
hinged at the forward edge, provision has to be made in the front pillar for the door hinges, door check and courtesy light switches. All such factors should be taken into account in addition to any relevant legal requirements. Aluminium welding processes for use with aluminium. The more malleable and ductile the
material of the blank is, the more readily it can be formed; the less malleable and ductile, the more quickly does the metal work hardened thus need more frequent annealing. Argon is an inert gas. The capacity range for these models is: a 2 m blade, which will cut up to 1.2 mm; a 2.5 m blade, which will cut up to 1.00 mm; and a 1.25 m blade, which
will cut up to 1.6 mm. 30 State three problems which can arise if cellulose stopper is applied too heavily. When the wing forms an integral part of the housing around the wheel arch. Welding rods and fluxes Almost any copper-zinc alloy or copper-tin alloy or copper-phosphorus alloy (see
Table 8.2) can be used as a medium for such welding, but the consideration of costs, flowing qualities, strength and ductility of the deposit have led to the adoption of one general purpose 60-40 copper-zinc alloy with minor constituents incorporated to prevent zinc oxide forming and to improve fluidity and strength. The strength of the joint will be
dependent upon the wetted area between the parts to be joined. The mallet is normally used on aluminium and thingauge mild steel. The disc operates at a pressure of about 90 bar. This draws the bolt tight, clamping the sheets together. This multi-release interface chemically bonds to the mould's surface and forms on it a microthin layer of a
chemically resistant coating. The spray gun, like all tools, is only effective in the hands of a skilled operator, and therefore a painter should know as much as possible about what has become the main tool of the trade. Though undesirable in the normal painting of motor vehicles, cobwebbing can be used to advantage to obtain decorative effects. No
mixing Fast. The hose is made from oil-proof rubber reinforced by woven steel wire which is covered on the outside by a fabric and rubber combination (Figure 13.51). The force applied is sufficient to stress the metal beyond its elastic limit so that the change in shape is permanent. However, it is important to keep up to date with the latest
regulations. Lights Most light fittings are screwed to the front panel or wing. Alternatively it is possible to use a jig constructed to the correct size and shape, usually in wood. Power tools play an important part in the modern techniques used by the panel beater in the repairing of crash damage to motor vehicles. This type of flanging can be carried
out by using a swaging machine fitted with flanging rolls, which turns the metal edge at right angles as it is fed through the rolls. When the locating pin. Quick-release fasteners (quarter turn) consist of a stud, cam and an optional retaining washer. The ECU
may also be called by other names including ECM or 'brain'. It delivers a punch when hand pressure is applied to the knurled head. The type of weave will also influence the strength (due, in part, to the amount of crimp in the fabric), and usually satin weave fabrics, which have little crimp, give stronger laminates than plain weaves which have a
higher crimp. MIG/MAG welding is particularly high in ultraviolet radiation which can seriously affect the eyes. When a car has been damaged the relationship of the vital points, such as rear suspension spring hangers, front hub centres, and front suspension centres, must be checked on a flat floor surface with the vehicle jacked clear of the floor, all
four road wheels removed, and safety axle stands in position. HyResist 22/5 duplex is a highly alloyed austenitic/ferritic stainless steel. Special thinners are provided for etch primers and should be kept for this purpose only. The current adjuster is operated by turning a handwheel or crank. Keep the tools for use with aluminium bodies in an enclosed
tool box separate from those used on other vehicles. The dolly block is placed under the high spot formed by the stretched metal of the damaged panel and the panel is hammered down into the groove with hammer or mallet to form Craft techniques and minor accident damage 367 a valley, care being taken not to make the valley any longer or deeper
than is necessary to draw the stretched metal back to its original contour. They are characterized by high solids content and low solvent content, which results in high build and good scratch filling with the minimum number of coats, thus resulting in savings on labour time and overspray wastage. When ordering, have the factory paint color code to
match the parts, cautions Family Handyman. Step 1 to Replace the Entire Unit: Remove PanelsYou'll need to take the door panels and trim off the door if you're repairing a power mirror. This is done by relating the jig brackets to the corresponding holes on both the cross beams and the frame. 13.9.4 Shrinking equipment 13.10 Cold shrinking Cold
shrinking is another method of repairing stretched sections on vehicle body panels. Reynolds Number air density air velocity length of flow/air Viscosity Re 1 Drag is the aerodynamic resistance of the vehicle, its resistance to pass through air. Work hardening has the added effect of decreasing the malleability. Spray colour coats, thinned 1:1 to a
viscosity of 19-23 seconds, at a pressure of 3 bars (45 psi). Chromium Increased hardness and resistance to corrosion. Supply items are usually difficult to price because of the makers' fluctuating prices, and therefore they should be listed 'at cost'. Adjustment B provides for varying depth of cut so that only the upper panel is released (c), leaving the
original spot weld behind on the lower panel. Annealed: O The temper designation O applies to wrought products which are annealed to obtain the lowest strength condition. 6.3.4 Vee blocks These blocks are made in matching pairs, and have to be used in conjunction with a marking-off table. This patch must be tapped down below the panel level,
then filled with body solder or plastic filler to obtain the final finish. For wrought products there are no specified requirements for mechanical properties. Zinc should be worked while still hot, as it loses much of its malleability when cold. It is difficult to seal a wet vehicle because, if a fault is found, it cannot be rectified quickly before moving to
another area. In general low-carbon steel is used for all parts not requiring great strength or resistance to wear and not subject to high temperature or exposed to corrosion. Always disconnect the same lead last. Various sealants for windscreen replacement are available. The construction of the rails permits
limitless tiedown points. All other tools have been developed around these, giving us the specialist tools which are smaller in size and have two carrying handles. The symbol or text used on the sign must be black and
placed centrally on the background. One of the properties of steel is that, within certain limits, it is elastic: that is, if it is distorted by a load or force it will change shape, but it will return to its original shape when the force is removed. The front bumper/spoiler and rear bumper valance are flexible reinforced polyurethane mouldings resistant to
damage from minor knocks. Use the same colour coding system and store them separately under covers. Moisture penetrates through the metal to the paint film and causes it to swell at localized spots. This is a two-part product which has been developed to meet the specific requirements of the car repairer. The best way to do this is with a computer
control system. Among the many shapes available in this composite material are lorry cabs, bus front Renault have designed a high-rise car which has a skeletal steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, bus front Renault have designed a high-rise car which has a skeletal steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, bus front Renault have designed a high-rise car which has a skeletal steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, bus front Renault have designed a high-rise car which has a skeletal steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, bus front Renault have designed a high-rise car which has a skeletal steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, bus front Renault have designed a high-rise car which has a skeletal steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, bus front Renault have designed a high-rise car which has a skeletal steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, bus front Renault have designed a high-rise car which has a skeletal steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, but a steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, but a steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, but a steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, but a steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, but a steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, but a steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, but a steel body shell (Figure 1.38, clad entirely with composite material are lorry cabs, but a steel body shell (Figure 1.38, clad entirely with cabs, but a steel body shell (
Side View Mirror's GlassIf it's just the glass that's cracked, chipped or otherwise damaged, it's an easy fix. When it comes to repairing a body which has been damaged or distorted in an accident it is only logical that accurate alignment jigs should be used to ensure a safe, roadworthy repair and one which has the appearance of a new vehicle. Several
local authorities, for instance Surrey and Hampshire, are now looking at ways of using the energy produced by burning waste material to produce electricity. Hand polish small areas, corners, edges (Figure 14.135). 4 Finish preparation of area to be repaired by sanding or filing a scarf edge to the laminate. Correction in Major accident damage 465
most cases can be made by diagonal pushing with the body jack within the aperture. Brushing activators are available for those shops where spray painting is not practical. Extra fine cut clades are 17 tpi and suitable for cast iron, steel or any narrow section of metal. The contour of the parts changes irregularly, causing a wide variation of stresses;
for example, wrinkling or excess of metal may occur in one section while the metal tends to cause tears in other sections. Figure 12.36 Excessive penetration on the underside of a full penetration weld. Knowledge and experience come with study
and time, but without the right tools, even the best body worker cannot carry out quality repair work. Apply the tinning compound by brushing it over the cleaned section so that an area slightly larger than that to be soldered 368 Repair of Vehicle Bodies is covered with tinning paste. All dismantled mechanical and body trim parts can be
reassembled, including any necessary replacements to windscreen, rear window and door windows. It increases as the electrode size is increased and it should also be increased as the weld progresses in order to allow for the rise in temperature of the parent metal. If the minerals are close together the abrasive is close coated. The order of hardness
of various metals is as follows: high-carbon steel, white cast iron, cast iron, mild steel, copper, aluminium, zinc, tin, lead. This is done by pickling the coils in either dilute hydrochloric acid or dilute sulphuric acid and then washing them in hot water to remove the acid. The history, development and construction of the car body 29 Figure 1.27 Finite-
element structural analysis (Ford Motor Company Ltd ) Front impact test Frontal impact test Frontal impact takes place at 64 kph (40 mph) when a car strikes a deformable barrier that is offset (Figure 1.28a). BLMC, Rootes, Standard, Triumph and Rover followed suit by changing most of their colours to the acrylic range. Processes: oxy-acetylene welding, manual metal
arc welding, inert gas metal arc welding. It has been designed to act as a shrinking dolly when used in combination with a shrinking hammer and the application of heat. Pitch of rivets In load-bearing joints the distance between rivets in the same row should not exceed six times the rivet diameter. Not only is this painful but it can, in extreme cases,
cause loss of sight. Moreover, at a given cruising speed, the more streamlined vehicle has more power left available for acceleration: this is a safety factor. 17.10.3 Spraying external corners Figure 17.33 shows the method of spraying the edges and corners of a panel, the centre being sprayed like a plain panel. Replacement time schedules A number
of tables are available for each vehicle, these give single panel times and combination panel times. Owing to the inaccuracy of this system, the drop-line method has been superseded by the use of alignment jigs, using either a bracket alignment check
system or a universal measuring system. More simply, it refers to the thickness or otherwise of a fluid such as paint. Dust respiratory protection is the disposable filtering half-mask, typically used when preparing or finishing bodywork such as by rubbing down or buffing, and where dust, mist and fumes are
a problem. The end of the tool is recessed to fit over the joint formed when the edges of the two pieces of metal are prebent into a U-shape and interlocked. With this tool, windows bonded in with polyurethane adhesive can be taken out without difficulty. Tap lightly at the dolly to obtain the feel of metal to metal, and check for control of force of blow;
each blow will give a metallic ring which should be the same for each stroke of the hammer. An oxidizing flame is only used for special applications, and should always be avoided when welding steel, because it causes rapid oxidation of the metal. The difference in the faces stops the panel surface being marked with the edge of the hammer when used
in conjunction with the dolly block. 81 class D black, blue or green cream or blue blue, but it must be an inert dry powder Liquid and gas fires are easily spread by using water, water can also conduct electricity. Use of controls: Regulation 8 Employees
shall make full and proper use of the controls provided. T should not exceed 10 mm This method of preparation avoids the use of a separate filler wire and is suitable mainly for machine welding applications. Further resin is applied, usually by brush, and carefully cut-out pieces of mat or woven cloth are laid in position. 4 Wet flat stopper with 320-
P400 grade paper, dry off and tack off. 5454 B 0.25 0.40 0.10 0.50-1.0 2.4-3.0 0.05-0.20 - 0.25 - 0.20 0.05 0.15 Rem. When the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the metal is at the proper temperature the bronze spreads out evenly over the bronze spreads out evenly over the bronze spreads out evenly over the
and sockets, ensure that only one plug is used in one socket. A good hot melt adhesive or sealant Procedure Repeat degreasing After abrasion, repeat degreasing After etching wash thoroughly in cold running distilled (or deionized) water must exhibit six properties: high physical strength; a degree of flexibility to cater for differential movements in
joints and vibrational stresses; good specific adhesion; a melt temperature well above maximum Figure 7.66 Adhesive joint design (Permabond Adhesives Ltd.) 232 Repair of Vehicle Bodies service temperature; a low viscosity at the application temperature; and a good substrate wetting. 52 Why are radiator grilles shaped differently on different
makes of cars? (d) Clearance 5.5 mm, obtained by the diameter of locking pin (1) with the components in contact with one another. Livesey 2000 Copyright © 2006, A. Pack into drums, seal and store prior to collection by specialized chemical disposal company. Oxidation Chemical reaction between oxygen and some other element resulting in oxides.
Copes with contamination well. The figure also shows the paint and trim codes which are usually included on the VIN plate. This can be done by chipping, machining, filing or grinding. Spray gun testing must be into an extracted area. In such cases it may be necessary to base the design upon the known performance of a similar structure and to
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produce a prototype moulding for testing under service conditions. Toughened adhesives Toughened variants are hailed as a breakthrough in adhesive technology. Typically ECUs are used for the engine management system, the ABS, the security system and electronically controlled transmission systems. Never use gas from a cylinder which has no
label; return the cylinder to the supplier. The foot pumps actuate the ram units which in turn tension the chains and slowly pull out the damaged section to its original position. Questions 1 Describe, with the aid of sketches, the processes of hollowing and raising. Gas metal arc welding (GMAW) This is the terminology used in America and many parts
of Europe for the MIG/MAG welding processes, and it is becoming increasingly accepted as the standard terminology for these processes. Look for signs of rubbing or scraping by the bottom edges of the door on the sill panels or centre pillar. Its function is to build up the coating thickness, whilst filling up minor defects such as scratches. This change
is the result of the need to reduce body weight and cost per unit of the total vehicle. Reheat the bit until a green flame forms around it, again taking care not to overheat it and destroy the tinning on its surface. 4 Connect the earth lead, ensuring as good a contact as possible to the workpiece (if necessary, clean off any surface coating rust). 5 Glass
fibre mat, precut to exact size, is laid on the mould and a further small quantity of resin is poured on to the mat. Because of its high lead content, its wetting properties are very inferior and the surfaces usually have to be tinned with a solder of higher tin content first. The process begins with the issue of drawing office instructions to the experimental
prototype workshop. 6 Keep the person warm with a blanket or coat. One is based around EC Directives and provides for the approval of whole vehicles, vehicle systems and separate components. PVAL is available as a soultion in water or solvent, or as a concentrate which has to be diluted, and it may be in either coloured or colourless form. 0.5 mm
0.8 mm 1.3 mm 2.6 mm 3.0 mm 12.5 mm thick (N/mm2) min. The lifting capacity of the jig lifts ranges from 2.5 tonnes to 3 tonnes, and so large cars and light commercial vehicles can be worked on. The rule of the bodyshop is flexibility. 18 What is the minimum carbon content required for steel which will be hardened by heat treatment? Coupé
limousine A vehicle having a totally enclosed rear compartment and the front driving position closed on the sides only. This method is normally used by panel beaters in smoothing and finalizing new work; it can also be used by body repair workers, but the difficulty arises that the panel has to be dismantled and removed from the body shell, and is
therefore an uneconomical proposition. Other monomers form chains with side branches. Front-end damage is the result of head-on collision, collapsing panels from the bumper to the front bulkhead. Repair method Suppose a bumper to the front bulkhead. Repair method Suppose a bumper to the front bulkhead. Repair method Suppose a bumper to the front bulkhead. Repair method Suppose a bumper to the front bulkhead. Repair method Suppose a bumper to the front bulkhead. Repair method Suppose a bumper to the front bulkhead. Repair method Suppose a bumper to the front bulkhead.
Describe three different ways in which the surface of steel can be protected. Moulding properties can also be modified by the use of fillers; for example, shrinkage of the moulding during cure can be considerably reduced. The cellulose stoving enamel should be thinned with the converter thinner to a viscosity of 23 to 26 seconds with a BS B4 flow
cup. The instrument panel, which is usually considered as part of the cowl panel although it is a complex panel in itself, provides a mounting for the instruments necessary to check the performance of the vehicle during operation. In a case of minor repair the point of impact is now the lowest part of the damage. 6 List the necessary areas to be
considered for inclusion in a new workshop. If the work is being carried out in a shop where several vehicles are being refinished, it is advisable to store these fittings in boxes which should be Automotive finishing and refinished, it is advisable to store these fittings in boxes which should be Automotive finishing and refinished, it is advisable to store these fittings in boxes which should be Automotive finishing and refinished, it is advisable to store these fittings in boxes which should be Automotive finishing and refinishing and refinishing and refinishing and refinished, it is advisable to store these fittings in boxes which should be Automotive finishing and refinishing and refinish
hardened and tempered and ground to great accuracy. If possible, design the paint shop so that the vehicle moves forward in a relatively straight line or an easy loop, and try to keep it inside the workshop to avoid the problem of coming into contact with dirty, dusty air. Central locking may be operated with or without a key. Storage
at higher temperatures, even for only a few days, will considerably reduce the shelf life. The routing of vehicles is probably the most important feature of bodyshop layout. They also improve metal transfer and weld finish. Steel particles from tools and abrasives can cause corrosion to aluminium, so careful consideration must be given to every
possibility of cross contamination between tools and panels to prevent corrosion taking place. With its bottom sides or sill panels, wheel arches, cross members and heelboard, it is the strongest part of the whole body. Weld bonding are already standard procedures in many types of vehicle construction. The repairer must therefore
choose the repair system most appropriate to the degree of damage present. The arc length, defined as the distance between the tip of the electrode and the current used. Tacking off is essential before applying finishing coats. In the context of
bodyshops, the main problems are fillers and paint dust from the rubbing down and flatting processes, and welding fumes. The major difference between composite and integral construction is hence the design and construction of the floor (Figure 1.35). Remove the paint from all
the edges and weld in as in the previous examples (blow gun or soldering iron). Keep dipping the rod in the flux as the weld progresses forward. 7.7.4 Nut grip 7.7.5 Cable clip The nut grip (Figure 7.57) is used in a square hole and replaces costly welded cage nuts and similar fastenings. Dataliner drive-on rack system This system has been designed
to repair cars and small commercial vehicles. Glass is discussed separately in Section 16.4 • Adhesive properties - in relation to the type of fibres being used, and if metal inserts are to be used such as for body fitting. This may be obtained in the panel either by stretching the metal at these points until enough is obtained to meet the requirements, or
by welding in V-shaped pieces of metal. Any members which are beyond economical repair can be cut out and replaced with new sections by using a combination of power tools and MIG welding equipment. A range of interchangeable weld arms and electrodes of different shapes and lengths can be used to convert the standard gun instantly into the
special tool that a job may require (see Figure 10.19). When repairing a metallic finish, two options are available to the refinisher. To ensure passenger safety, all body apertures around the passenger area Figure 1.9 Crumple zones (Volvo Concessionaires Ltd.) should be reinforced by box-type profiles; seats should be secured rigidly to the floor; and
heavy interior padding should be used around the dashboard areas. Heat until bright red or to the preset time, then immediately cool with water. Calibrate To check irregularities in measuring instruments. Spraying The finishing material is thinned 7:2 and sprayed in one single coat followed by a double-header coat, with a 15 minute flash-off
between coats. The standard three-point seatbelt is defined as the primary restraint system. Do not put contaminated or oily rags in pockets or tuck them under a belt, as this can cause continuous skin contact. 4 Jigs, lifts and other panel bay movable equipment should be a minimum of 600 mm from any fixed obstruction to allow adequate safe
working distances. Press the trigger button once and release it. Risk grid One way to assess risks is to give both the severity of the hazard and the likelihood of occurrence, a factor between one and five. Figure 16.48 Poor adhesion of the gel coat (Scott Bader Co. Ltd.) 570 Repair of Vehicle Bodies 16.10.4 Fibre pattern The pattern of the composite
reinforcement is sometimes visible through the gel coat or prominently noticeable on its surface. Headlining The cloth or other material used to cover the inner surface of the car roof. Some mouldings are likely to stick if only PVAL is used. 16 Check all door apertures and rubber seals. The final dimensions of the interior and luggage space are shown
in a drawing, together with provision for the engine and remaining mechanical assemblies. A major feature of the Monobolt construction is the visible locking element which allows easy, visible inspection after placement (see Figure 7.32). systems. Spray painting can be quoted either by itemizing each part separately or by a complete price for the
total spray operation. Consequently there has been a growth in the development of measuring systems which can be used in a wide variety of repair situations with speed and accuracy. The same can of solvent left without a top and placed on the floor is likely to get kicked over, or the vapour could cause a fire. 5251 A 0.40 0.50 0.15 0.10-0.50 1.7-2.4
0.15 - 0.15 - 0.15 0.05 0.15 Rem. This is a mechanical distortion totally unconnected with the spot welding process; the same type of distortion would occur with rivets or with any similar localized joining method. An important factor is that heat can be used to relieve stress in correcting damaged sections that have been badly creased or buckled as a
result of impact. The tonnage specifications are usually determined by using a V-die opening of eight times the stock thickness, with a corner radius to the bend not less Figure 5.20 Brake press (Edwards Pearson Ltd ) than the metal thickness, with a corner radius to the bend not less Figure 5.20 Brake press (Edwards Pearson Ltd ) than the metal thickness.
materials, thus providing better surfaces for the finishing coats. The red lamps should not be illuminated. If the light stays on then the system has a fault. The basic building blocks of plastics are monomers. The design of a motor car body must, however, remain compatible with imperatives of production, of overall measurements and of inside
spaciousness. The hydraulic ram may be actuated either by a manual pump or by the air/hydraulic pump, which is quicker and leaves the operator with free hands. Start with the preparation area. Removal is usually simply unscrewing and unplugging the cable socket. Ceramic plaque heaters are silent in operation and are marketed
as being ideal for spot heating and for the heating of lofty uninsulated buildings which suffer high air movement. Each of these give white light similar to fluorescent, although not good enough for colour matching. It is often necessary for the
driver of such a vehicle to struggle constantly to maintain a straight course, and this becomes greater as the speed increases. 4 Only work on hard and level ground. Leather aprons are often used by beginners in order to protect their clothes (11.6), although most experienced welders seldom wear an apron on the job except in situations where there
may be an excessive amount of metal spatter resulting from awkward welding positions. 22 Explain the role of the stylist in the design organization. However, with any body alignment system, whether jig brackets or a measuring system, it is vital that the completion of repair should be followed by a full suspension and wheel alignment check to make
sure that the car is completely roadworthy. The replacement of the moulded headlining is a simple, straightforward operation because of its one-piece rigid structure. The element reacts with the carbon to produce fine particles which spread through the steel. Butt welds in thin-gauge materials are carried out with a progressive forward motion
without weaving, but a slightly different technique is required when tackling medium- and heavy-section plate. (f) Be extremely careful when working close to plastic fuel lines. It consists of a captive brass nut in a resilient neoprene bush which can be installed from one side of the workpiece using only a screw and a screwdriver (Figure 7.16). To
prevent a buildup of fumes and dust in the workshop the use of an extractor system is advised. In this case the windscreen opening, are merely part of the cowl panel. Any damage or leaks should be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be immediately reported to your supervisor or manager so that they can be imm
repaired. Care is necessary in handling the cylinders as any leak is liable to lead to fire, especially in confined spaces. Not only do these coatings help stabilize the arc, but they also perform the important functions of stopping oxidation of the heated electrode tip and molten workpiece. The basic packages are usually referred to as cakes and
Reinforced composite materials 535 Figure 16.2 Manufacture of glass fibre. That is, it now has a potential to cause a major injury and is very likely to happen. The paper used for masking purposes is a prime area of concern. If Automotive finishing and refinishing 581 these are widely spaced the paper is referred to as open coated and is used to
remove paint or rust which tend to fill up the spaces on finer grades. In ductile materials a special allowance must be made for wasting or reduction of original cross-sectional area. Conversion sets are also available for other jig benches. A thermoplastic is one which melts when it is heated up. Resin and gel mix The panels on GRP vehicles are
manufactured using different types of materials. 13.17.10 Miracle repairs Lifting and repairing damaged panels from the outside without removing interior trim or on otherwise blind sections can be done using Miracle tools (Figure 13.73). 6 It is best to store all cylinders upright, taking steps, particularly with round bottomed cylinders, to see that
they are secured to prevent them from falling. Then mask off the area surrounding the repair to reduce the sanding and clean-up time. Bumpers, door handles and trim strips are all cleverly made-up dummies, and the windows are made of Plexiglass. Let us have a look at the characteristics of the material, particularly its advantage over steel. In
addition there are plastic coated laminated or annealed safety glasses. The designer, engineer or fabricator of a particular component may think that stainless steel is going to be both difficult to work and expensive. The vehicle is
then subjected to an air stream of up to 112 mile/h; the sensitive balances register the effect of the headwind on the vehicle as it is either pressed down or lifted up from the floor, pushed to the left or right, or rotated about its longitudinal axis. Figure 14.124 Defective plastics welds and their causes (Welwyn Tool Co. Ltd ) (a) (b) (c) (d) (e) Weld
started correctly but completed too quickly: no wash, indicating haste or welding temperature too low Hot air tool not allowed to attain the correct welding temperature before starting, and weld finished too soon, leaving a hole Weld started too late with an unprepared welding rod end: hole and protrusion of plastic result Too much pressure applied
to the welding rod, leaving a low and deformed weld bead: filling may be necessary Welding temperature too hot for the material, blistering the sides of the weld; repair area may be brittle Duramix is a urethane composition. The greater the distance between the compressor and consumption points, the greater will be the pressure drop. Bordering on
the fusion zone is the zone of thermal disturbance, consisting of that portion of the parent metal which, although not melted by the flame, has been heated sufficiently to disturbance meet is known as the junction (Figure 9.14). A dot is used to locate the 12 o'clock position and a
dash to indicate the strength grade. Any person who is using a spray gun for the first time should obviously spray a few practice panels such as disused car doors, wings, bonnets and so on to get the feel of the gun before undertaking actual work. In this case, however, the dies, which are preheated, have to remain closed for the curing cycle of the
pre-impregnated mat, which may involve a period from 15 to 30 seconds. Where exposure exceeds this level, suitable hearing protection must be provided on request (Figure 2.10). Body file blades These flexible, double-sided blades are produced from a special alloy steel and heat treated. 6 Measuring and marking-out instruments 6.1 Marking out A
body repair worker must have a good general knowledge of engineering drawing and surface developments in order to mark out replacement parts on sheet metal, as this requires accurate calculation of sizes and angles. Mn max. When using a round-faced mallet the metal should be struck as squarely as possible to avoid wear on one side of the face
Clean the panel immediately before welding with a stainless steel Figure 13.74 Snip-off the studs (Courtesy of POWER-TEC ®) Applying a guide coat then using a long sanding block, as is used for filler, high spots can be identified without removing metal. For example, an alternative to using cellulose primer surfacer at stage 3 would be to use a
synthetic resin primer surfacer which has better build qualities and may be preferable on rough surfaces. The British Standards Institute defines safety glass indirectly as follows: 'All glass, including windscreen glass, shall be such that, in the event of shattering, the danger of personal injury is reduced to a minimum. 525 15.6.10 Workplace (Health
Safety and Welfare) Regulations 1992 The Regulations vill be insufficient to melt the plate and the molten pool will be small, resulting in lack of fusion (Figure 11.9). Figure 11.3 AC transformers and circuit (Murex Welding Processes
Ltd ) Manual metal arc welding 297 adjustable reactor in the output circuit of the transformer or by the adjustment of the internal reactance of the transformer. It can be placed very simply by manual or pneumatic tools. The hole is then filled with molten metal to form the plug. Robinson and W. The automotive stylist needs to be a combination of
artist, inventor, craftsman and engineer, with the ability to conceive new and imaginative ideas and to bring these ideas to economic reality by using up-to-date techniques and facilities. In making set-ups with the jack, always be careful to anchor the ram unit so that its pushing force will not tend to bend or break the hose fittings. Typical welding
defects and their causes are as follows (see Figure 14.124): Poor weld penetration or bonding Incorrect weld site preparation; welding speed too fast; temperature too low; weld attempted with dissimilar materials; poor technique. Where the third level is exceeded, steps must be taken to reduce noise levels as far as is reasonably practicable. 4 Tyre
pressure and wheels: check pressure and set to specifications; check for bent or eggshape rims. Since the blades are very narrow the sheet can be easily turned during cutting. Some of them are not explicitly mentioned in the general duties of the Health and Safety at Work Act. The zero plane is the most
basic but accurate of all available references, and is used The Mark 5 collision repair system This is a universal measuring system developed from the Mark 4 system. 606 Repair of Vehicle Bodies 6 Wet flat with P600 grade paper, rinse, dry off and tack off. Test with a solution of 1 per cent Teepol in water; apply with a brush. Hold the end of your
finger in the low spot. Check the vehicle when it comes in for signs of external corrosion or paint damage; 620 Repair of Vehicle Bodies if neglected it risks forfeiting the protection of any body warranty given. Coupé de ville A coupé having people
tend to fall into the trap of the generic term 'stainless steels'. After the impact, internal damage is caused by the forced movement of objects and passengers towards the point of impact, and can be seen in the form of damaged dash panels, broken seat frames and twisted steering wheels. It is recommended that the machine should be cleaned with
compressed air once yearly, or more frequently if it is used in dusty conditions. This offers the greatest advantages of all sideways movement of the vehicles. Rubber flooring generally has a vinyl coating to provide colour. Set the welding power dial. 16.11.5 Fire hazards Many resins and associated products are either flammable or contain flammable
additives. Another hazard is the electrical energy present in all car batteries. Burnishing and polishing is seldom required as these paints provide a good gloss from the gun. In the manufacture of vessels to contain liquids or gases under pressure it is not always possible to use metals with a high tensile strength; for instance, copper is chosen to make
domestic hot water storage cylinders because this metal has a high resistance to corrosion. The main advantages of brazing are: 1 The relatively low temperature (750-900 °C) necessary for a successful brazing job reduces the risk of distortion. These fillet welds may consist of T-joints or lap joints; in the former the parts are usually set at right angles
to one another, and in the latter the weld is made in the angle formed by the overlap. When all the shaping has been carried out, the next stage is to join these pieces by welding. It will be necessary to heat the panel to soften it to remove the dent and bring the panel back into shape and contour. Contact should be maintained between the nozzle and
the workpiece but, as with the tacking operation, no pressure should be applied with the gun. From 7.9 mm to 15.9 mm; 60° bevel, gap of 3.2 mm, and weld made in one pass. Parting is used when the blanks will not interlock perfectly. The arc form of welding, using the metallic electrodes, was discovered by Slavinoff in 1892, but had very little
success because of the use of bare metal electrodes. Table 15.1 Guide to safe working practices: to be filled in by the bodyshop. 3.15.6 Drill cutting attachment This is a drill attachment for cutting sheet metal up to 18 gauge (1.2 mm) mild steel and 16 gauge (1.6 mm) aluminium (Figure 3.31). When using the wheeling machine for wheeling
aluminium and its alloys, care should be taken not to put too much pressure on the work of raising the bottom wheel. Unless this is done, there is a risk of the welding current arcing between the contact nozzle and the gas nozzle to the workpiece, which could cause severe damage to the welding current arcing between the contact nozzle and the gas nozzle to the workpiece, which could cause severe damage to the welding current arcing between the contact nozzle and the gas nozzle to the workpiece, which could cause severe damage to the welding current arcing between the contact nozzle and the gas nozzle to the workpiece, which could cause severe damage to the welding current arcing between the contact nozzle and the gas nozzle to the workpiece, which could cause severe damage to the welding current arcing between the contact nozzle and the gas nozzle to the workpiece, which could cause severe damage to the workpiece and the gas nozzle to the workpiece.
meant by profile aerodynamic drag. The guillotine is probably the most widely used of the straight-line cutting Figure 5.7 Treadle operated guillotine (Selson Machine Tool Co. Ltd.) machines. All plastics have one important common property. Dust created during the sanding or sawing process is immediately extracted into a handy, easily emptied
vacuum pump. 28 With the aid of a sketch, explain how heat is generated to form the spot weld. This is necessary to remove buckles formed during annealing, to impart the appropriate surface texture to the strip, and to control the metallurgical properties of the strip. It is an ideal material in door shuts and as the gasket for window glass, and in both
instances it provides the means for excluding dust and water, although with windscreens and back-lights additional use has generally to be made of a sealing material. The characteristics of the rightward technique are as follows: Position Flat. 10.3 Resistance projection welding Projection welding (Figure 10.6) involves the joining of parts by a
resistance welding process which closely resembles spot welding. Low-carbon coil, strip and sheet steel have been used in the manufacture of car bodies and chassis members. Warning: the integrity of the vehicle's safety features can be impaired if incorrect windscreen replacement bonding materials and fitting instructions are used. The speed-weld
nozzle is fixed to the gun, and the temperature is again adjusted prior to carrying out the weld. If the distance between the gun and the painted surface varies, dark and light patches will result. Always carry, or handle, an airbag module so that it is kept in the upright position. Welding plastics does not produce fumes when the correct procedure is
followed. Intermittent or stitch welding may be used. Very often a layer of scum or a fine stain of 601 primer is left on the surface but this can be quite easily accessible to the secretarial staff employed by the 506 Repair of
Vehicle Bodies Figure 15.2 Bodyshop layouts (Martyn Ferguson, Dana Distribution Ltd.) Bodyshop planning company for the day-to-day clerical administration of the company. Craft techniques and minor accident damage 359 Figure 13.31 The techniques an
force, the panel will spring back almost to the contour it had prior to the damage. When spraying into narrow sections, the nozzle should enter the section 17.14.7 Acrylic lacquer: complete respray over an existing finish The method chosen here must
obviously depend on the condition of the paint film. Incorrect included angle would cause heavy steering and excessive tyre wear. In body repair work, panel beating is used to advantage where sections which are either unobtainable or uneconomical to replace completely can be fabricated by hand either in part or as a whole. The most commonly
used bonnet on later constructions is known as the mono or one-piece type, and can be opened by a variety of methods. The function of a solvent is merely to reduce the viscosity of the paint to assist its application to the work. This point is particularly important in residential areas. It is important to assert ain that the design of the unit being
considered is suitable for the area to be heated and will not cause any safety problems. As acrylic primer, though recommended, is not essential provided that the metal substrate has been properly prepared and treated with a phosphating solution. So, it became possible to carry out
calculations for large sections of the car very quickly. However, all three can be made to cure rapidly using a variety of techniques. The company should establishment, and all personnel should receive a copy. Their use often involves specialized
equipment and complex procedures. This stake is used for forming pipes and cylindrical workpieces. For more detailed information HSE Form 2508 should be completed. Some mallets have interchangeable heads so that the correct head can be used for the material being worked. A separate colour mixing room should be provided where possible
which has plenty of natural light and also has 'daylight' fluorescent lighting. The whole of the lower part of the structure is then sprayed over with a coat of chipproof underseal. Loss of tungsten in this manner will cause the arc to become erratic Gas shielded arc welding and unstable, and the electrode will certainly require to be replaced before
current range, polarity and power supply 7 Recommendations for special storage conditions 8 Any other significant information on electrode characteristics or limitations on use 9 Health warnings. Soldering and brazing are methods of joining components by lapping them together and using a low-melting point alloy so that the parent material is not
emulsions of mineral oils and water with the addition of an emulsifying agent. 4 Before interior cleaning, remove all loose carpets, tools, ashtrays and person for 'authorized transport purposes'. The unthreaded portion of the shank of the
bolt is intended for fitting into clearance holes, and a washer can be used to minimize the effect of Figure 7.46 Bolt identification. A uniform gap should exist between the sides of the bonnet and the wings. Check under all seats, glove box, door pockets. 25 State what is meant by 'VOCs'. More obscure areas such as ledges within wheel arches should
finishing stages. When the pressure has been adjusted to 10 psi, the air cap is removed and a more conventional type fitted (Figure 17.20). The resin polyvinyl chloride, the main ingredient of the coating based on polyvinyl chloride, the main ingredient of the coating based on polyvinyl chloride.
this country. 41 Describe two ways of locating a bonnet stay. It is suitable for application on all vehicle construction materials including wood. Hot press moulding using matched dies have good finish on both surfaces. The important point is that people come first and property second, although the amount of damage to the property should be kept to
the minimum. In the majority of straightening operations it is also necessary to use a hydraulic ram with special attachments in conjunction with the frame and body straightener to keep the metal. This is best done with soft yellow dusters rather than
mutton cloth, which can leave striations on the surface and spoil the finished effect. Carefully align the masking tape strips, then lower the screen into position. 34 With the aid of a sketch, illustrate and name a type of self-securing joint. An adjustment is provided to vary the open-circuit voltage so that welding can be done in different positions.
Figure 17.18 High-volume low-pressure (HVLP) cup gun (DeVilbiss Automotive Refinishing Products) Figure 17.22 HVLP gravity-fed
spray gun (DeVilbiss Automotive Refinishing Products) 17.8 Basic parts of a standard spray gun Air cap This is the nozzle at the front of the gun that directs compressed air into the stream of paint, thus atomizing it and forming the spray pattern. The utmost care must be taken when welding to ensure that there is adequate penetration, but not so
much as to leave unwanted surplus weld metal on the underside, while reinforcement on the face side should be slightly above the surface of the panel to allow the worn to protect the mouth and nose. There are two designs: inside calipers, which
have straight legs than turn outwards towards the points and are used for measuring bores and internal spaces; and outside calipers, which have curved legs that turn inwards towards the points, and which are used for external diameters and other outside
measurements. They are made in a very hard steel, and the head shapes available are round head and countersunk. Multipulling facilities for simultaneous repair over 360 degrees, and enough pulling power to cope with HSS. The heated end of the filler rod should always be kept within the influence of the shrouding argon gas in order to prevent its
oxidation. Hardening It has already been said that if a piece of steel is allowed to cool naturally after heating to above its upper critical point, it will change from austenite back to its original composition. 11 Fit the windscreen wiper finisher panel and air intake mouldings and the wiper arms and blades. Zinc-coated steel sheets are increasingly being
specified for automobile production, both for body and chassis parts, as improved corrosion protection is sought. The reverse sort of problem, that of a panel with a fullness or stretched area just in from the edge of the sheet, can also be overcome by wheeling. This means thick and strong over-trousers, coat, boots, gloves and a hat. Furniture should
be serviceable and comfortable without being elaborate, and sufficient to seat at least six people. The systems should actually be extraction and arrestment systems and should extract the pollutant materials and collect them in a safe and manageable form (Figure 15.6). When the final shaping and smoothing of the loaded area is complete it is
essential to remove all traces of soldering flux, oils and grease which may have been used during the loading operation. Further measuring during the repair will indicate when alignment is restored. With all mono constructed bodies, special attention must be given to certain load-bearing or structural members such as frame side members, inner
wheel arch panels, cowl areas, cross members and the floor pan that form a part of the emergency services operator will ask you which service you require. Heat The attainment of a certain temperature (once a fire has started it normally
maintains its own heat supply). Consequently the cars initially sold 12 Repair of Vehicle Bodies Figure 1.6 (c) estate (d) coupé (e) convertible 13 14 Repair of Vehicle Bodies Figure 1.6 (f) sports (g) limousine to the public mostly
resembled horse-drawn carriages with engines added. Sweating Uniting two or more metal surfaces by the use of heat and soft solder. (c) Cold sprayed: one light coat; allow 60 to 90 minutes before applying a doubleheader coat, but take care not to apply too wet a coating otherwise runs will result. It is of the utmost importance, therefore, first to
determine the extent of the collision damage to the underbody and then to correct it. 3 Do not cut containers which have held inflammable materials, tools and techniques which could have a significant impact on repair methods. Its
value lies in its long range and directional capability, so that the product can be directed precisely where pointed. These scale models can look convincingly real (Figure 1.14). As with any equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to read the instructions to enable the equipment it is important to enable the equip
and burn instantly from a spark 268 Repair of Vehicle Bodies or piece of hot metal. It is likely that early coach builders used putties of some kind - possibly paint fillers - to bridge joints in various applications on motor bodies, but it is generally conceded that the first use of specialized sealers on a large scale was in the early 1920s when, in America,
the pressed steel body became popular. The inner panel forms the lock pillar and also the hinge pillar section of the door. Multiply the factors to get a severity of risk. These paints consist of a base material and a catalyst or activator. It is almost pure resin and its object is to give a good finish as well as to protect the working surface from corrosion
and other damage. Vapours of chlorinated solvents can form the toxic gas phosgene when exposed to UV radiation from an electric arc. The highest proportion of any repair bill is made up of the cost of labour involved in stripping out to gain access to the damaged area, and rebuilding after replacement is effected. A certain amount of gun tilting is
usually unavoidable when reaching across a car roof and overspray is thus created. Thus the cheapest sound deadening materials are based on mixtures of sand and bitumen, although these tend to be brittle. 22 What is an HVLP spray gun? Maximum exposure limits must not be exceeded or employers may be prosecuted. When the finishers or
mouldings have been removed to expose the bonded area of the glass, the wire has to be fed through the bonding. It possesses a combination of adhesion, sealant and gap filling qualities; it is a one-component adhesive and sealing compound of permanent elasticity. Other manufacturers like DeVilbiss do not have restrictors in the guns and only need
25 psi at the inlet to give 10 psi at the cap (Figures 17.18 and 17.19). Mounted standard fluorescent fittings at a 45 degree angle are unsuitable as the disability glare and uneven light levels can effectively prevent even major faults from being seen (Figure 15.4). Hold the torch still until a pool of molten metal forms, then move the puddle across the
principles for selecting, providing, maintaining and using PPE. This can be provided on the sheet itself or by adding stiffening agents. Common nuts are: Hexagonal plain nut Used in all classes of engineering. These factors mean that in the assembly shop the operators (and drivers) can insert more screws in less time and with less fatigue. The figure
should represent the amount consumed in the process, i.e. lost through evaporation, spillage and transfer. Estate This type of vehicle is styled so that the rear seats are lowered (Figure 1.6c). Look out for the locking mechanism when working on vehicle doors. It was not until the
late 1930s, when all-steel bodies and unitary construction became a common feature of mass produced cars, that more thought was given to the prepainted skin panel is now placed over the frame and aligned using the door lock
holes as a guide, and MIG tacked on to the joint pillars if necessary. Possible hazards come in different forms. The cleaning authority must be satisfied that the proposed building will meet the standards set by the Building Regulations, the Town
and Country Planning Acts, the Fire Precaution Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations, the Storage and Use of Liquids and Gases Regulations a
beating trade since its infancy. These are limited too in that it is not possible to track heat travel to adjacent panels. In the event of the windscreen shattering, the driver shall still be able to see the road clearly so that he can brake and stop his vehicle safely.' Metals and non-metals used in vehicle bodies Two types of windscreen fulfil these
requirements - those made from heat-treated (or toughened) glass, and those of laminated glass. If the flame burns back far enough it may burst through the hose of the tower is fitted to the jig using four bolts into the modularly Major
accident damage 415 Figure 14.14 Use of the Celette UK) spaced holes. Access is generally good, and the essential services of gas, electricity, water, drains and telephone are already available. 49 Explain what is meant by the term 'universal jig bracket'. Figure 16.44 Refitting lower quarter panel by bonding (Lotus Engineering) 568
Repair of Vehicle Bodies Figure 16.45 Centring and aligning composite components using special clamps (Lotus Engineering) (a) Side components wing, front and rear door external panels, rear wing) are centred and aligned with respect to each other, using tools available in the form of a kit. Also make sure that the lower piece of metal is well
supported to allow pressure to be applied to the electrode by the operator. 26 What is meant by duty of care? Apply a sealer, then primer surfacer, then finishing coats to suit the plastic panel or bumper bar being repaired. The proper maintenance of the electrode tip face is therefore vital to ensure that effective current flow is produced. Spray either
three single coats or one single and one double-header coat at 4-5 bars (60-75 psi), allowing 15 minutes flash-off between coats and another 15 minutes flash-off betw
O-Liner (UK) Ltd ) Major accident damage 431 The data sheet files contain checklists for most car models and show height, length and width dimensions at a number of measuring points on the vehicle. The size of the square is the inside length of the blade. Front-wheel drive eliminates the driveshaft and tunnel and the occupants can sit more
comfortably. This paper produces copies of the drawing in white lines on a blue background. 15 Explain the changes which affect metal when heated and then cooled. It has been granted research status by 492 Repair of Vehicle Bodies the government, and is funded by levies on the members of the Association of British Insurers and Lloyd's Motor
Underwriters Association. The torch is tilted at an angle with the work surface to obtain plasma flow, and gradually straightened up until it lies flush with the workpiece when cutting. Training in how to use fire fighting equipment can stop a fire in its early stages. This allows the panels to be bolted directly to the supporting square-section steel tube
armatures located on the main chassis frame. There are a number of suppliers, manufacturers and independent consultants offering a range of planning, design and consultants offering a range of planning and consultants offering a range of planning area.
hour; however, at 60 °C full hardening is achieved in 30 minutes. 13.2.4 Split-and-weld system of shaping metal The introduction of welding into the panel beating, which is at once less laborious and much quicker than the older methods of hollowing and raising. Remove the paint
coating using 80-grit or finer abrasive. One of the objects of aerodynamic research is to reduce the latter: in other words to design a shape that will, for identical performance, require lower energy production. True structural adhesive Joint function Where a coaxial joint needs dismantling for maintenance, the weaker grades of anaerobic should be
used. The paint is charged with electricity and the shell is earthed through the conveyor. The excess rod is then trimmed off. The strength of this crowned surface can be used to support the surface being hammered without the use of a dolly. The guns can maintain a critical temperature Figure 14.116 Leister Triac electric welding tool and
accessories (Welwyn Tool Co. Ltd ) Major accident damage 475 surfaces is important. It is mounted on four robust wheels, allowing it to be easily moved around the workshop. New hoses in use for the first time should be blown through to remove any grit that may be present. maximum metal active gas (welding) metal inert gas (welding) metal
Identification of major body pressings The front-end assembly (Figure 1.45) is made up from the two front side member assemblies which are designed to carry the weight of the engine, suspension, steering gear and radiator. Blackhawk Automotive Ltd markets a hydraulic body jack under the name of Porto Power. When the Major accident damage
451 repairer is satisfied with the vehicle's performance and that all repairs have been completed, the vehicle will need refinishing to return it to its original factory finished condition (Figures 14.81-14.88). The current ranges recommended for different thicknesses will depend on the nature of the work and the size of the plate. Artificial ageing is
often called precipitation treatment; this refers to the precipitation of the two inter-metallic compounds responsible for the hardening, namely copper and manganese silicon. Increased production of polyester, although small compounds responsible for the hardening, namely copper and manganese silicon. Increased production of polyester, although small compounds responsible for the hardening, namely copper and manganese silicon.
combination competitive with traditional materials for the manufacture of many components. Depending on the type of equipment selected, the following functions are available: seam, spot, stitch and latching (four-cycle). The filler rod is usually held at an angle of about 15° to the surface of the work and slowly fed into the weld pool. Although
dissimilar metals can be joined by hard or soft soldering, corrosion may occur due to the electrolytic action between the two dissimilar metals in the presence of moisture. There are two types of generator: water to carbide, and carbide to water. The speed limit was raised to 12 mile/h and remained at that until 1903, when the 20 mile/h limit in built
up areas was introduced. Vehicle parts which are manufactured from light-gauge sheet brass, stainless steel, very thin mild steel, sheet products or components fabricated from nickel, bronze or copper, can be very effectively joined by silver soldering. 14.2.12 Car-O-Liner repair and measuring systems Car-O-Liner have introduced the Mark 5
alignment jig system together with a drive-on collision repair system called BenchRack and an electronic measuring system called Car-O-Tronic which can be used on both jigs. Aluminium of commercial purity contains at least 99 per cent aluminium, while higher grades contain 99.5-99.8 per cent of pure metal. It is still used by the body worker and
sheet metal worker, as metal sheet thickness may be given in SWG size. As pressure is increased the angle will continuously change in response to the pressure applied (Figure 14.90). Each process has its own limitations as to part size, shape, production rate, compatible resin Lotus Carsaver is increased the angle will continuously change in response to the pressure applied (Figure 14.90). Each process has its own characteristics, as well as its own characteristics, as well as its own characteristics.
Ltd Lotus have been producing reinforced composite motor cars since 1957. 7 Prepare the resin and, if working from the laminate, first paint the temporary moulds with a gel coat of activated resin and allow this to cure. Figure 17.75 Volumetric colour mixing machine In both systems the materials required to mix and match colours are
base colours, full-strength tinters, and reduced-strength tinters. Unless otherwise stated, the diameter of the former should be used when operating the following power tools: power saw, power chisel, disc sander. However, laminated glass is
being increasingly used on locations other than windscreens for reasons of vehicle security and also for passenger safety (containment in an accident), especially in estates with seating in the rear. This method of shaping metal which can be used in conjunction with hollowing and raising is that of
wheeling. Spot prime with acrylic primer filler. Spanners are drop forged and made from chrome-vanadium steels. This is done by a technique known as roughing out, which must be carried out prior to any finishing process such as direct hammering or planishing. Use fine jet matt black aerosol or small spray gun. At the end of the production line the
bonnet will rejoin the car, the underpanels and stone guards will be fitted, and the water system, oil and fuel will be checked. When welding is interspersed with pauses in this way, the average amount of added heat is reduced, which prevents any melting through on difficult welding jobs. It is usual to allow a safety factor of between 1:3 and 3:5,
depending upon the conditions of service. The finished silver soldered joint should be smooth, regular in shape and require no dressing up apart from the removal of the flux by washing in water. Wood, metal, or plastic tubing and folded cardboard can all be used successfully as formers. However, as the motor car increased in popularity and demand
for it grew, a new and faster method of production had to be found. This structure uses isophthalic polyester resin in conjunction with continuous filament mat. In the production of aluminium, the ore bauxite is crushed and screened, then washed and pumped under pressure into tanks and filtered into rotating drums, which are then heated. In this
capacity the gas fulfils the major function of the fluxes used as electrode coverings or deposited as an enveloping layer during welding with other processes. Tapes Adequate for bonding small components, but cannot support heavy loads. Panel head stake is shaped like a mushroom and is made in various sizes. 2.6 COSHH The Control of Substances
mirror housings, control knobs and winder handles as well as decorative metallic trim. To overcome this problem, Stanners 6 7 8 9 Set the weld timer dial. The equipment can be used with a mobile bench, which can be anchored to the slotted channel sections using chains and anchor blocks. If the blank holder pressure is too high, metal flow will
Figure 5.22 Metal movement during forming be restricted and excessive stretching will cause the cup side walls to break. Glass saloon A large closed vehicle similar to a double Berlina but with enlarged windows. This not only smothers the fire very rapidly, but is also non-toxic and is harmless to most delicate mechanisms and materials. If this device
a given performance than would be needed with argon. Where the material is heavier than 3 mm, V-ing of the welding edges is necessary to ensure penetration. Specific requirements will cover: 1 Guarding of dangerous parts of machinery (replacing the current law on this) 2 Protection against specific hazards, i.e. falling/ejected articles and
substances, rupture/ disintegration of work equipment parts, equipment parts, equipment parts, equipment parts and substances at high or very low temperatures 4 Control systems and control devices 5 Isolation of equipment parts and substances at high or very low temperatures 4 Control systems and control devices 5 Isolation of equipment parts and substances at high or very low temperatures 4 Control systems and control devices 5 Isolation of equipment parts and substances at high or very low temperatures 4 Control systems and control devices 5 Isolation of equipment parts and substances at high or very low temperatures 4 Control systems and control devices 5 Isolation of equipment parts and substances at high or very low temperatures 4 Control systems and control devices 5 Isolation of equipment parts and substances at high or very low temperatures 4 Control systems and control systems and control devices 5 Isolation of equipment parts and substances at high or very low temperatures 4 Control systems and control systems are systems and control systems and control systems are systems are systems and control systems are systems are systems.
of equipment 7 Lighting 8 Maintaining operations 9 Warnings and markings. 1 Base coat: acrylic/polyurethane synthetic Clear coat: two pack (2K) 2 Base coat: acrylic synthetic Clear coat: acrylic synthetic modules mounted on to a steel frame in the form of an arch. The bonnet is made by taking three pieces of flat aluminium which are
cut to shape, wheeled up, then welded into one piece and finished off by wheeling; this operation takes almost 30 hours and is very skilled indeed. It should be as even in thickness as possible, as thicker areas are very susceptible to accidental damage, while thin patches can lower the resistance of the structure to moisture and to chemical attack.
They consist of a pair of conical rolls, geared and mating together and acting as pinch rolls. The applications for a spoon (b) (c) (e) (d) Figure 3.8 (a) Surface spoon (b) general-purpose spoon (c) high-crowned spoon (d) drip moulding spoon (Sykes-Pickavant Ltd.) offering such different curves are many and
metal being tested. Each end is usually a different size. The primary coil receives the alternating current from the source of supply and creates a magnetic field which constantly changes in direction and strength. Formable HSSs were developed to allow the automotive industry to design weight out of the car in support of fuel economy targets. Data
sheets for the system use manufacturers' specifications and measurements. On the HSE website can be found lists of all the latest publications and news items on current developments as well as other relevant information. The repairer will make a visual inspection of the assessed damage, and from the knowledge gained complete a written itemized
estimate which he will submit as a tender to the insurance company. Bonding will not only overcome some of the assembly problems which such materials often present, but will give a stiffer and stronger structure than could be obtained from either riveting or welding. All bright surfaces should be kept clean and free from scours and blemishes that
could be transferred to the body panels. There is a great variety of solders, e.g. aluminium, bismuth, cadmium, silver, gold, pewterer's, plumber's, tinman's; solders are usually named according to the purpose for which they are intended. After the ramps have been used, they can be folded up and used as stands Major accident damage 429 Figure
 14.40 Blackhawk PB30 measuring system (Blackhawk Automotive Ltd.) or as a work stool, thus helping to keep the workshop free from additional equipment. Olive oil A thin oil such as olive oil is generally used as a flux for soldering pewter. Be very careful when dealing with air conditioning radiators and other parts. Faster repairs are achievable, a
vehicles can be loaded and off-loaded very quickly. The resulting damage can be classified into two groups: Direct or primary damage This results from the impact on the area in actual contact with the object causing the damage. However, methods have now been evolved which allow engineers to solve problems with complicated geometry on a
graphical display computer which can be constructed to resemble a body shape (Figure 1.26). In estimator's skill in assessing the damage, his knowledge and experience in repair techniques, and the capabilities of the equipment available. Shop floors are usually of cement; they are
generally moist and, therefore, relatively good conductors of electricity. 3 What is meant by a skin care system as used in the workshop? There is also the EEVC (European Enhanced Vehicle-safety Committee). The Italian designer, Michelotti, styled the Scimitar body so that separately moulded body panels could be used and overlapped to hide the
attachment points. The light levels for this area should be between 800 and 1100 lux. 13 Identify the correct colour code for the following fire extinguishers: water, foam, CO2, powder, halon. Automotive finishing and refinishing and refinishing the correct colour code for the following fire extinguishers: water, foam, CO2, powder, halon. Automotive finishing and refinishing and refinishing the correct colour code for the following fire extinguishers: water, foam, CO2, powder, halon. Automotive finishing and refinishing and refinishing the correct colour code for the following fire extinguishers: water, foam, CO2, powder, halon. Automotive finishing and refinishing and refinishing the correct colour code for the following fire extinguishers: water, foam, CO2, powder, halon. Automotive finishing and refinishing and refinishing the correct colour code for the following fire extinguishers: water, foam, CO2, powder, halon. Automotive finishing and refinishing the correct colour code for the following fire extinguishers:
13.45 A portable dispenser extruding correct amounts of filler to hardener (Bondaglass-Voss Ltd.) The technique of repair using this plastic filler is carried out by first roughing out the damaged area to as near the original shape as possible, or, if the Figure 13.46 Mixing the filler and catalyst (hardener) on a non-porous surface (Bondaglass-Voss Ltd.)
Figure 13.47 Applying filler to damaged area (Bondaglass-Voss Ltd.) Plastic filler should never be used over rusted areas without patching the area with new metal so that the filler is applied to a solid base. In drawing
however, total stretching of the metal occurs, with a correspondingly large amount of structural change within the metal itself. The horizontal distance between the two cutting members is called the clearance (Figure 5.6), 5.6 Cutting machines 5.6.1 Hand lever shears There are the simplest sheet metal working machines. If this method is used, care
must 384 Repair of Vehicle Bodies (a) (b) (c) (d) (e) (f) Craft techniques and minor accident damage 385 (g) (h) (i) Figure 13.63 Reskinning door panel: (a) removing flanges (b) removing flanges (c) grinding through flanges (d) removing flanges (e) grinding through flanges (f) removing flanges (g) soldering the pillar joints (h)
finishing panel edges (i) completed reskinned door (Motor Insurance Research Repair Centre) be taken not to damage the door frame. If the plunger will not move by pumping, withdraw it by hand. The scriber can be set at various height above the
surface of the marking-off table. It is often advantageous to use rivets which are longer than those recommended as they will set satisfactorily on thinner materials, and the longer length, when expanded, increases the grip of the rivet, but the higher cost for longer rivets should be taken into account before doing so. PPE is defined as all equipment
designed to be worn or held to protect against a risk to health or safety. It is essential to choose the correct amount, if the optimum properties of the final cured resin or laminate are to be obtained. 9.14.5 Safety General 1 Do not operate the machine with any of the panels removed. That is,
you should dedicate a new set of tools for aluminium repair use only. It is important to note that the blanks must interlock perfectly before a cut-off operation is carried out so that no scrap is produced during cutting. Next the arc is directed through the hole to penetrate the inner metal panel. Shapes and forms which are acceptable in steel vehicle
bodies can also be produced in composite materials. Bodyshop planning 6 7 8 9 10 11 12 Exhaust duct openings must not be fitted with plates, caps or cowls that could act as restrictors or deflectors. Catalyst A chemical substance which brings about a chemical substance with plates, caps or cowls that could act as restrictors or deflectors. Catalyst A chemical substance with plates, caps or cowls that could act as restrictors or deflectors.
often applied. After the curing cycle the vacuum is reversed and the tools open, releasing the moulded panel or body section. The V-type blade and interchangeable die is used extensively for forming light mild steel sheet components, from simple bends to complex multibends in panels or sheet metals (Figure 5.21). Depending on the relevant current
and voltage used, metal transfer between electrode and work takes place in the following distinct forms each of which has certain operational advantages (Figure 12.16). Each trolley is fitted with a half-bridge carrying the vertical pointers and measuring adaptors which allow location on various points of the vehicle's underbody, including horizontal
axis locations. 2 New substances are introduced. A car with a damaged or weakened underbody can be a menace to safety on the road. This mode of transfer occurs with steel wires at high currents in carbon dioxide, but is generally regarded as unusable unless high spatter levels can be tolerated. The majority of cylinders have a bursting Figure 9.4
Cylinder valve (BOC Ltd) Gas welding, gas cutting disc on the back of the cylinder valve opposite the spindle. The outer panels which make up the body shell should be referred to by the manufacturer's recognized names, such as: Near-side front door (NSF door) Near-side rear door (NSF door) Off-side front door (OSF door)
Off-side rear door (OSR door) Roof panel Boot lid Bonnet Near-side sill panel (NS sill panel) Off-side front wing (NSF wing) Near-side front wing (NSF wing) N
metals Mild steel Select the appropriate method and always use a neutral flame. Hole size Drill sizes for each diameter of rivet are usually specified by the manufacturers. For sound welds, it is important that the physical properties of the rod be similar to the base metal. Remove the bulk of the unwanted section by cutting it away with a power saw,
leaving an allowance of about 20 mm from the joint line, which can be trimmed to size when the pieces of the panels are separated. Because they are lacking in opacity, these paints are generally applied in several layers to achieve the desired effect of colour depth and an even distribution of the metal flakes. The difference between these points is
termed the critical range. 3 The molten glass flows out of the furnace through a forehearth to a series of fiberizing units usually referred to as bushings, each containing several hundreds of fine holes. The clay is placed on to the framework by professional model makers, who create the final outside shape of the body to an accuracy of 0.375 mm. Brass
and copper do not lend themselves to this method because the projections usually collapse under pressure. Then determine the most suitable point at which to make the joint: this will be influenced by the length of the weld, and the ease with which it can be dressed up. 7.8.1 Adhesive types
To facilitate the selection of adhesives, it is convenient to classify them into the following major groups (see Tables 7.2, 7.3 and 7.4): Figure 7.64 Edge fasteners, D type (TRW United-Carr Ltd.) being that of the weakest link. All floor panels are reinforced on the underside by stiffening members or cross members. The principal advantage of the two-
stage regulator is that the working pressure remains constant until the gas in the cylinder is exhausted, and little adjustment of gas flow is needed. This pressure is applied to the chain by extending the ram; this puts tension in the
chain, which in turn Major accident damage 453 Figure 14.89 Direct pulling (Kroll (UK) Ltd.) creates a pulling force on the damage. Bracketless universal systems offer certain advantages over the traditional fixed bracket systems. Goggles These should be worn at all times during welding, cutting or
merely observing. Unless the assessment is very simple, a written record will be needed. 6 What is meant by the term 'work hardened material'? The data sheets provide accurate measurements of vital control points for mechanical parts both in position and dismantled. Motor vehicle manufacturers are now extensively using highperformance
epoxides (often toughened) to supplement welded joints in their vehicles. This head is usually fitted with a spirit level and a scriber, which is contained in the head. 6 Metals have different conducting characteristics: copper, brass and aluminium conduct heat more rapidly than steel. The trainee body repairer can help the employer comply with this
Act by working in a clean and tidy manner and reporting any breakages, or shortages, immediately to the chargehand or senior technician. Four-door Denotes the type of saloon body having four doors. As competition to manufacture Europe's safest car 20 Repair of Vehicle Bodies (a) Figure 1.11 (a) Safety features included in the safety cage
(Vauxhall Motors Ltd) (b) Reinforced BC-pillar and anti-roll bar (Volvo Concessionaires Ltd) The history, development and construction of the car body 21 Figure 1.12 Driver's airbag system (Du Pont (UK) Ltd) increases, more manufacturers including those in the UK are starting to fit airbags. • Attempt to tamper, dismantle or repair any
components. As in the previous method the electrode is promptly raised a distance equal to its diameter, otherwise it will stick to the plate. When premoulded sheets are joined, edges are angled to give more bonding area. The stroke is started off the panel and the trigger is pulled when the gun reaches the edge of the panel. • Cost - the different
materials cost different prices. If the tool is allowed to tilt it is liable to make indentations on the area of the metal which has been riveted. Roll-over damage is caused by the vehicle rolling completely over and returning to its wheels. To facilitate a closer examination, it may be necessary to remove parts and mechanical components to determine the
extent of the damage. 4 Wet flat the whole vehicle with P600 grade paper, using liquid detergent or water miscible solution as a lubricant and to remove wax. It is important to note that if glass cloths or woven mat are used, it is possible to lay up the materials so that the reinforcement is in the direction of the greatest stresses, thus giving extra
strength to the entire fabrication. The rubber weather strip has two rebates, one for the glass and one to seat over the metal flange of the body aperture. The tubes can be used in special tools which can be either manually or pneumatically operated. The most common reinforcement material is glass. Most foot operated machines will cut up to 1.6 mm
metal. Planishing can be performed in three different ways. 3 Support for the company and liaison with the BSI and/or independent assessors and certification bodies. Width is compared with specifications by reading the scale through a convenient window on the top of the centre housing (see Figure 14.48). Resin and catalyst are premixed, so they
give high performance without mixing by the user. 1 The most popular sizes in common use are the 4 in (6.3 mm) pistol drill, and the 83 in and 12 in (9.5 mm and 12 in (9.5 mm and 12 in (9.5 mm) heavy-duty machines. Mallet or shrinking hammer. The number of counts the counter has made,
from when it was turned on by the beam striking the end 9 10 11 12 Target attachments Upper body bar Lower body bar Scales of the housing to when it is turned off by the beam striking the end 9 10 11 12 Target attachments Upper body bar Lower bod
rules which are referred to as steel tapes. 2 Spray two coats of primer filler thinned 1:1, 26 to 29 seconds at 25 °C. 29 List the types of adhesive that could be used by the body repairer. 1.5.7 Boot floor assembly This is a section of the floor between the seat panel and the extreme back of the boot. The code letters used by manufacturers outside the
SPI system are often registered trade marks, this creates legal problems as well as identification problems. Other alloys cannot be brazed because they start to melt at temperatures below that of any available brazing alloy. Cross filing means a change in the direction of the file strokes so that the file is moved at an angle between 45° and 90° over the
previous file strokes, thus checking the accuracy of the curvature in that direction. Also radiant heat absorbed by its surroundings does not easily escape through service doors: therefore heat loss is reduced and a saving is made on energy costs. 17.13.1 Preparation by using paint remover If the existing paintwork is in poor condition, or if the
damaged area is so extensive that the remaining paintwork on the damaged panel is not worth rubbing down, the existing finish can be removed with paint remover. Measuring rules can be adjustable or non-adjustable or non-adjustab
usually require an anaerobic. 584 Repair of Vehicle Bodies using an air hose of diameter 8 mm over the same length and at the same supplied pressure, the drop would only be 0.2 bar (3.5 psi). The vehicle is then passed over to the road test engineer who will run it for approximately 100 miles. It consists of a body and a stem and is supplied as a one-
piece assembly. 26 With the aid of a sketch, explain how plug welding is carried out in repair work. Stiffening is provided by the formed edge, the plastic moulding being used for decoration and also to render the edge safe. They require employers not only to assess risks from fire, but now to include the preparation of an evacuation plan, to train staff
in fire precautions, and to keep records. Threads on the vehicle exterior as well as smoke streams indicate the air flow, and enable test engineers to see where disturbance exists and where air flow, and therefore where reshaping of the body is necessary in order to produce better aerodynamics (Figures 1.19 and 1.20).
The first two noise action levels relate to exposure over a period (one day) and are intended to cater for the risks of prolonged work in noisy surroundings. All the systems are used with either a rubber weather strip moulding without a sealing compound (Figure 14.105b).
This is laid on the GRP surface and is laminated over to produce reinforcing ribs, which give added stiffness with little extra weight. Care must be taken not to rub through the colour coats, especially where projections exist in the vehicle construction. Distortion may result in unacceptable appearance (buckled body panels), prevention of subassembly
fabrication or the inability of the structure to perform its intended function (alignment of body panels after welding). During this time period the component should not be moved nor Table 16.7 Foam A variety of materials are used, one of the most common is foam. Moreover, numerous parts may be assembled or riveted together and will not suffer as
a result of the ageing treatment. A further check can be made by joining the sets of points transversely. 2.7 RIDDOR The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 require that certain information is reported to the Health and Safety Executive (HSE). The committee should consist of members with specialized
knowledge of the risks of a particular area, i.e. bodyshop, paint shop, parts department, offices. Figure 3.12 Panel pullers (Sykes-Pickavant Ltd.) Hand and power tools hole and screwing it until a firm grip is obtained. A short-circuit across the terminals of a battery can produce sufficient energy to form a weld and in turn heating, a prime source of
ignition. When shutting down, release the pressure on the control spring after the pressure in the hoses has been released. No matter how much technical data is available, in the final analysis it becomes a system of trial and error, with the spray painter trying out various spray gun set-ups, varying the air pressure, speed of gun stroke, and distance
from the surface. This is a positive system which allows the repairer to check and hold the most important underbody points on a vehicle. The curing sequence is completed under the action of temperature and pressure in matched die compression moulded tools to produce components which have three-dimensional form and a controllable degree of
rigidity. The nose of the tool is then pushed over the tail of the bolt and the catalysed resin and the catalysed resin is smoothed over the gel-coated mould.
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Care must be taken to avoid overstretching the metal by using too hard a blow. This also applies to the housing for the bottom wheel, enabling it to move in conjunction with the top wheel. Keep goggles clean and in good condition. Further brackets, for repair and panel assembly, are provided for fitting to the front and rear suspension and mechanical
pick-up points of any type of vehicle. Figure 17.37 shows a typical method, but this may vary depending on the size and shape Automotive finishing and refinishing 595 Figure 17.37 shows a typical method, but this may vary depending on the size and shape Automotive finishing and refinishing 595 Figure 17.37 shows a typical method, but this may vary depending on the size and shape Automotive finishing and refinishing 595 Figure 17.37 shows a typical method, but this may vary depending on the size and shape Automotive finishing 595 Figure 17.38 and 17.39).
usefully to the stiffness of the moulding. 7 What safety precautions should be taken if an acetylene cylinder was to take fire internally? The documents produced will be tailor made to your own letterhead stationery. Pneumatic or air operated hammers are used extensively for closing over rivet heads. 3 Never use anything but an oxy-acetylene welding
torch for heating a stretched section. When the film has been processed, any defect in the weld will show up as shadows in the photographic image. Always spray a sample card with the appropriate number of coats and allow it to dry before comparing it with the colour to be matched. With few exceptions they are of one-piece construction, sometimes
swept back as much as 65° from the vertical. 30 Describe how the plasma arc process can be used in vehicle body repair. Small reinforcement angles are usually used between the door. 2.8.18 Machines and equipment are isolated, where
appropriate, from the mains prior to cleaning and routine maintenance or repairs. Acetone has the remarkable property of being able to dissolve large volumes of acetylene gas. The strip is then carefully eased up
and pulled out slowly around the entire assembly. Health and safety (a) (b) (c) Figure 2.12 (a) Types of fire fighting equipment (UK Fire International Ltd.) (c) Portable fire extinguishers suitable for a bodyshop (Chubb Fire Ltd.) 69 70 Repair of Vehicle Bodies Foam extinguishers can be pressurized either by a
CO2 gas cartridge or by stored pressure. Concealed damage This is indirect damage, but is not easily detected by visual examination unless the vehicle has been partially dismantled to allow a detailed inspection. 9 Why is it dangerous to allow a detailed inspection. 9 with it dangerous to allow a detailed inspection. 9 why is it dangerous to allow a detailed inspection. 9 why is it dangerous to allow a detailed inspection.
causes damage to vegetation and can also cause serious breathing difficulties in humans and animals. The paint application industry is among the third largest group of environment polluters, and it is because of this that the EPA introduces many refinishing industry specific controls. To help you to choose the correct fire extinguisher, fires are
 classified into four classes: Class Description Colour of extinguisher class A fires of solid material, such as wood, paper, cloth, rubber fire of liquids, such as petrol, paraffin, brake fluid fires involving leaking gas such as acetylene, Calor or natural gas fires of metals which burn, such as magnesium and nickel red class B class C 2.8.14
Alarm/alert/evacuation systems are activated immediately by authorized persons Generally only senior staff (managers) are allowed to operate alarms and other forms of alert/evacuation systems. They are designed to be used in the hand with an on/off trigger control built in the handle. Wet flat surrounding paintwork with P400-P600 grade paper.
Brake fluid is a special hazard because if it is spilled on the vehicle's paint work it will soften the paint 77 stripper. Joint contact is maintained by tacking at 75-150 mm apart. 15.6.11 Risk assessment For every task which is carried out in the workshop a risk assessment should be carried out. Excess metal
then being carefully trimmed and the edge dressed up with hammer and dolly, the new panel is ready to be 458 Repair of Vehicle Bodies Figure 14.93 Wheel alignment (Sun Electric UK Ltd ) (a) Front wheel toe angle of the 
always be used, preferably Gas shielded arc welding of the helmet and visor type. Glass reinforced plastics are essentially a family of structural materials which utilize a very wide range of thermosetting resins. This hammering has the effect of sinking the metal into the sandbag, which is of course resilient to the blows. Skin fusion
has several advantages. Coarse blades have 14-16 teeth to 1 in (25.4 mm) and are used to cut soft metals; finer blades have 18-24 teeth to 1 in (25.4 mm) and are used to cut harder metals. 564 Repair of Vehicle Bodies from which work will be carried out. Dip transfer (short arc) This condition requires comparatively low current and voltage values.
 Never use a naked flame to trace leaks. (b) Not covered by British Standard (general engineering) specification. This is a safety device in the form of a nonreturnable valve which is fitted behind the welding torch and connected to the hose (Figure 9.12). 8 Then check the low spots, if any, by cross filing and raise them by further planishing or pick
hammering. The V-angle is smaller, less welding rod is required and there is less distortion. The actual cutting is done by the edge of the punch which is reciprocated at high speed, leaving a slot or channel in the metal. The SVA test station will then check that the vehicle aligns to the documentation presented. Figure 6.15 Drill gauge (Neill Tools Ltd
(Moore and Wright)) Measuring and marking-out instruments 193 6.3.3 Surface gauge or scribing block There are various types of surface gauges (metric) (Neill Tools Ltd (Moore and Wright)) The poorest grade is used for
marking out material appertaining to body work; it also supports the work during marking out, and is often used as a datum from which all measurements can be taken. This indicates a balance between Figure 10.1 Automatic spot welding using robots on body framing assembly line (Vauxhall Motors Ltd ) 278 Repair of Vehicle Bodies energy2 input
and weld time; therefore the faster the welding, the greater the clamping force. A collar of expanded metal mesh (for coarse metal screen) is tack-welded to a threaded pipe coupling. In other words it is the upward lifting force which is generated when passing horizontally through air. 13.16.1 Repairing rust damage In this work the body repairer
relies on his own judgement, skill and experience. At least eight such points should be selected, four on each side, which could include front and rear spring shackle bolts, or intersection of crossmembers common to both side members. With most machines three standard wheels are
supplied which are generally referred to as flat, medium and full curved. Chopped strands consist of continuous glass strands chopped to a desired length and are available with a wide veriety of surface treatments to ensure compatibility with most resin systems. Reinforced composite materials 571 Figure 16.51 Crazing (Scott Bader Co. Ltd ) Figure
16.53 Internal dry patch (Scott Bader Co. Ltd ) has not been adequately cured, or that it is an unsatisfactory resin for that particular application. A stoving room can be acquired which can be connected to an existing spray booth, or where workshop space is limited a combined spray booth and low-bake oven can be installed (Figure 17.52). The floor
panel itself prevents lozenging, and the joints between side members and cross members are designed to resist torsional stresses. It also eliminates the problem of heat Craft techniques and minor accident damage 369 (b) (a) (d) (c) (f) (e) Figure 13.43 Body soldering; (a) panel preparation (b) applying the tinning paste (c) heating the tinning paste
ready for soldering (d) applying the solder (e) forming the solder (e) forming the solder (Motor Insurance Repair Research Centre) 370 Repair of Vehicle Bodies distortion which can occur when solder filling flat body panels. The total toe is the sum of angles A and B. Underfill is usually avoided by careful placement and
operating technique. They are able to provide insurance engineers and repairers with essential repair information, often as soon as new vehicle models become available at the dealers. Tin has a melting point of 232 °C and lead 327 °C, but the alloy has a lower melting point than either of the two base metals and its lowest melting point is 183 °C; this
melting point may be raised by varying the percentage of lead or tin in the alloy (see Table 8.1). Best results are obtained if the paint is applied with a gravity-fed spray gun. The speed of the reactions will depend on the resin and the activity of the catalyst. The symbol displayed on the sign must be black and placed centrally on the background,
without obliterating the crossbar. 3 Many repairs are ruined by attempting to smooth off or polish before the resin is thoroughly cured. Thin toe dolly (a) (b) (a) (c) (g) Figure 3.7 (a) Thin toe dolly (b) angle dolly (c) utility dolly (d) general-purpose dolly (e) grid
dolly (f) double-ended dolly (g) curved dolly or comma block (Sykes-Pickavant Ltd ) 89 places where other dollies cannot be used. The overhead measuring system can help restore the upper part of the vehicle body to its original shape as on the data sheets. These should then be filled after the welding has been completed. Following application, can
be passed through drying ovens at a maximum temperature of 90 °C Particularly suitable for sealing joints, welded seams and butt joints on vehicle bodies. In an accident, it will absorb double the energy of a similar steel component. Degreasing Best done with a chlorinated solvent, except for sensitive materials. Single panels finished in a material
such as Bergers Standox 2K are baked in 4 to 5 minutes, whilst primers and fillers bake even faster. In this method, rovings are automatically fed through a chopping unit and the resultant chopped strands are blown or carried by the sprayed resin stream on to the mould. As to the future of motor vehicle finishing, it seems reasonable to expect water
borne paints to be developed to such an extent that they will become the accepted finish on new motor vehicles. General-purpose spoon (Figure 3.8b) is a doubleended body spoon and is also a basic item in most panel beaters' toolkits. 5 Explain the importance of entrances, roof supports and floor space when planning a workshop. The high proportion
of solvent used (60 per cent in most cases) results in shrinkage which causes the film to adhere poorly to the substrate. 2 Fuse rating - the fuse rating should be correct for the purpose as recommended by the equipment manufacturer. It should be noted that with the exception of tacking off and the actual application of the paint, all the process
stages should be done outside the spray booth. The first task is to remove any flashes or chrome strips that can easily be removed. Alignment and repair equipment permits several pulling set-ups to be made at one time. Both of these tools give an excellent fine cut edge suitable for instant rewelding without any dressing. The length of the tack weld is
determined by the thickness of the metal panel to be welded and is approximately a length of 15-30 times the thickness of the metal panel. In general the rear wing is an integral part of the body side frame assembly and rear quarter panel. The wired edge is still found to be a useful form of edge treatment on the wings of public service vehicles,
particularly where the wings are not integral with the body. Avoid dragging the cables over or around sharp corners. Porosity The presence of gas pockets or inclusions within a weld. Preparing door flanges should now be straightened up using a hammer and dolly and the face of the flanges sanded to make a smooth surface for the
attachment of the new skin panel. 28 Describe how you might account for waste paint products. This also saves painting time. The brazing process comprises the following steps: 1 Thoroughly clean the metal to be joined. Butt joints, where the adhesive is in tension. It is therefore necessary to use as low a current as possible when using the MIG/MAG
process on these thin panels. Additional structural rigidity and side impact protection is provided by steel cross-braces between the A-posts at the front and the B-posts at the rear (Figure 16.32). Bending rolls are sometimes used to repair flat aluminium panels by rolling them, then repairing them in this state, then rolling them flat again. 3.23.4 Dual-
 action sander Figure 3.55 Disc sander (Black and Decker Ltd ) solder prior to tinning; stripping paint prior to planishing or dressing out; dressing out; dressing off surplus weld metal after welding new sections; feather edging The dual action (DA) on this sander makes the pad oscillate counter-clockwise while the head revolves clockwise, resulting in a non-
repeating surface pattern that eliminates scratches on the surface of the panel (Figure 3.54). 280 Repair of Vehicle Bodies Spot welding torch comprises two needle valves (one for regulating the oxygen and the other the acetylene), a mixing chamber and an interchangeable welding
nozzle, all incorporated in a shank. The transverse contraction strain can be significant and, if the lowductility area along the centre line of the weld is unable to accommodate this strain, cracking takes place. Special POP rivets are shown in Figure 7.14. This test is called an angled side-swipe: the displacement is 27 degrees forward from the
perpendicular of the test vehicle's main axis. Coding example A typical classification for an electrode is therefore: E51 54 BB [160 3 0 H] the STC code is identified as follows: E51 strength of 28 J ($\geq 40\ ^\circ$C) Designation for tensile properties (British Standards Institution) Minimum
 elongation (%) Electrode designation digit Tensile strength (N/mm2) Minimum yield stress (N/mm2) When digit of Table 11.2 is 3, 4 or 5 E43— — E51— — 430-550 510-650 330 360 20 18 22 18 24 20 300 Repair of Vehicle Bodies Table 11.2 First digit for an impact value (British
J (\geqslant30 °C) BB covering (basic, high efficiency) The additional code, is as follows: 160 efficiency 3 welding positions 0 welding current and voltage conditions H hydrogen controlled Electrode dimensions and tolerances in all forms,
including gases, vapours, solids, dusts, liquids, and even micro-organisms. Care must be taken to check continually the shaping against the jig or former to see that no part is overshaped. Force Mass is to do with the number of atoms or molecules in a material. Semi-crystalline plastics have the following properties: High rigidity Hardness High heat
resistance Impact resistance Abrasion, chemical and stress crack resistance. Despite this the resin has the important task of transferring the stress from fibre to develop its full strength. The vehicle can be fastened in place on the bench using either four sill clamps or the modular cross beams. To set up the swaging
machine for operation, first select a pair of Wheels which will give the 178 Repair of Vehicle Bodies required section. The system traverses the full length Figure 14.53 Autorobot XLS II showing measurements to be taken at any point along its length
The bonnet consists of an outer panel and an inner reinforcement constructed in the H or cruciform pattern, which is spot welded to the outer skin panel at the flanged edges of the panels. The designs of all-steel body shells over the past years have provided many pockets which could be termed water or moisture traps, thus creating suitable
conditions for the rusting process. First the blank which is going to be shaped is cut to size and the edges trimmed for any rag by filing. To create double curvature on the same panel, stretching must take place in two opposing directions; therefore a second set of wheel tracks must cross the first set transversely, and this is achieved by turning the
panel through approximately 90° before making the second tracks. From the information provided by the customer the body repairer should be able to determine which area is the right one on which to concentrate. When the car body moves out of the tank, surplus paint drains out of it and the shell is then rinsed off under sprinklers, which does not
 affect the electrodeposited coating. 4.3.2 Micro-alloyed steel This steel is basically a carbon-manganese steel having a low carbon content, but with the addition of micro-alloying elements such as niobium and titanium. Then came the general use of celluloid for windows instead of side curtains, and next a raising and lowering mechanism for the
windows. The light intensity inside the spray booth should be in the region of 900-1200 lux and approximately the same at the sill level and the gutter line. 1 When would a body repairer need to make templates? In the case of the contraction of the solid metal the stress will be equal to the change in temperature as the metal cools from its meltingent and the gutter line.
point to its ambient temperature. 6 Replace all mechanical, trim and body parts. The swaging machine is used for swaging, wiring, joggling and closing sheet metal work edges. Research at Thatcham is divided into two stages. The centre screw jack allows preloading to put the restraining unit in tension. So, this time alone can be added to a
combination panel time for painting a larger combination of panels. This can be done by using a sanding machine with the right type of sanding disc until the area to be soldered is cleaned to the bare metal. When cutting it removes a continuous 3 mm strip from a panel without distortion. A special compound or a polish such as carnauba wax and/or
silicone lubricant can be used; plastics film is occasionally used as a separating membrane, as it will not adhere strongly to either the mould or t
swings after fracture is measured by a pointer on a dial calibrated in joules. The profile and diameter of the electrode face is dependent upon the material to be welded (Figure 10.14). However, efficiency is paramount in any workshop, and for this reason the location of tools, equipment, parts and personnel must be carefully organized. The semi-
crystalline products find major application in the automotive sector, where full use is made of the mechanical and thermal properties, together with abrasion and chemical resistance. An approval issued by one Authority will be accepted in all the member states. The AB screw combines the benefits of Taptite in a heavy-duty thread forming fastener
and is available in sizes M6 and above (see Figure 7.39). This means that both lateral and vertical movement must be determined to make sure the correct reversal of this damage can be achieved. Open the welding torch valves one at a time to release the pressure in the hose; open the oxygen valve and shut it; and open the acetylene valve and shut
it. Figure 6.3 Straight edges (with square or bevelled edges) (Neill Tools Ltd (Eclipse)) Measuring and marking-out instruments 187 6.2.4 Punches Centre punch This cast steel tool (Figure 6.4a) is driven into the metal with a hammer blow. 4 Finally the sill clamps are tightened. Ideally the customer should be able to see the site before he or she is on
top of it. Hollowing or blocking hammer This is a shaping hammer which has two ballpeined ends and is rather heavy. In order to remove everything in the The repair of aluminium panels and other components is slightly different to repairing steel ones. In some cases annealing has to be carried out
where the corners are very sharp so as not to split the metal. 2 Can you prove that your procedures are good penetration, even without edge preparation, the ability to handle all metal thicknesses and high weld strength (618 MN/m2 being easily achieved). Screws may be removed and the nuts reused
providing the screws are the same size and thread form. The main aim of the designer is to improve passenger comfort and protection, vision, heating and ventilation. It is usually sufficient to tap the end of the electrode on the work to crack off this coating, although it may be necessary to cut the tip off. It can be used for either straight or curved
 wiring, and is used extensively in the manufacture of wings made for heavy transport. Heat the soldering iron A clean flame such as gas is best for this purpose. 5 Name three types of gases that could be used in MIG/MAG welding. The main objective is to minimize the amount of handling of the vehicles by arranging for a flow system from the
vehicle's entry to its exit from the spray booth, thus preventing any dust entering the spray booth, thus preventing any dust entering the spray booth. Figure 3.41 Portable toolchest (Facom Tools Ltd ) 3.18 Power tools used in body repair work Speciality screwdrivers These are normally in sets of screwdriver tips and assorted drivers which are all interchangeable and prove most useful in vehicle body
repair work. If a sensor is faulty, the control unit should find it and illuminate the warning light. 3 Train staff in the correct procedures before things go wrong. The 3 mm blind fasteners have an expanding pin which, when inserted through the panel and released, exerts over 8 kg (18 lb) holding pressure. The most effective method of protecting hands
is the use of a barrier cream or rubber gloves, and this is strongly recommended. In order to meet this stated aim, the Part 11 provisions impose a 'duty of care' on everybody involved in the chain of waste management. 523 4 When waste is transferred, to make sure that there is also transferred a written description of the waste, which is good
enough to enable each person receiving it to avoid committing any offence under 1, and to comply with the duty at 2 to prevent the escape of waste. If you look at a strand of the glass from this matting through a microscope, or with a very strong magnifying glass, you will see that the glass is in fact made from very small diameter round tubes. A
concentrated load is applied across the width of the sheet or plate as cutting proceeds. If you apply a small amount of acetone to both of the broken surfaces you will often find that the lug can be bonded back into place. Registration is being sought by vehicle manufacturers and suppliers of parts and equipment, by car dealers, by garages offering
service and repair and by body repair shops. This process is employed Figure 8.5 Joint design for brazing, showing the brazing equivalents to welding Soft and hard soldering, when the parts have to withstand a temperature that would cause
soft solder to melt, and in cases where the high temperature developed by welding would seriously distort the metal parts. Where five or more persons work on the premises as employees, all assessments need to be recorded in writing. Stream lining The shaping of a vehicle body to minimize air resistance. A right- and left-hand pair of combination
snips will be suitable for most of the sheet metal cutting that will be encountered by the panel beater, and there is no need for any curved-blade snips. Paint refinish methods Thatcham publish refinish guide times for individual vehicles using the common variations in paint systems, these are: non-metallic non-meta
base coat and clear two-coat pearlescent The times allow for dry-flatting and the use of two-pack materials where appropriate. The fasteners are available in aluminium alloy, carbon steel and stainless steel, in diameters of 4.8 mm and 6.35 mm. The most common example of line measurement is the rule. Remember that the correct diameter rod is an account of the correct diameters of 4.8 mm and 6.35 mm.
important factor in securing perfect fusion. 16.4.4 Rovings These are formed by grouping untwisted strands together and winding them on a 'cheese'. The skilled panel beater is a craftsman who, to a great extent, relies on a good eye for line and form; this can only be cultivated by years of experience which, combined with dexterity in the use of hand
tools, is the secret of his craftsmanship. One or two cords may be used. A typical system for a local or spot repair is as follows: 1 2 Degrease with a solution of liquid detergent. In contrast to the single pivot of ordinary tin snips, aviation snips feature compound leverage for greater shearing power, being able to cut up to 18 gauge (1.2 mm) steel and
16 gauge (1.6 mm) aluminium. The most popular hand snips are the universal combination snips, which are made in sizes 10 in to 13 in (254-280 mm) with narrow or broad blades, with straight or cranked handles, and left or right handed. Figure 14.88 Panel
repairs complete (Motor Insurance Repair Research Centre) Direct pulling This is achieved by using systems which are designed around a base beam, sometimes mounted on castors for easy movement, with an upright beam pivoted at one end. Figure 3.67 Dust extraction system in a workshop (Minden Industrial Ltd.) 120 Repair of Vehicle Bodies to
remove the dust and debris which, with conventional systems, form a cloud and obscure the surface to be worked on as well as necessitating breathing apparatus for safety's sake. The 339 magnetic particles then collect along a line of crack when the current flows through the weld. Matt finish A surface finish which has no glossy effect. The
highcrowned end of the mallet is used for hollowing into a sandbag and the small-radiused end of the pear shape is used for glancing blows as used in raising. This can be done with the aid of a hand operated or compressed air cartridge gun. Service departments and bodyshops must establish: (a) What repairs each customer wants on the vehicle (b) are compressed air cartridge gun.
procedure for the ordering of necessary parts (c) A check that all tools are calibrated for use by trained and authorized staff (d) The production of a quality systems manual which will include all 18 procedures. It shrinks or stretches the metal into
need correcting by filing and sanding (Figures 13.63i). A small quantity of antimony is sometimes used in soft solder with a view to increasing its tenacity and improving its appearance by brightening the colour. Unless the molten puddle is kept active and flowing forward, correct fusion will not be achieved. Crack detection By using dye
 penetrant, surface defects in both ferrous and non-ferrous metals may be detected. Abbreviations for strain hardened materials The temper designation H for strain hardened products (wrought products only) applies to T3 solution heat treated, and naturally aged to a substantially stable condition T4 solution heat treated and naturally
 aged to a substantially stable condition T5 cooled from an elevated temperature shaping process and then artificially aged T6 solution heat treated and then artificially aged T8 solution heat treated, cold worked and then artificially aged T8 solution heat treated.
stretching. The vehicle itself is then held in place using individual jacking sill clamps attached to the methods of sheet metal work, and although the machine has displaced the man for certain operations there is an increasing demand for craftsmen who are capable of
of pin 4 Tail of pin breaks flush with collar and is ejected 210 Repair of Vehicle Bodies Figure 7.28 Hemlok fastener (Avdel Ltd.) 1 Hemlok inserted into power tool and workpiece 2 Tool operated: Hemlok tail deforms over material 3 Tail fully formed: fastener stem breaks off blind fastener, ideal for
Graphic Designs Rally Speed Rebecca Maturin - AVC Reliant Motors Ltd Rolls-Royce Motor Car Ltd Rover Cars Saab-Scania Schlegel (UK) Ltd Scott Bader Co. Ltd Selson Machine Tool Co. Ltd Selson Machine Tool Co. Ltd Sip (Industrial Products) Ltd Strode College, Street Sun Electric UK Ltd
Sykes-Pickavant Ltd Teroson UK The Institute of Materials The Motor Insurance Repair Research Centre The National Motor Museum Thornley and Knight Ltd THATCHAM Triplex Safety Glass Acknowledgements Tri-Sphere Ltd TRW United-Car Ltd Tucker Fasteners Ltd UK Fire International Ltd United Continental Steels Ltd USLB - AVC Vauxhall
 which lift the blade up and down. The elastic limit of a metal is a measure of the maximum amount by which it may be distorted and yet return to its original form on removal of the hammer strikes the metal hard on the stake top. Allowance must be made for the wastage of 81
in (3.1 mm) strip when cutting to a final size. • Carry SRS components inside the passenger compartment of a vehicle. A spring washer placed under an ordinary nut assists in preventing the slackening of the nut when the joint is subject to vibrations. It forms the smooth shiny surface of the finished article. Nuts, however, are produced in a variety of
special types; for example, high-tensile steel bolts having greater strength than hitherto use special shake-proof nuts which form a very efficient fastening. 621 Mobile hydraulic jacks These permit some saving of space in that they allow a tight turning circle both front and rear. These locking elements are designed to create gradually increasing areas
of friction on the bolt threads. 5 Do not wear inadequate footwear. Blind spots can be diminished firstly by good design of front pillars, making them slim and strong, and secondly by reducing the area of rear quarter sections. This relieves the tension on the glass which can then be lifted out of the weatherstrip by easing one corner first. The following
are examples in which the properties of malleability are most evident: It is also evident in the ability of mild steel and aluminium panels to be formed by mechanical presses into complicated contours for body shells. 22 Draw up a timetable for completion of action plan or development plan). 1 2 3 4 5 Using a router, cut through the rear of the
lower quarter panel just above the undertray. It is important to use a welding rod of the same material as the component: hence the importance of correct identification. Billet An oblong piece of metal having a square section. The exact temperature will depend on the purpose for which the steel is intended; the higher the temperature, the softer and
less brittle the tempered steel becomes. To initiate and maintain this chemical reaction, or in other words for an outbreak of fire to occur and continue, the following elements are essential (Figure 2.11): Figure 2.10 Ear protectors (Racal Safety Ltd.) Figure 2.11 The fire triangle (Chubb Fire Ltd.) Health and safety 67 Fuel A combination substance,
either solid, liquid or gas. Since the Second World War, the self-tapping screw has in many cases taken the place of more traditional fastenings and has justified itself completely on all types of motor vehicles. One of the main causes of flashback is due to backfeeding, which occurs when higher-pressure gas feeds back up a lower pressure stream
Before you use any electrical equipment visually check it for signs of damage and check that the cable is not frayed or split. 275 Compressed air compressed air is potentially dangerous. Equipment visually check that the cable is not frayed or split. 275 Compressed air is potentially dangerous.
The constant-flow compressed air line breathing apparatus is designed to operate from an industrial compressed air system in conjunction with the spray gun. When there is a flange at the rear of the spot weld it is supported by the clamping action of the C-shaped arm, while the drill is cutting out the spot weld to a preset depth, allowing the panels
to separate. Health and Safety at Work Act 1974 (HSWA) This states that it is the duty of every employee to work in a safe and secure manner that will not cause any harm or injury to the individual or anybody else, also to take care of any safety equipment and to cooperate with employers to comply with any related regulations. Adjustments
Necessary alterations to improve tolerances in fit. In order to speed up this reaction at room temperature it is usual to add an accelerator. A selection of lengths and head forms is available to suit a variety of assembly conditions. A large dip tank containing 2500 litres of a water-borne paint is included in the production line. Figure 13.11 Standard
wheel sets (Frost Auto Restoration Techniques Ltd ) Figure 13.12 Split and weld pattern The most important points when using the machine are: 13.2.5 Planishing 1 The wheels must be kept clean, free from dirt and in perfect condition. The use of zinc coated steels has dramatically increased to meet these challenges. This prevents the heat
dissipating along the blade and gives a constant temperature as well as eliminating smoke and fumes emitted from the cutting operation. They are designed to deliver the right weight of blow at the correct speed to form the rivet head speedily and accurately. In polyethylene, for example, a typical chain of 50 000 ethylene links is only about 0.02 mm
long. Weld tests for shear and peel for HSLA steels When shear testing spot welds produced when welding together two HSLA steels, partial spot-weld failure may occur. Although much of the manual labour of the hand lay-up is eliminated by using the spray process, thorough rolling is still necessary, not only to consolidate the deposited glass resin
mixture, but also 546 Repair of Vehicle Bodies to ensure that the accelerated and catalysed portions of the resin are adequately mixed. Figure 9.25 Cutting technique (BOC Ltd ) Propane Cylinder colour: bright red and bearing the words 'Propane' and 'Highly flammable'. If you look at the swage lines on the latest vehicles, you will see that many
panels are stiffened by the use of swaging. Emptying used solvents into the drain can lead to a heavy fine or even imprisonment. The above is a brief introduction to Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods, and it is recommended that the body repairer takes one of the Thatcham Methods are taken to the taken taken to the taken taken to the taken taken taken to the taken tak
maximum at 15 °C. Allow to dry for 15 minutes. Once the car is in position, the platform can be raised hydraulically to a horizontal plane and locked into place. (a) Powered respirators visited into place and locked into place and locked into place.
pseudo one part Medium modulus Medium strength Sensitive to moisture. The larger the handle, the better the grip and the more torque it will generate when turned. If splitting occurs the metal is insufficiently malleable or has been overworked (work hardened). 572 Repair of Vehicle Bodies 16.11 Safety precautions The handling of polyester resin,
 glass fibre, and ancillary materials such as catalysts, presents several hazards which can be reduced to a minimum if the correct precautions are taken. Dust off and tack off. 14 Define the importance of the property 'ductility' in a material. This ensures satisfactory repairs and adherence to the specified dimensions. In the event of an accident people
come first. Fluxes and their residues are highly corrosive and therefore Table 8.4 must be completely removed after brazing by washing with hot water. The speed at which this welding can be carried out in the repair of the modern mono constructed body shell is proving itself to be an economical asset. The working faces of the mallet must be kept in
first-class order, or marks on the surface of the metal will result. The use of water means that the emission of volatile organic compounds (VOCs) is eliminated. Rotate the torch to form overlapping ovals and keep raising and lowering that once a critical
point had been repaired and locked in place with the jig bracket, it would not be disturbed by subsequent repairs. 270 Repair of Vehicle Bodies Figure 9.26 Acetylene cylinders in fires (BOC Ltd ) Ventilation and oxygen-enriched areas Whenever cylinder gases are used, constant and thorough ventilation should be maintained. Stretching and flanging
 hammer This is used to form external and internal flanges on curved surfaces by hand. Figure 7.18 The Chobert grooved rivet (Avdel Ltd ) the rivet is expanded (Figure 2.14 Standard safety signs Safe condition The safe condition signs provide information for a
particular facility (Figure 2.15d) and have a green square or rectangular background to accommodate the symbol or text, which must be in white. Check local Building Regulations, and ask to see proposals for the future of the selected site and surrounding area at the town hall. Watts (W) Volts (V) Amps (A) 746 W equals 1 HP. Figure 13.18 Panel
 beater's hand tools (Aston Martin Lagonda Ltd ) The doors, bonnets and boot lids have always been hand made on site, the door skins (panels) because they have a relatively simple shape which can be made more economically than a rubberpressed panel which will always have a certain amount of wastage. 13.18.4 Suggested further reading Tom
Denton, Automobile Electrical and Electronic Systems, Elsevier, ISBN 0 7506 6219 0. Figure 13.68 Audi A8 - Aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium repair (Courtesy of POWER-TEC ®) Craft techniques and minor accident damage 393 Figure 13.69 Aluminium body (Courtesy of POWER-TEC ®) Craft techniques and minor accident damage 393 Figure 13.69 Aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium repair (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium repair (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work booth for aluminium body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work body (Courtesy of POWER-TEC ®) Figure 13.70 Enclosed work body (Courtesy of POWER-TEC ®) Figure 13.70 E
POWER-TEC ®) 394 Repair of Vehicle Bodies 13.17.4 Riveting When drilling out steel rivets from aluminium panels be sure to collect any steel chipping to prevent contamination and possible corrosion. Heat the windscreen finishers to 45 °C and, commencing at one end of the screen lower corners, press into position around its entire perimeter.
Protective goggles should be worn as a necessary precaution. This visual check will usually determine the following: Weld size Profile or weld face shape Surface defects in weld face Undercut and overlap Root defects Weld penetration.
overheated, and this extends their life. 17.14.11 Low-bake enamels These are modified high-bake enamels rather similar in composition to those used by motor vehicle manufacturers. Downward pulls can be carried out using a chain wheel which can be mounted on the bench frame. Adhesives may be used alone; or in a secondary role to supplement
 welding, brazing or riveting; or in a primary role, complemented by welds or rivets. All the outer body panels are a nominal 2 mm as they are cosmetic and not load bearing. There are other Directives setting out conditions which much new equipment (especially machinery) will have to satisfy before it can be sold in the EC member states. Of course
velocity is a vector quantity, it is related to the direction of the wind. Elastic blow, where either the head or the tool or both is made of a resilient material such as wood. Inspection and test drive on a straight flat road should show whether the car needs to go for wheel alignment. 3.23.3 Pneumatic
sander/filer This is a dual-purpose tool for either sanding or filing (Figure 3.57). 13.4.4 Wiring Wiring is the process of forming a sheet metal fold round thin wire to give extra strength to the edges of a panel and also to improve its appearance (Figure 13.26). Overspray from the spray gun can create unnecessary work when carrying out local paint
repairs, but this can be restricted by using a narrower fan pattern than that used for spraying a whole panel. Figure 14.117 Rotary control on rear of hot air tool for temperature setting (Welwyn Tool Co. Ltd.) setting to 5 °C, independent of any mains voltage fluctuations. Welding upwards also makes it possible to create a shelf upon which successive
layers of weld can be placed. Atomization The breaking up of paint or other materials into very fine particles. Among the samples which he threw aside as unsuitable was one containing about 14 per cent chromium. The schedules for body panels and methodologies for paint refinishing. Particular care must
be taken with liquid catalysts to avoid splashing, spilling or contact with the eyes. The basic differences between bolts, set screws and carriage bolts are illustrated in Figure 7.45. If access is limited to one side of a butt joint it may be necessary to employ integral backing or complex plate preparation to ensure that adequate quality is achieved in the
weld root (Figure 11.18). The operator in this manner controls the work: hence the term 'bronze welding'. The temperatures generated are over 3300 °C for resistance spot welds, for joints of similar strength. After rinsing and drying off, the system described for bare metal can then be used. Progress
accelerated as a result of the First World War, when productivity and speed of welding was of prime importance. Give another half turn on the handscrew and repeat the operation until the wheel 'bottoms', at which stage the swage will be fully formed. Any marks on the handscrew and repeat the operation until the wheel 'bottoms', at which stage the swage will be fully formed. Any marks on the handscrew and repeat the operation until the wheel 'bottoms', at which stage the swage will be fully formed.
additional work. Thermosets in the form of GRP using woven glass fibre or woven carbon fibre may be hand layed-up (HLU) or compression moulded (com). The following sections contain the causes and remedies of all the troubles most commonly encountered in spraying. Where it is difficult to obtain an anchor point owing to inaccessibility, a
aramid. 15.1.4 Planning the workshop layout The layout and design of the bodyshop will depend upon the type of work to be undertaken: minor repair, complete refinishing, PDI paint rectification, special customizing, the repair of light commercial vehicles, and any combination of these. Return sweep A reverse curve. The amount
of energy required is in direct relation to the volume of air contained within the area to be heated. Repeat the above process, this time by cutting the applicator head and using it to apply a coat of primer 17 mm wide (0.7 in) to the windscreen aperture. This cures the thermoset material under heat and pressure. Here customers get their first
impressions by meeting the receptionist, who represents the company. After cold working, metals tend to lose their malleable properties and are said to be in a work hardened condition. The wire drawing machines operate at 162 Repair of Vehicle Bodies exceptionally high speeds and the finished product conforms to close tolerances of measurement
frequent failure of the material during the various stages of drawing would be very costly. They require only a source of electric current, and so are suitable for immediate use anywhere in the workshop. The lamp/filter assembly is the hottest part of the heater, with surface temperatures of 750-800 °C, broadly similar to the surface temperature of the
lamp in a tungsten halogen floodlamp. They can be used in drilled or punched holes with normal tolerances (Figure 7.15). The top layer of resin is comparatively thin, and the weave of cloth can show up underneath it, especially if some areas have to be buffed subsequently. The resin is an essential component of glass fibre reinforced plastic. In such a
case repair is more difficult but can be still carried out. Advanced high-strength steel types are aimed at producing steel with suitable mechanical properties for the forming of vehicle body parts, usually through the hydro forming process - using water pressure to mould the metal over the die. 2.8.11 Incidents and accidents are reported in an
accident book By law all companies are required to maintain records of accidents which take place at work. It may therefore be necessary to design for additional rigidity rather than for optimum tensile strength. These automatic 'body lock' front seatbelt tensioners reduce the severity of head injuries by 20 per cent with similar gains in chest
protection. Aside from the effects it has on steering control and tyre wear, it can also place undue stress on other mechanical parts of the vehicle. They are used as a template to check radii sizes on the workpiece (Figure 6.14). L. 7 Cylinders must not be handled roughly, knocked or allowed to fall to the ground. Seal protects against ingress of
moisture Figure 7.34 Unhardened wood screws (European Industrial Services Ltd ) Figure 7.35 Fixing self-tapping screws (European Industrial Services Ltd ) Methods of joining 213 thread engagement; thus the best conditions are obtained if both sheets are extruded together. In addition it has the advantage of spreading very little heat beyond thereof the services Ltd ) Methods of joining 213 thread engagement; thus the best conditions are obtained in the services Ltd ) Figure 7.35 Fixing self-tapping screws (European Industrial Services Ltd ) Methods of joining 213 thread engagement; thus the best conditions are obtained in the services Ltd ) Methods of joining 213 thread engagement; thus the best conditions are obtained in the services Ltd ) Methods of joining 213 thread engagement; thus the best conditions are obtained in the services Ltd ) Methods of joining 213 thread engagement; thus the best conditions are obtained in the services Ltd ) Methods of joining 213 thread engagement; thus the best conditions are obtained in the services Ltd ) Methods of joining 213 thread engagement; thus the best conditions are obtained in the services Ltd ) Methods of joining 213 thread engagement; thus the best conditions are obtained in the services Ltd ) Methods of joining 213 thread engagement; the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread engagement in the services Ltd ) Methods of joining 213 thread e
actual welding point, and this helps to avoid distortion and shrinking stresses which are a disadvantage in the oxy-acetylene process. 0.5 mm 0.8 mm 1.3 mm 2.6 mm 3.0 mm (mm) (N/mm2) (N/mm2) min. Before carrying out any dismantling which entails disconnecting any electrical or electronic components or connections it is good
for this method, which gives deep penetration with a very narrow weld bead, whereas DC positive gives a shallow penetration with a very narrow weld bead (Figure 12.8). For its success the body design relies on the sheet metal to crumple or fold rather than tear in a collision. Most bonnets, however, are of the alligator pattern, which is hinged at the rear so that
the front end swings up when opened. In the event of its accidentally doing so, the affected part should be rinsed thoroughly in running water. Tanker shells and divisions Welded body construction. The principle of the method (short-circuiting transfer) is briefly as follows. Almost everything that is manufactured or made will use adhesives. Torque
of grey. The system is calibrated using points on the vehicle's underbody, all other gauge must be lowered to clear some obstruction on the underbody, all other gauge must be lowered to clear some obstruction on the underbody, all other gauge must be lowered to clear some obstruction on the underbody, all other gauge must be lowered to clear some obstruction on the underbody, all other gauge must be lowered to clear some obstruction on the underbody, all other gauge must be lowered to clear some obstruction on the underbody, all other gauge must be lowered to clear some obstruction on the underbody which are accurately jigged during manufacture. If one gauge must be lowered to clear some obstruction on the underbody which are accurately jigged during manufacture.
painter to adjust the outlet pressure. These cross beams are bolted directly on to the bench and have the MZ bracket system attached above them. These rovings consist of continuous glass strands, gathered together without any mechanical twist and wound to form a tubular, cylindrical package (Owens-Corning Fiberglas) 536 Repair of Vehicle
 Bodies Figure 16.5 Manufacture of mats. 9.13.6 Backfiring and flashbacks of welding torch is said to backfire when it goes out with a loud pop, and then relights itself immediately, providing the heat of the job is sufficient to 271 ignite the acetylene. 25 What is meant by repairing using partial panel replacement? The use of simple or
compound curves in the design may be the answer, or perhaps local corrugations can be introduced as in metal designs; these can often be incorporated into the overall styling, especially in vehicle bodies. The paint combination time is the productive part of actual painting, that is, it does not include paint mixing, test panel spraying, changing
overalls or cleaning. If the laminate is wet for a long period, the water solution inside the laminate will draw in more water through the osmosis process. Since the introduction of this nut, hundreds of different fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years, and in some private cars over 200 spring steel fastenings have been introduced over the years.
opening easier the hinges are usually counterbalanced by means of tension or torsion springs. Be aware, that not all plastics can be repaired. (a) (b) (c) Figure 11.18 Plate preparation for limited access butt joints: (a) permanent backing strip (b) fusible insert (c) U preparation for root access (BOC Ltd) In positional applications, non-symmetrical
preparations may be necessary to improve joint profile and avoid excess weld metal. Two-pack paints These are probably the most widely used paints in the vehicle refinishing trade, with more than 80 per cent of refinishers preferring them. 1.5.2 Inner construction This is considered as all the brackets, braces and panel assemblies that are used to
give the car strength (Figure 1.44). It is very common for the faces of the dolly blocks to become coated with paint, road tar, or anti-drum compounds which it picks up from the underside of panels under repair. Typical resistance spot-welding rates are 100 spots per minute. Electrical circuit Consists of a step-down transformer, which reduces the
 voltage and proportionally increases the amperage to provide the necessary heat at the point of weld. 3 Use high travel speed and low heat input to limit heat build-up in the panels to be welded. 8 Spray lacquer coats as necessary using one light coat followed by a double header. 14 Explain the importance of dust and fume extraction systems. Once
the damage is optically clear, curing can commence. The ram stroke has a length of travel of 500 mm, which has the advantage of speeding up the pulling operation and hence the repair. At this temperature it is withdrawn from the furnace and chilled by blasts of cold air. The British Plastics Federation are trying to encourage all European plastics
manufacturers to use the American Society of the Plastics Industry (SPI) material code system. No mixing Fast curing possible. During fracture, energy being absorbed by strong materials. In a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to about 70 per cent, whilst in a double-riveted joint this is raised to a double-riveted joint this is raised t
trebleriveted joint 80 per cent or greater efficiency may be attained. In dynamic loading situations the joint profile is more significant and it is important to avoid discontinuities which may act as stress raisers. Both tests employ a swinging pendulum which breaks accurately prepared specimens to which a notch has been applied. This heelboard also
stiffens the front edges of the rear seat panel. 2 If it cannot be put out easily can the spread of the fire be slowed down or stopped without risk by using an extinguisher? 2 Leave the premises by the nearest route, go to assembly point (AP) 1 which is in the customers' car park. 10 What are the four types of heating system that could be used in
 workshops? Figure 7.30 Standard Nutsert (Avdel Ltd.) 7.5.5 Avtainer system 7.5.4 Monobolt is a precision engineered two-part component. Sizes range from 4.763 mm, 1 3 16 in diameter up to 12.7 mm, 2 in and in lengths from 19 mm to 254 mm, 43 in to 10 in (Figure 7.44). Once it has done its job and is covered in overspray it is
important that it is correctly disposed of, ideally in a metal container with a lid, and not scrunched up and thrown on the floor to form the potential start of a deep seated fire. It is ideal for removal of rusted-in screws and other fasteners in locations such as door locks and door hinges. Sports coupé and coupé A sports coupé is a two-seater sports car
 with a fixed roof and a highperformance engine. The key terms in computer equipment are as follows: Computer-aided design (CAD) Computer-assisted design work, basically using graphics. The key terms in computer equipment are as follows: Computer-aided design (CAD) Computer and a highperformance engine. The key terms in computer equipment are as follows: Computer-aided design (CAD) Computer-aided design (CAD) Computer-aided design (CAD) Computer-aided design (CAD) Computer aided a
panel is buckling, apply a dolly block or spoon with enough pressure to hold the buckling section up, then allow the metal to cool. After the gun has been cleaned, a drop of oil should be applied to the fluid needle packing, air valve packing, and trigger fulcrum screw. The properties of the composite are thus determined by: • The properties of the
fibre. The technique is used to reduce high spots which sometimes form as a panel is planished. The machine is mostly used in sheet metal industries, but it does find a use in the manufacturing side of commercial body work where large and complicated panels are to be formed. When dry, wipe with a clean cloth. Many factors have aided the adoption
of plastics by the automotive industry, which uses them in the following areas: body, chassis, engine, electrical system, interior and vehicle accessories. 8 State the reason why copper or high-coppercontent alloy tubing should not be used for an acetylene connection. If the temperature reached is too high, metal will be forced from the weld zone and
may induce cavities and weld cracks. The position of the laser spot on the transparent scale shows when the correct alignment point has been reached. Synthetic resin primers have not been included in this process as they have a tendency to peel back from the edges when rubbing down takes place. This type of machine is best suited for the heavier
gauges of metal 3 mm and upwards. On account of its strongly inactive properties it can prevent oxidation or any other chemical reaction from taking place in the molten metal during the welding operation. Figure 9.13 Types of welding products Limited 19.3.10 Cylinder trolley Figure 9.12 Hose check valves (Murex Welding place).
Products Ltd ) It is advisable to have all welding equipment portable and mobile when in use in a body repair shop, and for this purpose a cylinder trolley can be used. On a volumetric system, never use a dented tin or one with a concaved or convexed bottom to mix the colour in. The last part of the weld pool to solidify is usually rich in low-melting-
point impurity elements, and liquid films are often present at the centre line of the weld; as a result the ductility of the weld metal is lowered. There are other types of safety glass - mostly crossbreeds of the pure toughened glass screen - which are designed to combine vision with safety. When carrying out this smoothing work, or planishing as it
could be termed, the pressure exerted on the work by the wheels should be very slight. 26 Describe the importance of toughened structural adhesives. For lowcarbon steel, heat may be applied with an oxyacetylene welding torch. This will result in the largest area of visible damage and is the cause of all other consequent damage. 4.7.1 Wrought light
aluminium alloys: BS specifications 1470-75 Material designations Unalloyed aluminium 99.5 per cent 1200 commercial pure aluminium 99.8 per cent 135 products subjected to the application of cold work after annealing (hot forming) and
partial annealing or stabilizing, in order to achieve the specified mechanical properties. Describe a simple process to determine whether it is the air cap or fluid tip which is at fault. If the aluminium oxide. (%) Temper4
(mm) \ (mm) \ (N/mm2) \ 0.15 \ 0.03 \ 0.02 \ 0.02 \ - 0.06 \ 0.03 \ 0.02 \ 0.02 \ - 0.06 \ 0.03 \ 0.02 \ 0.02 \ 0.02 \ 0.03 \ 0.05 \ 0.05 \ - - 0.07 \ - 0.05 \ 0.05 \ 0.05 \ - - 0.07 \ - 0.05 \ 0.03 \ - 0.05 \ 0.05 \ 0.05 \ - - 0.07 \ - 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ - - 0.07 \ - 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.05 \ 0.
Elongation on Materials thicker than 5.65 \sqrt{So} over Max. This is illustrated by the fact that a low crown, i.e. a surface with very little curve, such as a door panel, is springy and is not very resistant to change of shape. A substance may be a 'hazard to health' if the substance itself is harmful or if: 1 There are hazards from impurities. To meet the
requirements of BS EN ISO 9001-2000, the business must ensure that complete controls exist for such areas as workshop loading and receiving customer orders. Equipment is now specially produced for thin-gauge welding in the repair of vehicle bodywork. These properties are described in the following sections, and some typical values of
characteristics are shown in Tables 5.1 and 5.2. 5.1.1 Malleability A malleable metal may be stretched in all directions without fracture occurring, and this property Table 5.1 is essential in the processes of rolling, spinning, wheeling, raising, flanging, stretching and shrinking. 3.22.3 Specialized air drill (spot-weld remover) 3.23.1 Disc sander This is a
hand-held clamp-type drilling tool designed for cutting out spot welds (Figure 3.54). Heaters should be rated at 1.5 kW for more adverse conditions. The eye which is observing the reading should be vertically above the mark being read; this avoids what is known as Figure 6.1 Marking out with a
scriber and rule (Neill Tools Ltd (Eclipse)) 186 Repair of Vehicle Bodies 6.2.3 Straight edges These are used to test that surfaces are level or that parts are in line one with another, and are ideal for lining up and jig work. So, panel beating is not an option, replacement panels must be fitted in most cases. That is, it is, whether you are the newest
apprentice or the oldest manager, you have a legal requirement to comply with the relevant regulations. In order to change the nose-piece or the gripping jaws which hold the mandrels. Next the current is turned on momentarily. It is also available with a side lift, making
positioning of the vehicle on the bench very simple; and, because of the mobility of the side lift, the vehicle can be easily moved around the workshop area (Figure 14.27). Then the blows are directed on the centre of the heat spot, which pushes the metal down 366 Repair of Vehicle Bodies while it is still red hot. It is available in several different
thicknesses and specified by weight: 300, 450 and 600 g/m2. 6 Explain the difference between a try square and a centre square. Push-in panel fasteners (W-buttons) are designed to hold board, plastic, rubber or other soft materials to secondary panels. 12.11.2 MIG/MAG basic welding processes There are six basic welding processes used in collision
repair work on vehicle bodies. The hammer should not be held tensely, but during the complete cycle of movement it should be held loosely in the hand. Steel can be heat treated by normalizing, hardening, tempering and case hardening, which has already been described in Section 5.2.1. Normalizing Normalizing is a process
used to refine the grain structure of steel after it has been subjected to prolonged heating above the critical range (as in the case of forging) and to remove internal stresses caused by cold working. You cannot simply identify thermoplastics just by warming them up; we'll look at ways of identifying plastics later in the article. These dust extractors can
be in the form of either a vacuum bag attached to the sanding tool, or a large vacuum dust collecting unit remote from the tool and to which two or more sanders can be connected. PPE should be relied upon only as a last resort, but where risks are not adequately controlled by other means the employer will have a duty to ensure that suitable PPE is
provided free of charge for employees Bodyshop planning exposed to these risks. Before disconnecting the battery you should ensure that the security codes are available for the radio/cassette/CD player. Ideally this nozzle should only be used with underbody sealants on to easily accessible panels. Broadly speaking, motor vehicle regulations specify
that windscreens must be of safety glass. Both designs are equally good for flame cutting. Match the speed of your sweep to the amount of spray to avoid build-up of wax. All these stakes must have highly polished working surface. This legislation
held back the development of the motor vehicle in Great Britain for 31 years, allowing the continental countries to take the lead in this field. The system is called Dataliner (see Figure 14.29). In addition to storing the compressor and the spray gun,
blanketing out pulsations so the compressed air can be drawn from it at a steady even pressure. 12 File and sand the repair smooth and, if necessary, finish with a proprietary polyester filler. The system consists of making a pattern on a panel jig with pattern paper. 4 Do avoid butt joints. The incorporation of glass fibres in the resins changes them
from relatively low-strength, brittle materials into strong and resilient structural materials. GlassReport A statistics package for analysing the estimate in terms of common concepts, such as average estimate cost and parts-to-labour ratio. Wrinkling can be avoided by ensuring that the resin formulation is correct and the gel coat is not too thin, and by
controlling temperature and humidity and keeping the work away from moving air, especially warm air. The brackets included in the system are strong and truly universal; each has a single bolt fixing, providing quick and simple assembly. Charles and Frank Duryea built the first American petrol-driven car, although steam cars had been in use long
before this. Much lighter than air. This allows welds to be made in positions where access is possible only from one side. For instance, a chromed trim moulding which has been deeply scratched can be readily filled with brazing and then filed up ready for chroming. Remove the trim where necessary, to gain access to the rear quarter panel. The
amount of current used is very important. There are four primary types of respirators, and constant-flow air line breathing apparatus. Figure 7.48 Machine screw head types: slotted and (a) countersunk (b) round (c) cheese (d) mushroom (e)
pan; Pozidriv and (f) countersunk (g) pan; socket and (h) cap (i) cap (g) pan; socket and (h) cap (g) pan; socket and 
costs involved, the capabilities of the production machinery, the sources of supply and the directions of worldwide changes. Light rolling ensures that wetting is uniform over the whole area. The head of the hammer is curved and has two very sharp chisel-like cross-peins which allow it access to tuck down the metal around the wired edge. High
abrasion resistance and good sound deadening properties Good protection against stone chips and corrosion. Main dealerships sell body parts to outside trade and retail outlets. This in fact is achieved by the sequence of hammering just off, or at the side of, the dolly block; hence the name of indirect hammering (Figure 13.36). (a) Encased. Should
moisture be allowed to penetrate the primer, it will eventually break down and corrosion of the substrate will result. Surface spoon (Figure 3.8a) has an extra large working area which is very slightly crowned, and it is ideal for working in between and round struts and brackets without much dismantling. The nugget size should be 4.5vt. It is sited in
front of the laser unit and splits the beam to travel simultaneously along the two rails. Behaviour of the metal in bending In bending In bending In bending In bending sheet metal to an angle, the inner fibres in the metal on the beam to travel simultaneously along the two rails. Behaviour of the metal in bending In b
better for unloaded and toughened variants for loaded lap joints. The double-riveted lap joints. The double-riveted lap joints arranged either in line or staggered alternately. Minor impacts that could deform steel beyond repair can be absorbed by plastic. 5.7 Bending theory Many metals and their alloys may be formed by bending. It is a totally sealed rivet
designed for use on roofing but is suitable for materials like composite board, GRP, hard rubber and laminates, and is used in commercial vehicle construction and caravans. A front-end impact, for example, may easily cause the bulkhead to split without the defect being easily visible. 12.8.1 Principles of operation Metal inert-gas or
active-gas shielded arc welding (consumable) is accomplished by means of a gas shielded arc (Figures 12.13 and 12.14) maintained between the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from which metal is transferred to the workpiece and a consumable (bare wire) electrode from whi
the UK by Regulations made by the Department of Trade and Industry. Wet flat with P600 grade paper. Figure 2.2 Lightweight safety spectacles (Racal Safety Ltd.) Figure 2.3 General-purpose safety goggles (Racal Safety Ltd.) Figure 2.3 General-purpose safety spectacles (Racal Safety Ltd.) Fig
Applications of plastics in automobiles (Motor Insurance Repair Research Centre) 1 2 Front bumper (Pocan S7913) Front spoiler (Xenoy CL100) 5 Front bumper (Pocan S7913) Front bumper insert (PVC and EB-type
Nylar) 7 Front grille (moulding, ABS; Benzel, MS Chrome) 8 Bonnet/boot lid/tailgate badges (ABS, aluminium and PU skin) 9 Underbonnet felt (moulded felt) 10 Door mirror casing RH and LH (polyamide, 15% glass reinforced) 12 Front/rear wheel trims RH and LH (cap, Noryl
731; moulding, Bayer Duretan BM30X, ICI Maranyl TB570) 13 Front/rear mudflaps RH and LH (front, rubber to BLS.22 RD.27 Ref. 600 Repair of Vehicle Bodies Figure 17.48 Festo dust extractor (Minden Industrial Ltd.) 17.12.2 Polishing machines There are many types of
machine suitable for polishing, and they all operate with a common circular movement. For other emergencies say a serious injury, an audible warning from a speaker announcement system (often called a tannoy) may be used. A bond between two surfaces may be regarded as a chain of three links, the strength of the bond Figure 7.62 Trim panel
fasteners (TRW United-Carr Ltd ) 224 Repair of Vehicle Bodies Figure 7.63 Quick-release fasteners, quarter turn (TRW United-Carr Ltd ) linkage, the adhesive must thoroughly wet the surface whilst liquid, and when dry must adhere by penetration into the pores or fibres (Figure 7.65). A further drawback is that the convector radiators need to be
mounted on the walls of the workshop, thus taking up valuable space. When you rust- proof the chassis legs you should use a penetrating fluid and the flexible lance for all enclosed areas. A simple precaution is to apply a barrier cream to the hands before commencing paint stripping, and to rinse off with water any remover which comes into contact
with the skin. Glass reinforcements are supplied in a number of forms, including chopped strand mats, needled mats, bidirectional materials such as woven rovings and glass fabrics, and rovings which are used for chopping into random lengths or as high-strength directional reinforcements (Figures 16.4–16.7). 20 Why is it important to have adequate
air extraction when welding in confined situations? The gun must have this volume of air from the air receiver regardless of the pressure. Even brief exposure reduces bonding strength Care should be taken in handling as the surfaces are easily damaged Bonding surfaces should not be touched (even with gloves) or wiped with cloths or paper Repeat
degreasing If using epoxies, heat plastics for 1 h at 95 °C and apply adhesive while still warm NB Follow manufacturer's instructions to avoid premature curing of epoxy adhesive Repeat degreasing Let solvent evaporate completely before applying adhesive 230 Repair of Vehicle Bodies Table 7.5 (Continued ) Material Cleaning Diallylphthalate
plastics Degrease with solvent, unless using cyanoacrylates Degrease with medium grit emery paper Repeat degreasing Abrade with medium grit emery paper Repeat degree and a supplication of the supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a supplied abrade with medium grit emery paper Repeat degree and a suppl
Chromium trioxide 1 Or, use a silane primer in accordance with the manufacturer's instructions Repeat degrease with solvent Glass and quartz (non-optical) Degrease with solvent Glass and quartz (non-optical) Degrease with solvent Melamine
and melamine faced laminates including Formica, Warite, etc. (See Figure 3.11.) The cutting tools known as aviation snips were originally developed for the aircraft industry (Figure 3.29). The main requirements of flooring are wear resistance, colour fastness to light and water, and adequate strength to enable the customer to remove the flooring
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from the car without it suffering damage. The basic checks are: 1 Measure ride height. This practice continues today. In addition, in 68 Repair of Vehicle Bodies the bodyshop the use of welding and cutting equipment produces sparks which can, in the absence of good housekeeping, start a big fire. Wipe the panel with wax and grease remover and
dry off with lint free cloth or a wiper. The sides of the floor are stiffened by vertical boot side panels at the rear, while the wheel arch panels complete the floor structure by joining the rear end of the main floor and its side members. However, in most cases the damage will not be completely restored to its original contour, although it will be roughed
out and can be straightened to its correct contour by direct hammering or by combination of direct hammering and indirect hammering. For cellulose synthetic paints and air pressure of about 4 bars (60 psi) is normal, though this can be adjusted by the spray painter to suit his own requirements. These materials are, however, more suitable for
welding thicknesses in excess of 6 mm. The face of the bed sometimes has a graduated scale which permits the cutting is done by a pair of very narrow blades, one of which is fixed while the other moves up and down from the fixed blade
at fairly high speeds. This leaves wider spaces between the abrasive grains. With the introduction of electronic telephone exchanges the number to help confirm that your call is not a hoax. Mini cross beam plates have consequently been designed to attach to
the special support arms and have exactly the same function as the original cross beams, although they can now be moved nearer the car for the attachment of this style of bracket. Whatever the Figure 1.3 First Vauxhall, tiller operated, 1903 (Vauxhall Motors Ltd.) mechanical future of the car, we may rest assured that the shape of the motor car
body will continue to change as technical progress is made (Figure 1.5). The screws are obtainable with countersunk, flat and round heads. Therefore the repairer can see how far to push or pull to realign the section under repair.
is very important that the correct welding rod is used for the appropriate alloy. 3 The correct flux for the particular job in hand. Some time ago a tough rubber strap was offered as an alternative to the traditional metal clip for retaining loose cables and wires. Remove any deformations in the plastic panel. Therefore when two objects are adjacent to
one another and one is hotter than the other, there will always be an exchange of heat from the hotter object to the cooler one. Insulation A material which is probably less effective as a panel damper than sand-filled bitumen, it is nevertheless
more suitable owing to its better ductility. In some cases the damage will appear to have been corrected although it has not. Table 7.1 gives rivet and hole diameters. The molten wire is transferred to the weld in droplets, and as each drop touches the weld the circuit is shorted
and the arc is momentarily extinguished. checks on dimensional accuracy are made during the course of building, before the chassis frame can be ready for the panel shop. Saloon An enclosed body not having a partition between the front and rear seats. Although by tradition PVC is produced with a simulated leather appearance, on the Continent and
particularly in the USA it is widely used with fancy embosses, and patterns. With its locally applied heat and pressure it has an obvious relationship with the forge welding technique practised by blacksmiths when joining metal. The welding industry grew very rapidly, and by the year 1907 the use of oxy-acetylene equipment was very popular in all
parts of Europe. On-site valeting (vehicle washing) would require special drainage to cope with excess dirt and grease. Lay-up Layers of glass fibres are laid on top of wet resin and then pressed down into the liquid resin. Curved pein and finishing hammer This tool (Figure 3.3e) is identical in use to the straight pein and finishing hammer except that
its Fender bumping hammer This tool (Figure 3.3f) has a long curved head with one face which is circular to reduce the effect of stretching the metal when in use. Heat maybe applied to help disassemble an adhesively secured or bonded joint; but be careful not to apply any heat to a joint which should be kept intact. 6.2.9 Combination square 6.2.10
Centre square This is used to test that work is true, to measure and check angles, and to locate the centres of round bar or centre lines of tubes. 30 Describe the difference between a laminated glass windscreen and a toughened glass windscreen. The most common
transistor has three connections, base, collector and emitter. The thermoplastic curls right back on itself, but the thermoplastic curls right bac
made from copper, brass, aluminium and aluminium alloys are used. GlassImage A system for capturing and storing digital images from video data. 31 With the aid of a sketch, describe the fitting of an indirect glazed windscreen. For this reason it must not be flatted down, through a light denib, carefully done, is permissible. The ramps can be
removed when necessary to facilitate access when measurements are taken or alignment work is carried out. Single V preparation consists of bevelling the edges of each plate so that a V is formed when they are brought together. This heat at the junction of the two parts changes the metal to a plastic state. Contrary to popular belief, air volume is
more important to the spray painter than is air pressure. Also, pure argon must be used as the shielding gas owing to its total inert characteristics, and not argon mixes or carbon dioxide. These are the features of metal sheet which has been formed in a press into a permanent shape, with die-formed stresses throughout its entire area tending to hold
the shape. Cleanliness is important both for health of the operators and for preventing contamination of resin and reinforcement. The Health and Safety at Work Act requires that where more than 50 personnel are employed, one qualified first aid person must be appointed. It not only gives strength but prevents cracks developing in the edges of the
wing due to vibration, and it provides a smooth finished appearance to the edge of the wing. Wet flat with P800 grade paper, dry with air gun, tack off. Cream for foam. 17.12 Sanding and polishing by hand can prove to be both laborious and expensive. Satin weaves are fundamentally twill weaves modified to produce
fewer intersections of warp and weft. The chrome coat- 151 ing can be made much thinner and yet have a longer effective life, with a consequent saving in cost. For the average refinishing shop an internal diameter of 25 mm will suffice. Wear welding overhead so that the welding overhead so the welding overhead so that the welding overhead so the weld the welding overhead so the welding overhead so the welding ove
spatter does not run down the neck or sleeves of the overall worn. Most glass fibre materials and resins are perfectly safe to use provided the potential hazards are recognized and reasonable precautions are adopted. Remove the suction cups. The feed wire unit also houses the controls which govern the feeding of the wire at the required constant
Figure 12.17 Air-cooled MIG welding torch (Murex Welding Processes Ltd ) 326 Repair of Vehicle Bodies speed, plus the automatic control of current and gas flow. 7.6.5 Coach screws These are designed for securing heavy-gauge metal and fittings to timber, and are obtainable with either hexagon or square heads suitable for using a spanner or
socket wrench. The quantity of accelerator added will control the time of gelation and the rate of hardening. A right-angled bend greatly increases Figure 5.4 Strength in angles and flanges Figure 5.4 Strength in U-channel and box sections Metal forming processes and machines 169 5.4 Machines for sheet metal fabrication The mass produced, all
steel bodies of both private cars and light commercial vehicles call for the production of involved panel shapes on a massive scale. A Gas shielded arc welding 317 To avoid contamination of either the electrode tip or the work, which would occur if the normal method of arc striking were employed, a high-frequency spark unit or an arc stabilizing
device is used to stop the operator from having to touch the electrode on the surface of the works. 8 Discuss the importance of the workshop. A common feature in the design and manufacture of a motor vehicle is the many curved surfaces which are normally referred to as crowns. Polishing, if carefully done, (b) Figure
17.63 Application of water-based paints is strictly controlled by the size of the fluid tip on the spray gun Automotive finishing continued until a smooth glossy surface is achieved. In cases where there is
a tear in the damaged section, this must be welded up before any pulling or pushing is attempted, otherwise the tear will hinder the rectification and possibly become greater on the application of force. 30 Explain the use of dummies in safety research and testing. The pulling tower can be used 360° around the vehicle to be repaired. When lifting
occurs there is little alternative but to strip and recoat. When they are mixed together, a chemical reaction takes place which results in complete polymerization. Chisels are made from high-quality steel. During welding, or when the machine is hotter than 70 °C, the fan cools the rectifier and the transformer. It is with these VOCs that the legislation
is concerned. (d) 3.6 Hand snips Figure 3.10 (a) Flexible panel file (b) flat file (c) half-round body file (d) abrasive file (Sykes-Pickavant Ltd) The offset combination of universal snips is preferred by the panel beater when cutting thin gauge metal. Some of the important points to be aware of are given below. With a twist, hold and support the
undamaged part and apply a downward force to the front while allowing the other end to pivot up. When the roughed area. Figure 6.11a and b illustrate the two types. (g) Petrol tanks are a potential hazard: supposedly empty tanks may be full of vapour. The larger patch is then bonded to the
underside so that it attaches to both the original item and the piece which is filling the hole. Thatcham provides courses for insurance company staff engineers and independent consultant assessors, concentrating on the latest developments in jig technology, welding and refinishing. It is important to apply the zinc primer uniformly between the panel
surfaces to be welded. Clean hoses, wiring, plastic and paintwork with appropriate dressings. In the oxy-acetylene method the weld metal and surrounding panels are liable to distort owing to heat input. The base has a plain flat face for normal finishing work. The shape of the job is retained in the vision of the panel beater, who can, by beating on the
sandbag and raising over a suitable stake, obtain a very good approximation to the desired form. An exception would be where a very narrow section is to be processed and it would be preferable to spray with a powerful directional jet, such as a bonnet or boot lid strengthener. They are used for scribing circles and arcs, and for marking off lengths. In
recent years they have been supplemented by methods such as inert-gas (MIG/MAG) and tungsten inert-gas (TIG) welding, carbon dioxide welding, metal inert-gas (TIG) welding, carbon dioxide welding, metal inert-gas (TIG) welding, carbon dioxide welding and atomic hydrogen welding. As the load increases, the dial registers the amount of applied load until fracture occurs. In some cases the outer panel is bonded to the inner
panel using epoxy resins. It provided the foundation for the world of plastics as we know it. Figure 15.12 Training record (Akzo Coatings PLC) Identify hazards cause harm) (a hazard is the potential to 1 Nature of hazard 2 Route of exposure 3 Possible interactions. 17 Explain the purpose of a metre square when marking out. 1.1.4 Vehicle
classification There are many ways in which motor vehicles may be classified into convenient groups for recognition. In direct hammering, by having a dolly which matches the original contour to give a smooth and
level finish. This can be achieved by using a piano wire, a special cutter or a hot knife, as follows: Piano wire Before using this method of removal there are certain safety precautions that should be observed. These edges can be formed either with hand tools or with the aid of a folding machine. They incorporate low-molecular-weight rubbers that
build in exceptional resistance to peel and impact forces. A further variation Automotive finishing and refinishing and refinishing and refinishing and refinishing and then automatically moves the proper distance for the next weld cycle. Macro examination This method uses a
low-power magnification to examine weld specimens which have been levelled, polished and etched to detect the following: lack of fusion, lack of penetration, porosity, oxide inclusions, internal cracks, 5 Always wear gloves and an apron when welding. 3 Certain mechanical components which it would be ill advised to repair and reuse owing to their
critical alignment and strength factors. 35 Give the advantages of blind riveting when compared with solid riveting when compared with solid riveting aluminium and its alloys, which type of gas would be most suitable for use? One such company is Tuff Kote Dinol (TKD). The unsupported edges of the wing are swaged edges known as beads. Because the material
has a wide liquidus-solidus range (about 80 °C), it remains in a pasty form for an appreciable time during cooling, and while in this condition it can be shaped or 'wiped' to form a lead pipe joint, or to the shape required for filling dents in a car body. 40 Explain the importance of correct alignment when fitting new body panels and state how this is
achieved. It makes no difference when the switch is released. The tendency will be for creases or wrinkles to appear on the edges of the metal and eventual cracking. The materials best suited for wheeling are aluminium, some of the aluminium alloys and mild steel, all of which
possess the properties of malleability and ductility to a certain degree. On some vehicles the warning lamp will flash to indicate a fault code - this may need to be triggered by a diagnostic tool. (%) min. 3 Describe a suitable application for the use of a flexible body file. The two parts can be held together with strips of masking tape on the reverse
whilst you carry out the welding. The principles of good adhesive joint design are shown in Figure 7.66. Usually, a small white lamp adjacent to the switched off mode. The upper portion of the door has a large opening which is closed by glass. The top section of the frame carrying the upper roller and shaft
is hinged at the back and kept in upward tension by a flat spring. These fine fibres are then assembled into textile yarn, or into reinforcement products, including glass fibre which, after drying, is processed into the various
reinforcement products (Figure 16.3). Red or maroon cellulose finishes which might bleed are best coated with a sealer before commencing the spraying of the surfacer coatings. 8.3.3 Soldering tools Soldering irons are made in different sizes and shapes. Butt joints are of several types, each having a number of variations. Aluminium is approximately
one-third of the weight of steel, and aluminium alloys can be produced which have an ultimate tensile strength of 340-620 MN/m2. Bonded-in car windscreens, for example, can be removed without damaging either the glass or the frame. Any weak points in the structure are most affected by the action and become the probable centres of failure,
either by fracture or by breaking. Blisters can also occur if the moulding is subjected to an excessive amount of radiant heat during cure. The main standards for the UK are now: BS 857 glazing is still valid but is seldom used because ECE R43 is accepted
throughout Europe, Japan and Australia. This estimate will show the total cost of repairs, and where the estimated amount is under a certain figure set by the insurance company, the owner has the right to authorize the repairer to do the work. Finally, the body shop is not complete unless it possesses a wheeling machine, which is used to produce
double curvature panels from flat sheets by passing the sheets to and fro between rollers or wheels in order to stretch the sheets and to create a curved shape. Blow off vehicle with air qun and tack off. Questions 1 Sketch four types of solid rivet. 15.3 Bodyshop heating The body repair shop can be a difficult building to heat because of the very nature
of the work that is carried out. The beam also strikes a target, which has retro-reflective material on one side, and which is attached at a control point on the underside of the vehicle. 13.14.5 Example of use of body jack Figure 13.58 demonstrates the jack being used diagonally to rectify a door opening. Anvil stake has a flat, square-shaped head with
a short shank and is used for general working operations. 17.9.3 Cleaning a pressure feed set-up Shut off the air supply to the pressure tank, release pressure in it and loosen the lid. It is useful for welding the heavier-gauge plates used for commercial vehicle body building and also for the type of metal plate processes in which the metal ranges in
thickness from 3 mm to 75 mm. The high-pressure system has the following advantages: 1 Portable equipment is used for welding and cutting metals, so that the operator can have his equipment close up to the work. Diagnosis The determination, by examination, of the cause of a problem. The proportions of damage sustained in different directions is
shown in Figure 14.1. Figure 14.1 Proportions of damage sustained in different directions in UK accidents (Motor Insurance Repair Research Centre) 14.2 Pulling, alignment and repair systems used on major accident damage Since the monocoque construction of car body-work based on engineering principles took the place of coach-built bodies
mounted on a separate chassis, the whole concept of repair work has undergone radical changes in both methods and the equipment employed. These tests can also be conducted by VOSA Examiners at 'designated premises' if certain conditions are met. Among them are filler rods for welding various grades of carbon and alloy steels, stainless steels can also be conducted by VOSA Examiners at 'designated premises' if certain conditions are met. Among them are filler rods for welding various grades of carbon and alloy steels, stainless steels can also be conducted by VOSA Examiners at 'designated premises' if certain conditions are met.
nickel and nickel alloys, copper and copper alloys, aluminium and most of its alloys, magnesium, titanium, and high-temperature alloys of various types. The quality of the cut is very high, with little or no dross and reduced distortion. The manufacturers can supply these materials in a variety of conditions. Facilities 1 2 3 4 5 Toilets. The test
equipment can vary, but the basic principles are that two sets of vice jaws are used to clamp the specimen, hydraulic power is applied to force the jaws apart, and a dial calibrated in tonnes or newtons records the load. At this stage approximately equal quantities of acetylene and oxygen are being used and combustion is complete, all the carbon
supplied by the acetylene being consumed and the maximum heat given out. 6 What is the difference between water-cooled torches in TIG welding? There are five different minerals which are commonly used for manufacturing abrasives. The holes needed for using this tool should then be welded up and the damaged area should be
sanded, filled with body solder and filed to achieve the final finish. The rate of change is referred to as frequency and is indicated as 25, 40, 50, 60, cycles per second (hertz). 1 State five basic rules concerning dress and behaviour which demonstrate personal safety in the workshop environment. Figure 6.5 Wright)) Try square (Neill Tools Ltd (Moore
and 188 Repair of Vehicle Bodies 6.2.6 Bevel gauge When two surfaces are at any angle other than 90°, the angle between them can be tested with an instrument called a bevel. Figure 13.59 shows rectification to a door opening using a push ram connected at both ends to push-pull clamps, which are bolted on to the door flange edges. 1.1.5 The
evolution of design When the first motor cars appeared, little attention was paid to their appearance; it was enough that they ran. The 450 g/m2 is the most frequently used, and is often supplemented with the 300 g/m2. If additional strength or water tightness is required the rivets can be pinned, giving in effect a solid rivet. They are based on the
polyester group of thermo-setting resins, and require a catalyst or activator to cure them. The ram and blades are driven at a speed between 1200 and 2100 rev/min, depending on the metal thickness and whether air or electrical power is used. This slightly raised area is next tapped down lightly with a planishing hammer or the finishing end of them.
pick hammer on to a suitably shaped dolly block, and the panel is finished off by filing with a panel file. Intermittent spot welding process does
not alter the original specifications of the steel. This type of windscreen has been fitted to various vehicles since 1962. Then, this assembly is pressed into a wet spray-up layer and cover layers are added for increased torque resistance. 428 Repair of Vehicle Bodies 14.2.11 Blackhawk mobile repair system PB30 The Blackhawk mobile repair system
PB30 offers a completely portable repair system that can easily be moved around the workshop. We'll have a look at a few procedures in detail. To prevent this fault, ensure the correct ratio of resin to glass and eliminate any draughts. On completion cool slowly. Figure 12.30 Stitch weld 12.12 Applications of MIG/MAG welding in vehicle body
construction Figure 12.28 MIG/MAG spot welding Lap spot weld In the MIG/MAG lap spot weld technique, the arc is directed to penetrate equally between the edge of the upper metal panel and the top surface of the lower metal panel of the lap joint, and the puddle is allowed to flow on to the edges of the top piece. The dangers occur typically when
gas is released in a confined space. Reducing the cup to a smaller diameter with greater height is called redrawing. If your company has no such a person on the staff then you will have a designated person who you must contact in the event of a colleague being injured. 7 Storage arrangements should ensure adequate rotation of stock. (e) Make sure
you do not exercise more pull than is needed to bring the panel back into its correct position, to avoid bulging. 3 Clean and refit all parts which have been removed for the painting process. The flashing action across the gap melts the metal, and as the two molten ends are forced together fusion takes place. The material acts as an effective heat shield
against radiant heat when it is applied over the surface to be protected. (e) (f) Trim panel remover This tool is designed to remove vehicle trim panels, upholstery and roof liners without damage (Figure 3.16c). The most commonly used elements in aluminium alloys are copper, manganese, silicon, magnesium and zinc. 9 State the current in amperes
and the size of electrode needed, for welding over 5 mm thick steel plate. 4 Appoint competent people either from inside the organization or from outside to help devise and apply measures needed to comply with duties under health and safety law. Many companies have a direct telephone line to the fire station, and these automatically call the fire
service if a fire is detected by sensors or by breaking the glass of a fire alarm. One hand holds the T-bar while the other pulls the sliding weight towards the stop; there the weight rebounds, forcing the dented panel out under the impact of the blow. With the floor pan, side rails and reinforcements welded to them, the suspension members become an
integral part of the underbody, and they form the supports for engine, front and rear suspension units and other chassis components. Secondly, a full geometry check must be undertaken to satisfy the repairer that the car is within the manufacturer's tolerances after the repair. The reinforcement is placed in the bottom half of the mould. 6 Suggest
one application of projection welding in the assembly of a vehicle body. A thyristor is such that a small current starts the flow which remains after the small current is stopped. Plate preparation Up to 1.00 mm: edges flanged. MIG seam and butt welding produce hard weld joints; they will tear from the sheet metal on impact. Fillet weld A weld in
which two surfaces at right angles to one another are welded together. Cellulose synthetics are used as repair materials over the high-bake synthetics applied by the car manufacturers; in addition, of course, they can be used for complete resprays. (b) Separately fabricated fibreglass stiffeners can be pressed into layers to be
reinforced while it is still wet. The paint system is of the simplest type. Figure 3.50 General duty drill (Desoutter Automotive Ltd.) Figure 3.52 Angle drill (Desoutter Automotive Ltd.) Figure 3.52 Cordless drill from the
rear would entail the cutting of the panel to be replaced, to obtain access for the tool clamp. 17.19.12 Shelving This term, though not widely used, is an extremely apt one to describe the advantages of brazing. The regulations are in most cases
very minimal. The speed of welding depends on the current and the operator's skill, but is usually about three times that of mild steel. To find the part, you have options: Order aftermarket parts online. It is installed into the panel by hand, This is a special clip used for carrying cables. A furnace is then placed over the stack and fired to heat the steel
coils to a temperature of about 650 °C for around 24 hours, depending upon charge size and steel grade. Edwards Ltd ) 100 Repair of Vehicle Bodies Round-faced mallets These are used in conjunction with steel stakes for forming and shaping. Tank cladding Body panelling. It is constructed in a similar way to the scale model but uses a metal, wood
and plastic frame called a buck. 7.6.11 Nyloc self-locking nut This is a self-locking nut with a built-in moulded nylon insert made of smaller diameter than the nut's normal thread (Figure 7.52a). 14.4.13 Plastic repair Duramix combines the tremendous strength and durability of a plastic weld system with the flexibility of chemical curing products, thus
extinguished in the early stages. Exact thickness will depend upon strength and stiffness requirements of the part. If not, a toothpick or sharpened matchstick can be used to clean out the hole. 386 Repair of Vehicle Bodies Final cleaning and inspection The soldered joints must be filed and sanded with a DA sander. Why are they used when marking
continuous filament glass (e) polyester surface finish (Reliant Motor PLC) self-tapping screws, rivets and others) can usually anodizing giving an identifiable colour. The aim in riveting is to swell the body of the rivet until
it completely fills the holes, and to complete the process as quickly as possible while the rivet is still very hot so that there is maximum contraction of the rivets after riveting to pull the plates together. In a garage these are usually operated from the service department office. 17.11 Spraying defects No matter how excellent a spraying equipment is,
scrupulously clean and perfectly smooth, otherwise it will be impossible to avoid marking the sheet. Figure 10.3 Stationary pedestal spot welding; resistance spot welding; resistance seam welding; resistance seam welding; resistance seam welding; resistance spot welding are classified as: resistance spot welding; resistance seam welding; resistance spot welding; resist
and resistance butt welding. Third, by its capacity for retaining gases in solution during solidification of the alloy, silicon prevents the formation of gas holes and porosity in the deposited metal, which would naturally reflect unfavourably upon its strength as a weld. Before any correction can be made of such damage it is necessary to restore this inner
construction. Plastics can be self-coloured so that painting costs are eliminated and accidental scratching remains inconspicuous, and they can be given a simulated metal finish. The wide range of valeting and chemical cleaners available is broadly divided up as follows: Exterior detergents and solvents Interior/exterior
rubber, PVC, plastic cleaners and conditioners Glass cleaners, paints, lacquer and protectorants Paintwork polishes and conditioners. They must be impervious to attack by weather, road salts, extremes of temperatures and all the other hazards that reduce older forms of body embellishments to pitted, rusted, dull, crumbling metal. Pressure is then
applied by tightening the rear bolt, which cants the jaws forward and causes them to bite into the surface of the metal. Designs may incorporate large areas of sandwich construction with cores for vibration dampening, stiffening, thermal inculation or flotation. Figure 13.27 Wiring process: 1 Allowance marked off and sheet folded 2 Metal beaten over
bending line. Lighting including emergency lighting. But rust can also develop as a result of any accidents. Some special vehicles have two batteries. Si Cu (max.) Mn (max.) Ti (max.) Mg (max.) Melting range (°C) 4004 4043A 4045 4047A 4104 4145A 4343 9.0/10.5 4.5/6.0 9.0/11.0 11.0/13.0 9.0/10.5 9.0/11.0 6.8/8.2 0.25 0.30 0.30 0.30 0.30 0.30
distinctive appearance 5 Specially built vehicles using the major components of mass-produced models 6 High-quality coach-built limousines (hand made). Finally, into all the tube sections, or any other closed areas that have been fabricated, a wax-based
preparation is injected through predrilled holes to give protection to all these inner surfaces. Inside corner fillet welds in this gauge are difficult to make because of the low heat input, which restricts the free flowing of the slag away from the depositing metal so that fusion is obstructed and the resulting weld is unsatisfactory. Also there should be a
secure outside compound for seriously damaged vehicles awaiting examination by the insurance assessor (third-party claims and total write-offs). The gel coat is a continuous skin on the working face of a moulding. Figure 9.20 Flame cutting process (BOC Ltd.) 9.11.2 Cutting torch This differs from the regular welding torch in that it has an additional torch are continuous skin on the working face of a moulding.
lever for the control of the oxygen used to burn the metal (Figures 9.21 and 9.22). Although patents were taken out in 1874 covering a method of increasing the strength of flat glass sheet by heating and cooling it in oil, toughened glass was not in common use until the 1930s. Where solid materials are involved they may continue to burn or smoulder
until the oxygen in the air is reduced to 6 per cent. Much heavier than air. Such steels are used for gear shafts, engine parts and all other parts subject to high stress. Frekote is a semi-permanent, multi-release, gloss finish, non-wax polymeric mould release system specially designed for high-gloss polyester mouldings. An alternative method of
achieving double curvature on a flat panel is to form the first curve by using a rolling machine, and then to wheel it in one direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only, allowing the tracks to cover the panel in the opposite direction only.
used on mild steel up to 1.2 mm (18 gauge) and applied in many situations which require this type of joint. 2 The hourly rate of withdrawal from the cylinder must not exceed 20 per cent of its content. Unless care is taken to see that edges or surfaces to be joined are in close contact along the seam, the heat conductivity of the weld area and the local
heat will cause burning through wherever a gap occurs. 4.1.1 Casting The steel is cast into a slab, or more commonly continuously cast into a slab, or more commonly cast into
of hot shrinking to restore a panel to its original contour. A major factor behind this decision Figure 16.30 First stages in building up chassis details on the Lotus Elan (Lotus Engineering) resin continuous filament glass fibre with additional local
reinforcements in high-load areas such as the body to chassis attachment points and the fuel tank mounting area. In addition it is equipped with a fan for solvent vapour removal, and a control panel which guarantees efficient control of the drying process according to the type of paint being used. These are therefore not present in the applied liquid
film to cause chilling and resulting condensation, called 'blushing', which occurs with certain paints on applications under humid conditions. 13.13 Body jack (hydraulic) 13.13.1 Development and principles The evolution in motor car bodywork design and construction has called for many changed methods of handling repairs. Special clamps are
available for holding composite body panels in alignment while they are under repair and being bonded in place (Figure 16.45). It does not burn, support combustion, or does not take part in any ordinary chemical reaction. Remove any paint within about 15 mm of the joint, a P40 disc is usually ideal; drill stress relieving holes at each end if it is a
crack; hold the gap closed with tape on the underside; run the soldering iron over the joint so that the material added to the joint. 1 2 3 4 5 6 4.2 Specifications of steels used in the automobile industry As each group may contain many different
Welding accessories (Murex Welding Products Ltd ) distance to be carried from the machine. Hatchet stake consists of a horizontal, sharp, straight edge, and is used for making straight sharp bends. 11 Valet car's interior and exterior. The front cross member assembly braces the front of the car and carries the radiator and headlamp units. With an
electric soldering iron the heat is automatically controlled at the right temperature. Glossary xxvii Leftward welding. If this is repeated about a dozen times, the purging action will clean out the fluid passages. Hold the rod at approximately
half the angle of the torch, but slant it away from the torch. However, where continuous welds are required or specific components carrying high stresses are to be fitted MIG/MAG welding is employed using semi-automatic equipment. The latter contains an accelerator compatible with the adhesive; this is applied evenly to the perimeter of the
windscreen (Figure 14.107). The rate of cooling does not affect the resulting softness of this metal. It is lighter than air and less likely than propane to collect in confined areas. This sheet metal cutter is capable of speedy and accurate removal of panels or parts of panels that have to be replaced. In daylight, colour is probably the most important
factor in enabling cars to be seen. The solder blocks must be kept continually coated with oil or grease to allow them to slide over the surface of the solder and much easier to apply. Finally, dual repair systems give the repairer the advantage
of precision measuring allied to the use of brackets. The most important feature of the brackets is that they provide progressive anchorage, locking newly repaired areas in place so that they are not disturbed by subsequent pulls to other areas. 9.11.5 Machine cutting Much oxygen cutting is done with machines, particularly if the cuts are long. The
rules are considered good shop practice and are directed towards the safety of the operator. In this case the stress resulting from the buckle helps to retain the metal in its damaged state, and even after it has been restored to its correct shape by the application of pressure from hydraulic equipment, the section will tend to return to its damaged
position if pressure is released. • Micro-cracking resistance - stress and age hardening causes the material to crack, the micro-cracks reduce the material strength and eventually lead to failure. With all electrodes all traces of slag should finally be removed by scrubbing with a wire brush and washing. It is customary to use rollers made up of split
washers for this operation, which is an extremely important one if consistency and strength of the moulding are to be obtained. The self-employed who do not employ anyone but whose premises are regularly open to the public may only require fire extinguishers and warning signs; they will, however, need to be able to demonstrate that there is a
means of escape in case of fire. He made it around 1860 and patented his method for making it in 1865. 6 Sketch and describe four essential hand tools used by the body repairer. Acceptable alternatives are listed in the SVA Inspection Manual which is produced by VOSA. As in all non-fusion processes the important factor is that the joint to be
soldered must be perfectly clean. 3 Adjust the torch to obtain a slightly oxidizing flame. The replacement panels can then be fitted by welding them into position and finished by planishing, filing and sanding. Every car should be designed with the following crash safety principles in mind: Figure 1.7 Style artist at work (Ford Motor Company Ltd.)
The impact from a collision is absorbed gradually by controlled deformation of the outer parts of the car body. This technique is used in conjunction with direct hammering or planishing to achieve a final finish on the panel surface. The hotter the metal, the more rapidly the oxide film forms. Easy to apply. Toughened acrylic Aluminium or steel
fitments bonded to GRP roof sections; patch repairs to metal or plastic ganels; internal steel fixtures bonded to steel. If you start to grind plastics components you will get powdered glass as well as the plastics dust. Shallow panels often incor- porate a great deal of stretch forming of metal. The smaller drive sizes are used for turning small fasteners
badges and trim where little torque is required. 3.20.2 Pneumatic metal shear This tool uses the same action as snips, having two fixed blades and one blade moving vertically between them (Figure 3.46). So, do not tamper with such a device unless you are authorized to do so or there is a dangerous fire. The load on the beam acts as near to the
centre of the beam as possible to avoid side strain. (e) Included angle is the sum of KPI (SAI) and camber. 11 Manual metal arc welding sheet and metal plate. The many different types of Cold forming steels Carbon steels Alloy steels
Free cutting steels Spring steels Rust-resisting and stainless steels. In extreme cases like this it may be necessary to repeat this operation in several different places in the buckled section. Engineer's squares are available in three grades of accuracy: B (workshop), A (inspection) and AA (reference). The shears are capable of cutting sheet metal up to
a maximum of 2 mm Hand and power tools Figure 3.43 Air power chisel and accessories (Black and Decker Ltd.) 111 112 Repair of Vehicle Bodies (14 SWG) or 3 mm (10 SWG) aluminium, which more than covers the automobile requirements. If there is still work to be carried out, place more Cold Front material on top of the existing mound to delay
the conduction of the heat. When the ignition is first switched on, the warning light will illuminate for between three and five seconds to indicate that the system is functional and that the control unit is carrying out a self test of the system. POP rivets are manufactured from aluminium alloys, Monel, mild steel, copper and stainless steel. This method
is known as plug welding. However, this method is not recommended because of the very ragged uneven cut edge left by the torch. 15 Describe the use of a screw nail in coachwork. The guillotine consists of a bed, a foot treadle, two cutting blades, and a front, back and two side gauges. 5.3.3 U-channels and box sections A U-channel, as the name
stage in the drying of the applied adhesive. Not only can it produce straight, sharp bends, but the tools can be interchanged to give curves or radius bends. It is difficult because the welder must assume an awkward stance, and at the same time work against gravity, which means that the molten pool has a tendency to drop, making it more difficult to
secure a uniform weld and correct penetration. 8 With the aid of a sketch, show the lay-up of a laminate in the mould. The atmosphere is purged with nitrogen and hydrogen to eliminate oxygen. It facilitates the removal of that part from the mould. The atmosphere is purged with nitrogen and hydrogen to eliminate oxygen. It facilitates the removal of that part from the mould. The atmosphere is purged with nitrogen and hydrogen to eliminate oxygen.
the packing nut with the fingers only to prevent leakage but not so tight as to bind the needle. This consists of a clamp to which is attached the blade around which the metal is bent, and is operated by a hand lever fastened to the end of the machine. The working strokes are usually between 50 mm and 150 mm long, and this length can be adjusted to
suit varying conditions. Respirators give protection against abrasive dusts, gases, vapours from caustic solutions and solvents, and spray mist from undercoats and finishing paint, by filtering the contaminated atmosphere before it is inhaled by the wearer. This type of fastener has the advantage that it can be fitted before or after panels have been
Methods of joining 219 Figure 7.53 Selection of fasteners used in the automotive industry (Forest Fasteners) painted, because there is no danger of clogging during any spraying operation. As a general guide, service life and physical properties improve as the density increases for any given hardness. This consists of a rubber tube covered with cotton
braid enclosed within a rubber covering; the three layers are vulcanized into one (Figure 17.10). The importance of using the correct thinner for a 582 Repair of Vehicle Bodies particular type or make of paint cannot be overstressed, as many painting defects can be traced to the incorrect use of solvents. Timing control Represents the switches which
regulate the volume of current, length of current time and the contact period. The micrograin structure of carbon steel has the following constituents: Ferrite Pure iron. (h) Rear wheel reference toe The front to rear wheel alignment measures the amount of out of alignment of the front and rear wheels. A scanner, linked to a computer, passes over the
entire body and records each and every dimension (Figure 1.16). Celette UK ECO 2000 mobile lifting trolley which operates using a compressed air supply at a pressure of 7 bar. This glass was indirectly glazed on to the body and secured using a self-tensioning rubber weather strip fitted to the aperture. This should
allow a vehicle to move from the stripping area, on to the preparation area, next to the paint area, then into the refit area, then into the refit area, then into the refit area, then into the repair area, and finally into the inspection area. Bend tests are carried out on butt welds and are used to determine the soundness of the weld zone. Even with slower revolving machines,
polishing in one spot for too long can cause scorching and blistering of the paint film. Carefully rout along a line 40 mm above the undertray and following the rear wheel arch to the B-post cover. Availability of initial training and further training and further training and further training and following the rear wheel arch to the B-post cover. Availability of initial training and further training and f
equipment, precautions and means of escape in case of fire (Figure 2.16). Control unit, is central to the operation of the SRS and is a form of ECU. Only use the hook nozzle where openings are insufficient for access with the 360 degree tooling. The door derives most of its strength
from the inner panel since this is constructed mainly to act as a frame for the door. A low area can be raised by hammering round the outer edges in such a manner that the rebound action of the block tends to push the low area upwards to its original contour. Administration offices This could include manager's office, foreman's office, accounts office
with secretarial staff, and if possible office space for visiting insurance engineers. When welding, always wear adequate eye protection for the process being used. Rivets are also available in 5056A material, but should not be used in cases where high temperatures occur in service. 17 When is it considered necessary to fill with body solder, in
preference to any other method of repair? The problem is best controlled by eliminating the source of the pore generating gas. Working by the roadside is always hazardous, but you can minimize the risks by following a few simple rules: 1 Always wear a reflective safety vest (bright green or orange). Great strides have been made in the evolution of
the motor car since 1770, when Cugnot's steam wagon travelled at 3 mile/h (4.8 km/h), to the modern The history, development of the Austin 16 Figure 1.2 Development of the Austin car body 1909 to 1992, from Edwardian to modern construction
1976 Austin Rover SDI 1980 Austin Metro 1983 Austin Metro 1983 Austin Maestro Figure 1.2 (continued ) 7 8 Repair of Vehicle Bodies 1992 Rover 220 Coupé 1992 MG
RV8 Figure 1.2 (continued) vehicle which can carry driver and passengers in silence, comfort and safety at speeds which at one time were thought to be beyond human endurance; indeed, special vehicles on prepared tracks are now approaching the speed of sound. This has resulted in a major reduction in the number of welds required and the gauge
of metal needed, and at the same time has increased body stiffness and reduced corrosion. 13.15.2 Care of the hose On remote control jacks, where the hydraulic pressure is supplied to the ram through a hose, it is well to exercise care so that the hose does not become damaged. It uses the basic framework concerning safety colours and design
adopted by BS 5378. For most road vehicles the frontal area and the plan area are proportional; also the coefficient of lift and the coefficient of lift and the coefficient of drag are also proportional. The electrolytic product is available in single-sided and double-sided coating. 3.24.2 Ratchet wrench 3.23.9 Supa-sander (miniature belt sander) This machine (Figures 3.54, 3.62)
has a 20 mm wide belt and is designed to handle small and accurate convex and concave contours. He called them macromolecules; today we call them polymers. General-purpose safety goggles with a moulded PVC frame which is resistant to oils, chemicals and water. The pulling equipment can be attached to the bed, giving a pulling facility all
from one side of the joint only (Figure 12.6). Move the grinder in the same manner whether using it for the removal of paint, rough or finish grinding. These categories can be subdivided further into the various physical forms in which they can be made available, which include mastic putties for hand application, extruded sections for placing in
precise locations, gun grade compositions which have the advantage of speed and economy of application, and pouring and spraying grades. Most attachments are now snap-on connections and therefore have no threads and need no maintenance. This function ensures uniform spot welds, providing the correct setting has been found. By a Ministry of application, and pouring and spraying grades.
equipped with a built-in hydraulic scissor lift which can lift a weight of 3 tonnes to a height of 1.4 metres, allowing the operator to select quickly a suitable height for any type of repair undertaken. It can be added to as a workshop expands, thus catering for both small and large bodyshops (Figure 14.53). 2 Switch on mains supply and check that the
mains light (red) is on. By careful use of this adjustment a reading can be taken to 0.02 mm or 0.001 in (Figure 6.20). Planishing hammer This should be used to complete the shrink after malleting, as the hammer is better for levelling out the surface of the panel than the mallet. The alloys most commonly used in vehicle body work are as shown in
Table 4.9. 136 Repair of Vehicle Bodies Table 4.5 General characteristics of all wrought forms of aluminium alloys General characteristics Purity or alloy Temper or condition Cold forming 5251 F O H22 H24 H28 F O H22 H24 F O H24 H28 F O H22 H24 F O H24 H28 F
G V V G F 5454 5154 5083 6082 1200 3103 (a) (b) (c) (d) (e) (f) Machining Durability Inert-gas shielded arc (MIG or TIG) G G V V V V V V E E Ge Fe F V V G V E E V V G V E E V V G F E E V V G F E E V V G F F F F G G F F F G G Welding
resistance (spot, seam, flash butt or stud)b,c Oxy-acetylened Metal arc Materials are graded thus: E excellent; V very good; F fair; P poor; N not recommended. Interior roof heights of 5.5 metres not only give the height for a mezzanine floor but are more acceptable to others if the building is subsequently sold. Holding a piece of cloth over the air cap
pull the trigger to divert air down the fluid tube and drive the paint back into the container. The panel is heated up if needed and the pulling towers and a measuring system it becomes the Autorobot XLS II (Figure 14.55). The power sources
commonly used have constant-voltage characteristics, and controls are provided for voltage and inductance adjustment. 5 Adjustable pause time button With this button the pause time button which is in the stitch position. 3 Are your staff trained professionals who take quality seriously? The boundary line in the metal thickness
between the two areas of stress is called the neutral axis. A repair job cannot be successfully carried out before one has completely mastered the skill is the basis of all body repair work involving the use of hand tools. The colour can now be applied. They
and/or body to the paint. A key constituent in world growth, therefore, is the developing nations who are involved in the assembly and production of motor vehicles. Press the electrode against the workpiece to be welded. Always keep the threads in all attachments clean and free from grease. 5 Pressure control systems must be provided which will
shut down the spray booth if it is over-pressurized and activate an audio alarm. 13.11.1 Composition and requirements of body solder Body solder consists of 68.5 per cent antimony and 30 per cent tin. If the flux is not completely removed after use, corrosion is set up in and around the joint, and the risk of this happening prevents
the use of these fluxes in electrical trades and food industries. Existing workplaces will have until 1996 to comply. 7 Give three requirements of a body sealing compound, and describe one type of sealer used in vehicle repair. Figure 14.23 Mobile lift with mini bracket support system (Car Bench International) be wheeled away. Reynolds Number is a
ratio which gives a good guide to the air flow pattern and is an important consideration of what is called scale effect. The final finish is accomplished with a fine grit to get the surface smooth enough for re-finishing by the painting department. A separate estimating area away from the main workshop area is ideal, as vehicles will need to be
thoroughly inspected all round and underneath. The vehicle is secured to the anchor pots using tie-down chains and wedge anchors which are fastened to the anchor pots by pulling each chain tightly by hand to remove excess slack and then inserting it into the fork of the wedge anchor. It is strengthened by the use of cross members to carry the rear
seat passengers. The roof, another pre-formed panel, is similarly shaped and is the first to be fitted. Press the trigger button once only. Metals and non-metals used in vehicle bodies Alloy 5154A is suitable for use in car panels which are to be pressed into shape; it is supplied in either annealed condition or H2 condition, which are the most suitable for
press work on vehicle bodies. The absence of chemical change means that the dried film does not increase in chemical resistance, and is readily softened by the original solvent. If this is then satisfactory it is trimmed to the correct size. 10.10 Single-sided spot welding,
single-sided spot welding equipment has become more widely used in the vehicle body repair industry. Sports This is a two-seater vehicle with a highperformance engine and a folding or removable roof (hood) (Figure 1.6f). The torch has conventional 9.11.1 Flame cutting, known also as oxygen cutting, is made possible by the fact that
oxygen has a marked affinity for ferrous metals which have been previously heated to their ignition temperature. Consequently spray booths and ovens can be used to their full capacity throughout the working day. Where costs permit, a coat of sealer could be applied prior to the finishing colour. It is one of the few processes which permit the rapid,
satisfactory welding of tiny or lightwalled objects. The manufacturers are now using different types of steel to construct their vehicle bodies, the main three being low-carbon steel, galvanized steel and high-strength steel. An estimate must be competitive to be acceptable to both the private car owner and the insurance company, for the majority of
collision jobs are paid for by an insurance company. 14.5.6 Motor Insurance company. 14.5.6 Motor Insurance endustry became concerned about the escalating cost of vehicle accident damage repair work and its effect on motor insurance premiums. Mastic, bitumen compounds and putties of various kinds have
been used since the invention of the horseless carriage. In selecting a dolly it is advisable to choose one that is rather light and slightly flatter than the panel being planished. 37 Why is it essential to check the steering geometry of a vehicle after major repair work has been carried out? 10.10.1 Single-sided spot welding equipment This equipment
(Figure 10.21) ranges from 2500 to 9200 amperes as follows: 1 2500 A using three phases at 415 V. Workshop staff must know the risks involved and should be aware of the procedures necessary to combat fire. With drying times like this, the savings on energy costs and the
gain in turnover of work are obvious. The interior dimensions of the car are part of the initial specifications and not subject to much modification. These wrenches are useful because they are manufactured in a range of sizes and each one can be adjusted to fit many sizes of nuts (Figure 3.38). There are two ways of welding thermoplastics. Overspray
thus created should be overcoated with a clear blend-in material to protect the overspray when burnishing is done. 6 Describe the difference between laminated safety glass and toughened safety glass and toughened safety glass. 16.11.1 Storage precautions Liquid polyester resins are flammable but not highly flammable, most of them having a flashpoint of 31 °C. 'Non-drip'
paint is an obvious example; another is gelcoat resin. • Ensure that all replacement parts are of the correct type and in good condition. The main requirement to measure the force to which the occupants will be subject in collision. 24 List the
stages of development in the creation of a new vehicle body design. When bolted to the backbone chassis this results in high torsional stiffness which gives the car exceptional handling characteristics (Figures 16.30 and 16.31). The outer panel flanges over the inner panel around all its 50 Repair of Vehicle Bodies edges to form a single unit, which is
then spot welded or, in some cases, bonded with adhesives to the frame. Besides fabrics manufactured from twisted yarns, it is now the practice to use woven fabrics manufactured from rovings. Phillips screws have a four-pronged funnel-shaped depression in the screw head, and are known as cross-heads. A good joint
has only a very thin film of solder, as too much solder weakens the joint. 8 If a limb has been trapped, use a safe jack to free the limb. They are supplied as a set having a number of pivoting flat blades each of hardened and tempered steel, cut to a specific radius size. The main group of electrodes include mild steel, high-carbon steel, special alloy
steel, cast iron and non-ferrous aluminium, classified as bare and flux-covered. Direct damage Primary damage which results from an impact on the area in actual contact with the object causing the damage. The file blades are specially designed so that they do not remove too much metal, and the milled serrations are wide apart and curved to
prevent clogging when filing metal which has been painted, soldered or plastic filled. This tool could be a worthy addition to any body shop because of its time saving over conventional methods and its neatness of finish. This avoids discomfort and fatigue caused by the effort of having to inhale air through filters, permitting longer working periods.
This is termed the equal-pressure or high-pressure cutting torch. 18 Decide what more needs to be done to eliminate or control risks, in accordance with the accepted priorities of risk prevention and showers, rest room, canteen, first aid room. Always ensure that the
connections are in place before re-fitting the door trim. Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.68 Two extraction points with self-closing flaps (Minden Industrial Ltd.) Figure 3.68 Two extraction points with self-closing flaps (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool with hose attachment for centralized system (Minden Industrial Ltd.) Figure 3.69 Air tool w
Sketch and describe each of the following hand tools, giving an example of the type of work it would be used for: (a) cross-pein and finishing hammer. The weight is 3 lb 6 oz (1530 g). Centred around the Celette MT10 mobile bench and Metro 2000 measuring system, Metro 90 is a complete package including a
pulling and clamping system, loading kit and full range of accessories (Figure 14.20). As the electrical current from the control unit can operate the SRS independently of the battery, obviously precautions must be taken to avoid accidental operation before working on the SRS. (e) Summon medical assistance as soon as possible. Both polyamide and
polyester are giving designers new scope for attractive colours and variation in seating upholstery and in panels, while fully meeting light fastness and other performance standards. One firm specializing in this type of equipment is Infrarödteknik AB, whose IRT 100 unit has a reflector coated with a thin layer of gold to give maximum reflectivity and
long life. Since the front and rear suspension units are connected, either directly or through the medium of a front or front and rear subframe, distortion of the body shell means a disturbance of the running wheels one with another. It was a modified roof sealer, and proved to have many applications in body production. These are
now losing favour to two-pack materials. Another application of bolting is in cases where fabrications are too large for workshop assembly; then the article is made in sections which are assisted resin injection moulding The bonnet is a pressure assisted
moulding of sandwich construction with polyester resin exterior on either side of a rigid urethane core. UNISON's 25 steps are: 1 Set up a programme of risk assessment UNISON have produced a step-by-step approach to risk assessment, the 25 steps are: 1 Set up a programme of risk assessment.
convince the repairer whether a more precise check should be made by using the dropline method, or a jig alignment system. Wheeling can therefore be used, first, for shaping a flat metal blank to a finished doublecurved panel; second, to finish a preshaped panel which has been hollowed or raised to its final shape; and
third, to smooth or planish a preshaped panel to its final finish. 12.2.5 Helium mixes These are specially formulated for MIG welding of stainless steels. You will have instant access to the progress of any job: most systems include this as standard. 13.12 Chemically hardening fillers (plastic fillers) Although body soldering still provides the best quality
of filling for a repair, there are cases where an alternative method is required. As with all forms of heating, care should be taken with these heaters if there is a risk of combustible dusts or flammable gas hazards. 16.5.5 Adhesives used with GRP Since polyester resin is highly adhesive, it is the logical choice for bonding most materials to GRP
surfaces. Steels over 0.83 per cent carbon up to 1.2 per cent carbon are a mixture of cementite and pearlite structures. It is important when pulling damaged sections back to their original shape not to apply all the force at one place at the same time. A number of different weaves and weights is available, and Reinforced composite materials 539
Table 16.2 Advantages and disadvantages of glass fibre reinforcement Advantages Uses Disadvantages Uses Disadvantages use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in hand lay-up Woven rovings Easy to handle Bidirectional strength Limited use in handle
shape High strength Smooth finish Fine texture Spray-up Local longitudinal strength Mechanical bond for bulkheads Making tubes To increase longitudinal and transverse strength Chopped strand mat Woven cloth Surface tissue Poor interlaminar adhesion Traps air, causes voids High cost Various General-purpose reinforcement Sheathing As a fire
barrier Reinforcing gelcoat thickness may range from 0.05 mm to 9.14 mm, with weights from 30 g/m2 and will be of plain, twill or satin weave. Plastics materials are made from petroleumbased products, this means that they are highly
flammable so you must avoid high levels of heat and naked flames. The stud is welded to the paint coating. Major accident damage 419 Figure 14.21 The ECO 2000 mobile lifting trolley (Celette UK) 14.2.7 Car Bench alignment and repair systems There is a wide range of body repair
equipment available from Car Bench. The boot lid is made in a similar fashion. These records are usually kept in an accident book. 3.16.3 Shrinker and stretcher machine This is a versatile sheet metal working tool, and will quickly and easily pull curved shapes into steel up to 18 gauge (1.2 mm) or aluminium up to 14 gauge (2.0 mm) (Figure 3.34).
Check engine starting. The effect of the build-up of exotherm is to cause excessive shrinking of the moulding and internal stress. To give some idea of the potential problem, consider one gallon of petrol: it will evaporate into 33 ft3 of neat vapour, which will mix with air to form 2140 ft3 of flammable vapour. To use floor space to its best advantage, it
is important to decide exactly what work will be carried out, how many employees will be needed, and what equipment of the holes. Rivet material The choice of rivet material will normally be related to the strength required from the riveted joint. At the
end of a period of treatment the oven is opened to allow the work to cool down. 22 Describe typical repair situations that would use a pincer welding gun and a single-sided welding gun. Dual phase (DP) steel has a yield strength of between 500 and 1000 MPa. It is made by adding carbon to enable the formation of (hard) martensite in a more ductile
ferrite matrix. When taken from the jig the panel retains the curved shape with the flange following its contour. It must be borne in mind that the speed of the vehicle is governed by (a) the type of power unit, (b) its stability and manoeuvring capabilities and (c) its shape, which is perhaps at present one of the most important features in high-speed
travel. The soft type is more complicated in its removal owing to the necessity of removing a large amount of trim in addition to the windscreen and rear window in some cases. It is also used for raising domes or hemispherical shapes by mallet or raising hammer. A small soldering tool is not suitable for soldering any heavy or comparatively large
sheet metal articles, because the heat loss by conduction is too fast to allow an even temperature to result which will allow the solder to flow freely and sweat into the seams or joints. Preparation area is of critical importance because the quality of preparation fixes the final finished paint level. Start the second
cord from the bottom left-hand corner and proceed to the right, following round up to the top left-hand corner. The oxyacetylene flame is also employed for cutting metal, case hardening and annealing (see Section 5.2). Third is the combination bevel, which consists of stock, split blade and auxiliary blade. The electrode tip should maintain its original
profile if good spot welds are to be achieved. The only accurate method of doing this is to fasten the appropriate pieces to the jig, making sure that the joints are butted and not overlapped together, leaving no gaps which may need extra welding filler rod which leads to later difficulties in planishing. Using the flexible lance, spray inside the front
cross member and any other reinforcing sections. 9 With the aid of sketches, describe three methods of edge stiffening a sheet metal body panel. When welding position (Migatronic Welding Equipment Ltd ) Figure 12.24 Typical MIG/MAG welding positions joint, the best procedure is
usually to start the weld at the top of the joint and pull downwards with a steady drag. Only welding materials reaching the design weld strength should be used. Keep the surface of the hammer face clean and highly polished. 2.8 Maintain the health, safety and security of the work environment 2.8.1 Guidelines, statutory regulations and safe systems
for health and safety protection are followed It is the duty of every employee and employer in the motor industry to comply with the statutory regulations relating to health and safety and the associated guidelines which are issued by the various government offices. It is imperative that all traces of paint remover be thoroughly rinsed off, otherwise it
will cause damage to any subsequent paint system applied to the job. Sinkage This trade term can have two interpretations. It is good practice to ensure that the windows are wound down before testing the central locking mechanism. (g) Set back Front wheel is ahead of the other. Amperes Amperes or
amperage refers to the amount or rate of current that flows through a circuit. 18 Give practical reasons for wearing safety gloves in the workshop. Only the owner of a cylinder can authorize its scrapping, and before this is done the cylinder must first be destroyed as a pressure vessel. This is particularly important in winter. In this process the metal
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pieces pass between roller-type electrodes. The size of the grains can be controlled by the temperature and the duration of the heating, and the speed at which the steel is cooled after the heating, and the speed at which the steel is cooled after the heating, and the speed at which the steel is cooled after the heating, and the speed at which the steel is cooled after the heating.
is dispersed, and then cooling it at a rate which will produce the desired structure. Fluxless brazing of copper High-purity alloy for vacuum assemblies Pure silver AG13 AG14 AG18 AG19 AG20 AG21 59-61 54-56 48-50 84-86 39-41 29-31 25-27 20-22 15-17 - 29-31 35-37 12-16 21-23 21-25 - - - - 6.5-8.5 14-16 - - - 4-5 - - 0.025 0.025 0.025
0.025 0.025 0.025 - 1.7-2.3 - - 1.7-2.3 - - 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.7-2.3 1.
to the repair procedure adopted in major collision damage. The Lotus VARI process provides a method of moulding fibre reinforced composite panels from matched tooling. 3 The centre head, which is V-shaped with two internal surfaces. 12.16 Equipment maintenance and safety For the best results the gas and contact nozzle of the welding torch
must be cleaned of welding spatter at regular intervals. In body work applications the heat input is limited on each side of the weld owing to the shielding gas; this has the effect of reducing possible distortion to a minimum so that adjacent parts do not get so hot as to damage trim, screen rubbers and windscreen glass. Manufacturers' specifications the
concerning this gap are available; however, a good general rule is that this clearance should be between 3 mm and 6 mm wide. To carry out this type of repair (see Figures 14.101a-f), the initial procedure is to make certain that the sections to be joined are from identical models. There are several firms worldwide who specialize in these types of
materials and the equipment for applying them. Each individual weld contains a number of overlapping spot welds, resulting in a joint which has good mechanical strength but which is not pressure tight. (At the powdery stage care is needed to avoid dislodging the flux, and it is often preferable to apply flux with the filler rod.) When the flux is molten
the brazing alloy is applied, preferably from above, so that gravity assists in the flow of metal. This type of torch is designed for small diameter feed wires, is extremely flexible and manoeuvrable and is particularly suitable for welding in confined areas. At this stage an initial batch of cars is built (a pilot run) to ensure that the plant facilities and the
workforce are ready for the start of full production. For difficult or unusual work, the experienced body repairer can switch to manual setting to control the unit's weld heat and time tolerance controls (see Figure 10.18). 22 With the aid of a sketch, show a repair application which involves MIG/MAG spot welding. First is the plain engineers' bevel,
which has an offset slot for testing angles which are not possible with a straight slot. The outer end of the spindle has a ratchet stud and a thimble which is graduated around its bevelled circumference. Use water dispersant if necessary. Buckles The resulting distortion of body panels after collision. Air Figure 17.7 Principal parts of a stationary two-
stage compressor Automotive finishing and refinishing The compressed air is stored in the receiver (or storage tank) for a cooling-off period, during which moisture and vapours within the air will condense and collect on the floor of the tank. For this reason the air line must be of sufficient internal diameter to carry a satisfactory volume of
compressed air into the spray room. The magnetic test liquid is sprayed along the weld. It is, however, a potential source of ignition for all of the fire classes mentioned above. The points are next screwed towards each other so that they just touch both sides of the part to be measured. To comply with COSHH Regulations, vinyl disposable gloves must
be used by painters to give skin protection against toxic substances. Care should be taken to avoid contact with the skin, and the wearing of suitable clothing, especially gloves, is highly recommended. 6 Always use props when vehicle cabs or other panels are raised. Sizes vary from 6 in Hand and power tools 103 of the cutters. Next came the
universal measuring system or bracketless jig, which involved a measuring bridge or in some cases laser measurement. Can be painted over with primer and fillers after curing, is non-shrinking, can be brushed and smoothed with a spatula. There are also engineering features such as impact energy-absorbing steering columns, head restraints,
bumpers, anti-burst door locks, and selfaligning steering wheels. These pots. Part panel replacement has long been established as an effective way of repairing body damage on all cars. The BS classification of an electrode is indicated by the following coding, in the order stated. 10.4 Resistance seam welding (Figure 10.7) is like spot
 welding except that the spots overlap each other, making a continuous weld seam. Some vehicles have an SRS OFF switch. Service conditions It is posible to indicate conditions using a threepoint scale: Benign Room temperature, where components are not expected to suffer high loads or impacts. I am also grateful for the efficient help given by the
library staff of the college. To purchase a site without regard to possible future expansion could be a mistake. It may be necessary to have a tunnel running the length of the floor in the centre to clear 40 Repair of Vehicle Bodies Figure 1.39 Espace high-rise car showing composite panel cladding (Renault UK Ltd ). Body lock pillar A body pillar that
incorporates a lock striker plate. 23 State the factors which determine whether damaged panels should be repaired or replaced. The torch is fully insulated electrically and has a quick release collet arrangement to facilitate convenient adjustment or changing of the tungsten electrodes. 502 Repair of Vehicle Bodies The nature and volume of work to
be undertaken will largely depend on the type of building and the total area needed. Broad padded steering wheels are used to prevent head or chest damage. Mercedes car produced. The realization that plastics are, in their own right, engineering materials of high merit has led to rapid advancement of material and application technology, with the
end result that plastics have gained a firm and increasing footing in the motor vehicle. Although older fire extinguishers are colour coded, new ones are all red in colour with labelling to identify their contents and applications. 7 Explain the types of materials which are used in the manufacture of blind rivets. Connect two earth clamp plates as close as
possible to the area to be welded. The benefit here derives from the fact that stiffness is a direct function of thickness. The size of a drill is found by inserting the drill in the holes until a hole is found which fits the drill exactly. Normally you will have no problems if you follow these rules: 1 Do not let any materials come into contact with the skin, eyes
or mouth. The repeal of the Red Flag Act. Suitability for the volume of work handled. 14.5.8 Glassmatrix II system Glass's Guide Services, famous for their pocketbook on car prices, offer a computer-based estimating system using Thatcham time schedules. 48 State the purposes of the inner reinforcement members of a bonnet panel and say how they
are held in place. The chassis clamps are bolted to the arms of the bench mountings and are fitted with tooth jaws which grip the sill flanges of the weld the machine lowers the
resistance of the steel by melting the coating, causing it to flow from the weld. As well as the normal workshop safety procedures, there are a number of specific hazards relating to plastics materials which you must take extreme care with, let's have a look at them before discussing some of the repair procedures. Both stage 2 research is
observed by a work study engineer, who determines the most effective method of repair. This is particularly true in those shops where expensive air conditioned spray booth ovens have been installed. 3 Disease - if a doctor notifies an employer that an employee suffers from a reportable workrelated disease then this must be
reported to the HSE. After changing parts the system will need re-charging and re-setting - this requires special equipment. 3 The lead and tin must not separate, as it is worked in vertical or overhead positions. When the more popular righthand snips are used, the waste metal forms a coil to the left of the cutting blades, thus causing little distortion
to the surface of the sheet or panel being cut; similarly, with the left-hand pair of snips the waste metal passes to the right of the cutting blades, leaving the undistorted sheet or panel on the left. With this construction, the bolts can be easily removed and the entire front (or in some cases rear) subframe can be replaced as one assembly in the event of
extensive damage. 6 What is meant by the term 'arc length'? A method called pack carburizing is often used in small workshops. The transfer of metal through the protected arc column provides greater efficiency of heat input than that obtained in the TIG welding process. Holding the gun too far from the surface creates excessive overspray and a
sandy finish (Figure 17.26). Synthetic paints These are mixtures of drying oils and synthetic resins. Again, follow all the necessary regulations. The combination used to obtain this external pull employs toes, links and clamps on the end of the push ram and extension tubes. Brush heavy soiling. The filaments are then drawn together to form a strand
which is wound on a removable sleeve on a high-speed winding head (Figure 16.2). Although aluminium is more expensive than steel, it is easy to work and manipulate and cleaner to handle. Austenitic/ferritic duplex Usually containing 22 per cent nickel, 3 per cent molybdenum, and 0.15 per cent nitrogen. Aluminium oxide is
the most important of these. Roof supports Wherever possible the working area should be clear with no roof supports (single spans of 30 metres), and this point should always be taken into consideration when working on a new workshop layout. Heat application With resistance welding the welding time is controlled by either electronic or e
(electrical) devices. The choice of tower, plus its required location and rotation, is clearly marked on the information sheets which accompany all MZ sets, showing both plan and three-quarters view. Craft techniques and minor accident damage 375 13.14 Application of the body jack 13.14.1 Pushing Figure 13.51 Hydraulic body jack (Blackhawk
 Automotive Ltd ) Pushing (Figure 13.53) is the simplest operation of all and is achieved by inserting the ram between two points and operating the remaistress might cause the crack to continue during or after the repair, it is a good idea to drill a small hole at each end of the crack
This gives the necessary clearance needed to enable the mobile bench to be moved freely around the workshop. The latter became established in this country in 1952. 15.1.2 Choosing a site The location of any building or bodyshop is a crucial factor in its profitability: no matter how efficient may be the management and staff, customers will not be
encouraged to bring their vehicles for repair if access to the site is difficult. In addition, a special feature which makes the buttons particularly suitable for the automotive industry is the various styles of textured and colour-moulded heads to match adjacent panels (see Figure 7.61a). Where workshop space permits, a better proposition would be to
install a low-bake oven which can be joined up to an existing spray booth with sliding shutter doors to seal the two areas (Figure 17.53). The main types of resins are polyesters, vinylesters, epoxies, phenolics, cyanate esters, silicones, polyurethanes, bismaleides (BMI) and polyamides. Clean, dry workshop air can be used when severing thin sheet
steel, but it is recommended to use an argon/hydrogen mix or nitrogen when cutting Figure 9.27 Simplified diagram of plasma arc cutter (Motor Insurance Repair Research Centre) gauges in excess of 5 mm, and for stainless steels, as these gases produce a higher thermal conductivity and will transfer more heat to the material to be cut. Make sure
that any metal tools such as hammers, dollies and spoons have smooth edges to avoid gouging the aluminium panel. The self-aligning steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the steering wheel is designed to distribute force more evenly if the driver comes into contact with the driver come
the booth. In general the method of repair is to analyse the crash, establish the order in which damage occurred, and those that do with certainty - the inert gases, notably argon - are relatively expensive. Economic considerations The
cost of any weld connection will be influenced by the joint design. Figure 14.125 Wet bay (Autoglym) Valeting should be carried out in a well lit, dry bay with adequate working space all round the vehicle. Absorbent granules should be carried out in a well lit, dry bay with adequate working space all round the vehicle.
inner body, which rests directly on the chassis frame and which forms the base for all internal trim equipment, is a complex GRP moulding. Considerable skill is needed to control the thickness of the laminate when using the resin glass spray gun. The stake is used for riveting, seaming and forming. Plain Reinforcing fibres The mechanical properties
of the composite material are usually dominated by the contribution of the reinforcing fibres. The flame should then be played over the joint so that the solder and flux flow freely through the joint by capillary attraction. A major non-conformance would be an error with possible adverse effect on quality. There were other ways in which this situation
could have been dealt with, but this one was acceptable because it provided a very quick solution and caused the minimum amount of damage to the vehicle. 4 State the correct pressures for full cylinders of oxygen and acetylene. The processes of hollowing and raising in sheet metal are often applied together in the making of articles in the form of
double-curvature shapes, bowl-like shapes, etc. In the automobile field the availability of resins of various types and an extensive range of reinforcing materials has widened the scope of the designer. At this stage high spots may develop due to stretching of the metal, and hot shrinking of these points will be necessary. This laminate can then be
tapped for study or countersunk for cap screws. An overlap occurs when the pool runs down to the lower side of the weld and solidifies on the surface without actually penetrating the metal. Various types of mask are available for use in a variety of environments where contaminants vary from nuisance dust particles to fine dusts and toxic mists.
14.5.5 Insurance procedure 14.5.4 Computer estimating Under the Road Traffic Act the car owner is obliged to insure his vehicle either under third party insurance cover or fully comprehensive insurance cover. In larger sections, retract the lance slowly so that one sweep will sufficiently cover all surfaces. 14.4.5 Partial panel replacement The reason
for replacing only part of a panel can vary according to the type of repair. Major accident damage 477 Figure 14.123 Weld dressing (Welwyn Tool Co. Ltd.) Welding defects A tack weld can be broken and restarted if panel alignment is not achieved on the first attempt. For assembling trim components at the end of an assembly line, hand or robot guns
can be employed. Early attempts to use glass fibre as a reinforcement were disappointing. There is no doubt, also, that the wet lay-up process on vertical surfaces would be virtually impossible if thixotropic fillers were not available. Where necessary, anneal creased sections with the oxy-acetylene welding torch prior to removing them. It should next
be tack welded at several points; then the clamps should be removed and the panel rechecked for alignment. A major feature of the Dataliner is that measurement and pulling can be carried out at the same time. A grid dolly has a serrated face to reduce the possibility of stretching in the panel. 26 List the advantages of the resistance spot welding
technique used in the repair of vehicle bodies. The coloured lenses are classified according to the current used. The principal components of most machines are welding transformer, rectifier, choke coil, wire feed unit, gas solenoid valve and electronic control box. Its weight is 2 lb 12 oz (1247 g). The normal procedure is to place the newly made
component in the oven, or autoclave, then rack up the temperature gently, over a period of about 30 minutes. Whenever possible the operator should draw the cutter towards him. Curved sections, ribbing or stiffening sections, notching plates, corrugating sheets, and punching holes in plates can also be formed. Square edge preparation is used for
material up to 3.2 mm thickness. Aluminium alloys are made by adding specified amounts of alloying elements to molten aluminium. When spraying local repairs the paint can be applied at the supplied viscosity, but for a large area a small quantity of the appropriate thinner may be added to obtain better atomization and to provide a smoother
coating. Moreover, if the panel has to be fastened to the jig this can be done by putting small panel pins through the metal into the wood jig. It was known as Dum Dum and is still in use. It will fit any drill chuck, air or electric. Where a steel component with equivalent damage would be replaced at some cost, the repair of the plastic 474 Repair of
Vehicle Bodies part can save time and expense, particularly when winter accident periods make great demands of the vehicle repairer's parts stock. Any form of applied heat to HSS and AHSS panels should be avoided, this includes trying to anneal or soften the purposes of straightening, heat shrinking or oxyacetylene cutting. When set
at gas test, the gas flows by pressing the switch on the torch handle. 25 Define the term 'HSLA steel'. 1.5.12 Rear wheel arch assembly This assembly as an integral part of the inner construction of the rear quarter panel. 6 When using hand tools only, the damaged area should be roughed out to its original shape, although this
operation can also be carried out using hydraulic equipment to push the damaged section back to its original shape. Heating of enamels etc. In some instances hardwood blocks are hollowed out to different depths and diameters. (mm) Current (A) Voltage (V) Wire feed speed (m/min) Welding speed (m/min) 3.0 6.0 10.0 Argoshield 5.0 Argoshield 5
Argoshield 5 Argoshield 5 Argoshield TC Argo
15 12 14 14 1.0 1.6 3.0 Butt weld, flat position Butt weld, overhead Butt weld, overhead Butt weld, overhead Butt weld, overhead Butt welding of aluminium While most welding of aluminium. The flux helps to clean the surface chemically so that the molten
solder can flow and penetrate into the metal, forming a strong joint. On paint and fibreglass it leaves a perfect key for primers. The idea is to be able to take the waterproof gear off and be dry underneath. In the gas shielded arc process, heat is produced by the fusion of an electric arc maintained between the end of a metal electrode, either
consumable or non-consumable, and the part to be welded, with a shield of protective gas surrounding the arc and the weld region. Metals and non-metals used in vehicle bodies Thin parts must be tough and resistant to the occasional impact. Any exposure to a naked welding arc, even for a fraction of a second, is sufficient to damage the cornea of
the eye (welding flash). I would like to thank ICI's Autocolor International Bodyshop Planning Consultant, Mr Ernest Godfrey, a partner at Pickles Godfrey Design Partnership; Martin Ferguson, Planning Manager of Dana Distribution Limited; and Gill Nichol, Editor of Bodyshop Magazine; for helping me compile the chapter on bodyshop planning. 2
The first coat is too dry before the second coat is applied. The sound deadening properties of a material are related to its ability to damp out panel vibrations, and this in turn is related to some extent (but not solely) to its weight per unit volume. Unless there is a complete change in the design and construction of the motor vehicle, the spray gun will
be used for many years to come. Owing to its small size and light weight it is ideal for grinding in confined spaces and tight corners. Employers will have to take three key steps: 1 Avoid hazardous manual handling operations wherever reasonably practicable. The only time that they receive a coat of paint is in the electropriming process carried out by
the vehicle manufacturer. 5 State two important conditions to be observed when using a wheeling machine. Snips are available in a variety of types and sizes and are made from the finest tool steel forgings. Churchill Wholesale Welding Supplies Ltd A. 583 be increased where angles are introduced into the system, and in consequence the number of
angles should be kept to a minimum. Many bodyshops favour a combined entrance and exit for ease of control and to allow easier traffic movement, but often site conditions dictate. Return on assets This is the assessment of how the workshop and equipment are being used. The result of this reaction is to interconnect the different polyester units to
form the three-dimensional cross-linked structure that is characteristic of thermosetting resins. Mobility, portability and ease of storage. Acetylene Cylinder colour: maroon. These machines normally use a hard disc for grinding. Generally the extra strength of HSS is brought about by changes in the steel microstructure during the steel processing.
15.2.8 First aid First aid equipment should be supplied at set points throughout the workshop, and staff should be encouraged to attend first aid classes. Blind rivets are manufactured by several companies under brand-names, the most famous of which is POP. This can usually be reset by pressing a button on the actual sensor. When the torch
handling is smooth and even, the weld bead will be of consistent height and width with a uniform closely spaced ripple. In the first instance, if the device is electrically operated see that it is properly connected and earthed. • Attach anything to, or otherwise mark components. It is most important to remember to release (turn out) the adjusting screwn and earthed.
on the regulator before opening the cylinder valve, otherwise the tremendous pressure of the gas in the cylinder is forced into the working pressure gauge and this could result in gauge damage. These must be brought back to the 454 Repair of Vehicle Bodies Figure 14.91 Simultaneous multipulls on two vehicles (vector pulling) (Blackhawk
Automotive Ltd ) Figure 14.92 Simultaneous multipulling using direct pulling (pulling towers) (Kroll (UK) Ltd ) equivalent of their original shape without wrinkles or excess thinning of the metal. The overhead measuring bridge is a standard feature of the Globaljig. The second method, which is less
time consuming, can be used if the dent is small and not very deep. In the case of the breathable leathercloth, the air permeability of the fabric has to be controlled. Iron and low-carbon steels should be heated to about 900 °C and allowed to cool very slowly to ensure maximum softness, as far as possible out of contact with air to prevent oxidation of
the surface; this can be done by cooling the metal in warm sand. Sharp or hot objects could easily penetrate unsuitable footwear such as canvas plimsolls or trainers. Control boxes are available to convert conventional MIG welders to weld aluminium (Figure 13.75). 4.13.4 Manufacturing processes There are many different methods of manufacturing processes.
plastics components. 4 The glass fibre reinforcement provides the strength of the repair, and either chopped strand mat or cloth must be used to achieve the required strength. 15.2.7 Valeting The vehicle should now be back at the valeting bay for both interior and exterior valeting, to emerge as good as new with the minimum wasted time. Often therefore a components are the valeting bay for both interior and exterior valeting bay for both interior valeting bay for bo
only initial evidence of crazing is that the resin has lost its surface gloss. This system was made possible by the use of computeraided design (CAD) equipment. Residual adhesive can be removed without damaging the body. These materials are frequently used to reinforce gel coats. The fuse will blow instead of starting a fire in the case of a short
circuit. 17.19.7 Excessive overspray Overspray can give a dry spray appearance and is invariably the result of faulty spray gun manipulation. A centre zero scale is useful for measuring the current flow when working on vehicles, as it can show the direction of the flow and you do not need to change the connection of the leads. These are direct and
vector pulling. The system can also be used as a building jig for classic cars or tubular framed sports cars, or as control equipment for estimation or diagnosis of damaged or previously repaired vehicles. Slope of angle should be 8:1. Typical welding goggles are shown in Figure 9.13. 290 Repair of Vehicle Bodies If the reject alarm is heard (a high
pitched pulse note: red light illuminates) for more than three welds, reduce the spot size setting until the reject alarm is only activated two or three times. If necessary, sponge or brush to remove grime. 45 State one advantage of self-tapping screws. If the operator of the bodyshop calculates the solvent usage to be less than 2 tonnes, then the best
advice would be to monitor solvent usage in order to demonstrate the fact to the local authority. The wired edge, although not so popular as in the past, is still used where impact strength is the most important requirement of the edge. Door hinge pin remover and replacer This is designed for the removal and replacement of hollow hinge pins used on
vehicle door hinges (Figure 3.16d). Satin weaves are very flat and have low crimp which means that they have excellent mechanical properties and drape well. This is a recognized loss, and therefore less solids are deposited per coat. The sandbag is resilient and at each blow of the mallet allows the metal to shape into the sandbag. That is, the body
parts can not necessarily be made of thinner metal as they are likely to sag. The material was formulated for the refinisher to enable him to match more closely the original finish of the car manufacturers. 15.6.9 Manual Handling Operations Regulations 1992 These will apply to any manual handling operations which may cause injury at work. If the
 which permits the stake to be fastened directly to the bench. Tipper body panelling. The alignment of the engine with the clutch and transmission may be affected. The panelling was of fabric, first canvas, then a layer of wadding calico and finally a covering of leather cloth. It is also imporant to operate the gun at the correct angle. The weld area is
 melted under the arc; the torch is withdrawn backwards for a short distance from 6 mm to 3 mm along the line of the seam and the filler rod is inserted in the molten pool (Figure 12.12). The top wheel and housing can be swivelled round through 90° to make it more accessible when wheeling certain shaped panels. Hook nozzle This produces a highly
 atomized forward-directed full-cone jet which gives a powerful long range and, at the same time, good dispersion. 250 Repair of Vehicle Bodies Figure 9.3 High-pressure welding equipment (Figure 9.3) comprises: 1 2 3 4 5 6 7 8 9 10
Cylinder of dissolved acetylene Cylinder of oxygen High-pressure welding torch with separate oxygen control, and various-sized tips for different thicknesses Acetylene canvas hose with clips and fitted with hose check valves
(red for acetylene and blue for oxygen) Acetylene flashback arrester and oxygen flashback arrester Keys to fit cylinders and spanners for gland nuts, and for fixing the regulators to the cylinders and spanners for gland nuts, and for fixing the regulators to the cylinders and spanners for gland nuts, and for fixing the regulators to the cylinders and spanners for gland nuts, and for fixing the regulators to the cylinders and spanners for gland nuts, and for fixing the regulators to the cylinders and spanners for gland nuts, and for fixing the regulators to the cylinder fixing the regulators to the cylinder fixing the regulators and spanners for gland nuts, and for fixing the regulators are fixed for fixing the regulators and spanners for gland nuts, and for fixing the regulators are fixed fixed for fixing the regulators are fixed fixed for fixing the regulators are fixed fixed for fixed 
 arc does not penetrate the metal then stop, as the machine is either on the wrong setting or not sufficiently powerful for the thickness being cut. 5.2.3 Heat treatment of aluminium alloys An aluminium alloy is heat treated by heating it rapidly, usually by quenching. 6 Set the wirea treated by heating it rapidly and then cooling it rapidly are treated by heating it for a prescribed period at a prescribed temperature, and then cooling it rapidly are treated by heating it for a prescribed period at a prescribed temperature.
speed and voltage control and select the mode of welding operation. The argon and the electric current are supplied to the torch through a combined cable and gas hose. Plain lap joints, where the adhesive is primarily loaded in either shear or compression. This fastener is designed to be used on thin-gauge materials for high-strength joints suited to
either hollowing or raising when shaping metal by hand to a double curvature shape. The use of wooden bossing hammers and purpose-made high density nylon hammers are recommended. In a body repair toolkit the basic tools are the hammer and dolly. 10.10.2 Setting up equipment for single-sided spot welding 1 2 3 4 Figure 10.26 Carbon pencil
shrinking attachment (Stanners Ltd ) 5 Welding captive nuts to vehicle This piece of equipment can be used to be replaced (Figure 10.27). In addition it often provides the retaining lip for the rear seat cushion, which is usually made detachable Figure 1.40 Body shell
intended to cut only flat sheet metal. GlassWord can be used to create parts order lists, letters to customers, invoices, and other documents using either plain paper or printed business letterheadings. However, in paint shops where spraying equipment is not available, this material still has a use. It is the contact area of the aperture that requires
careful attention whenever the glazing is disturbed or removed. Some examples of riveting tools are given in Figures 7.21-7.24. As a trainee mechanic you should take time to read the information which your employer has provided on the substances, these are known as COSHH sheets and will be available from either the service department office or
the parts department workshop counter. This looseness usually occurs along the back edge of the bonnet, which in most cases is a raw edge, and even the slightest stretch will cause a buckle. It is designed for use where the fastening to be used has to be pressure or water tight. 8 Under what circumstances would a bleeder-type spray gun be selected
in preference to a non-bleeder? This has been used to join pieces of carpet butted together. The resin is fully coating the material – so that there are no dry spots which could lead to component failure. 9.3.2 Oxygen supply in the high pressure system comes in seamless steel cylinders containing between 0.68 m3 and 9.66 m3 of
oxygen and painted black. Careful valeting work can transform the final appearance of the vehicle, thus creating customer satisfaction by returning the car looking like it did when new. These gauges consist of two sliding bars which can be adjusted by either pulling out or pushing in to make them fit correctly across a chassis frame or underbody. As
previously stated, several coats can be applied wet on wet without flash-off periods, and force dried for 15 minutes at about 75 °C. In the early 1920s the pioneers of aluminium construction were developing its use for both private and commercial bodies; indeed, the 1922 40 hp Lanchester limousine body had an aluminium alloy construction for the
 bulkhead and bottom frame, and aluminium was used for all the body panels. In the motor vehicle they see a great deal of use as a supplementary Methods of joining 225 Figure 7.65 Simplified cross-sectional representation of a typical joint (Permabond Adhesives Ltd ) bond to welding: the process is known as weldbonding. Always hold the metal flat
and firmly on the base plate of the guillotine; this will prevent drag (the effect of pulling the metal in towards the blades) which often occurs as the cutting edge loses its sharpness. This ensures that the rod is at the same electrical potential as the plate during transfer of metal to the weld and avoids any tendency of the rod to spatter. Linear guartz
heaters can be used for the spot heating of specific work areas, for zone heating of a particular area of the bodyshop, or for full coverage heating. Horse stake with heads has holders (the horse part of the stake) which can take various shaped small heads. When handling major crash repairs, the computer linked jig systems can give fast and accurate
readouts before, during and after repair. It is found in the United States in a natural gas and is therefore more widely used in America than anywhere else. The sensors may be fitted in a number of different places. 7 After curing, the moulds are broken and the completed sections are removed (Figure 16.19). This assists the filler strip installation. As
the intensity of the high-voltage impulses of the pulse generator is not sufficient, part of the cutting current (limited by a resistor) is admitted for the sufficient ionization of the pulse generator is not sufficient, part of the cutting current (limited by a resistor) is admitted for the sufficient ionization of the pulse generator is not sufficient ionization of the pulse ge
the same time so they help each other in working the panel back into place. 9.6.3 Flame adjustment of a good welding flame is affected by the pressure of the wire to be set to a constant level which will in turn determine the arc
current. These spanners come in sets ranging in AF from 14 in to 185 in and in metric from 3.2 mm to 42 mm (Figure 3.35). At present 1 mm is the thinnest gauge which can be readily welded by the MMAW process, and both butt and outside corner welds in this thickness can be produced with complete satisfaction. The rate and extent of vibration
over a specified time form the basis of most fatigue tests. Such pressure can if necessary be applied either locally or spread over larger areas by the introduction and use of pressure pads, which are usually hard wood blocks. The special cutter uses an AC/DC motor. The guillotine is used more in the coach building of new vehicles than in
the body repair side of the industry. However, the head lamp beams will need adjusting using a beam setter to ensure that they do not dazzle on-coming traffic and comply with the VOSA regulations. When spraying, avoid blocking the manufacturer's drain holes; they are a vital part of anit-rust protection. Resistance spot welding can weld dissimilar
metal thickness combinations by using a larger electrode contact tip area against the thicker sheet. The scale models are examined critically and tested. One method is to heat the hardened steel in a bath of molten lead and tin, the melting points of various combinations of these two metals being used as an indication of the temperature. You will not
find any specific statements in the HSWA, but the guidelines issued by government bodies and trade associations interpret how the HSWA should be read. By combining the monomers in different proportions and by different methods, a vast range of different properties can be achieved (see Tables 4.13 and 4.14). Another time consuming factor was
that the finished vehicle had to be burnished to obtain a high gloss. Though deep indentations are normally filled up by the body repair worker, the painter is sometimes required to carry out levelling work. Most of these requirements were already covered by existing legislation. The base metal is simply brought up to tinning temperature (dull red
colour) and a bead is deposited over the seam with a bronze filler rod. Specially produced deep-drawn steel including micro-alloyed steel is used for large body panels which require complex forming. For other metals, the brazing alloys are often based on copper-zinc alloys (brasses - hence the term brazing) and are necessarily dissimilar in
composition to the parent metal. If rust is present on the panel surface, sanding is a better method of preparation as it will leave the surface with a bright metallic finish which facilitates the flow of electric current. A liquid developer is then sprayed on to the weld to give a uniform dry powder coating which is white in colour. Artificial ageing at this
temperature does not distort the work. The computer is used to calculate the amount of energy which is entering each cube and in turn leaving it. This coating more mileage from each sheet or disc of the abrasive paper. Repairs must be
358 Repair of Vehicle Bodies performed using the reverse order and an opposing force to that of the damage. To lift a low area with a pick hammer, one or two taps with the pick end of the hammer are directed from underneath the panel under repair to the centre of the low area. 8 Welding voltage switch This sets the
welding voltage of the transformer. The heat produced is sufficient to fuse the edges of the plates at the joint, forming a small pool of molten metal. This type of Figure 10.6 Projection welding system welding is widely used in attaching fasteners to structural members. The importance of working cleanly cannot be overemphasized. The other
advantage of this system is that it does not need to identify whether the steel is high strength or low carbon. Automotive finishing and refinishing 623 17.19.8 Lifting This occurs when the paint film contracts too much on drying so that it pulls away from recesses and corners. Once the arc is struck, the welding torch is held with the
electrode positioned at an angle of about 75° to the surface of the metal to be welded. This gives the 50 per cent overlap necessary to obtain a wet coating. 5 Use glass scraper to remove all labels from windows. 17.14.12 Short-wave infrared paint drying lamps have been used in finishing shops for many years to force dry localized
areas of paintwork and to accelerate the curing of two-pack polyester stoppers and fillers. The test specimen is connected to a special power source. Spot-welded seams, which would be prime sites for corrosion, are sealed; and wheelarches, along with the underbody, are protected with anti-chip coatings. What steps do vehicle manufacturers take to
minimize this problem? The normal method of annealing the coils is box annealing. Plain water is normally adequate. Most mains operated equipment 78 Repair of Vehicle Bodies runs at 240 volts; an electric shock from such a voltage is most likely to kill you straight away. The light meter should be placed Figure 15.4 Lighting used in the preparation at 240 volts.
area (Fifth Generation Technology Ltd ) Paint mixing room area The paint mixing room usually contains only one or two light fittings, but if any colour comparison is to be done in this room the correct tubes must be used. The threads therefore have less crimp giving higher mechanical properties than the plain weave. All low-carbon steels of less than
0.83 per cent carbon content consist of a combination of ferrite and pearlite. With glass fibre as a reinforcement they could be used by relatively unskilled labour to produce strong, lightweight structures in complicated for pressing. That is, the whole panel beating or too complicated shapes which would be used by relatively unskilled labour to produce strong, lightweight structures in complicated for pressing. That is, the whole panel beating or too complicated shapes which would be either too expensive to produce strong, lightweight structures in complicated shapes which would be used by relatively unskilled labour to produce strong, lightweight structures in complicated shapes which would be either too expensive to produce strong, lightweight structures in complicated shapes which would be either too expensive to produce strong the structures in complicated shapes which would be used by relatively unskilled labour to produce strong the structures in complicated shapes which would be used by relatively unskilled labour to produce strong the structures in complicated shapes which would be used by relatively unskilled labour to produce strong the structures in complicated shapes which would be used by relatively unskilled labour to produce strong the structures in complicated shapes which would be used by relatively unskilled labour to produce strong the structures are strong to the structures and the structures are strong to the structures
becomes hot very quickly, as does the surrounding area. As the iron is oxidized, the oxygen jet is moved at a uniform speed so that a narrow cut is formed. These must be worn to protect the hands from the ultraviolet rays and from hot metal. The two most common types used in vehicle body construction are MSLA and HSLA. While a vehicle is on a
jig, the tool can be used to double check measurements taken by the jig's own measuring system. The clay surfaces are covered with thin coloured plastic sheet which closely resembles genuine painted metal. 15.2.5 Repair areas The bodyshop should make the best possible use of floor space to provide maximum productivity, while still taking into
account health and safety regulations. The strip is then rewound ready for despatch or finishing as appropriate. Frame gauges Self-centring alignment gauges which are hung from a car's underbody. If used together with a suitable dolly block it will bring the metal down to a level surface whilst hot, and also avoid stretching the panel as the mallet is
made of wood and not metal like the panel hammer. Extrude To draw into lengths. The finishing material can be sprayed either hot or cold and can also be brushed. 4 Describe the process of manual metal arc welding and explain how the necessary heat is produced. 7 Apply one wet coating of acrylic sealer, allow to dry for 30 minutes, denib and dry
Three-quarter frontal damage is the result of an angled front end collision, sustaining damage to one front wing, the grille and bonnet. These cross slides glide backwards and forwards on a longitudinal beam to record length measurements. A damaged vehicle body can be straightened to its original measurements with accuracy and ease using this
system. Leave to dry for 1 to 2 hours. This problem was overcome by the use of microalloying. Steering wheel replaces tiller. It is ideal for cutting a number of sheets to a predetermined size because it guarantees greater accuracy than is possible with hand methods. Replacement sections and panels Where the repair of a damaged vehicle calls for
replacement sections and panels, they may be obtained in most cases direct from the manufacturer of the vehicle under repair. Each gauge system. Bonnet, hood Boot lid, deck lid, trunk lid, tailgate Cantrail, roof side rail, drip rail Centre pillar, BC-post Courtesy light, interior
light Cowl, scuttle, bulkhead, fire wall Dash panel, facia panel Door opening plates, scuff plates Door skin, outside door panel 1.5.18 Complete body shell A contemporary vehicle embracing all the latest techniques of panel assembly is shown in Figures 1.50 and 1.51. This may lead to the wire becoming hot and burning, even causing damage to the
car. Also there will be maintenance and repair records for the workshop equipment which will include a regular schedule of cleaning and inspection. The purpose of camber is to bring the centre point of the strength
of the member is derived from internal stresses set up during the forming operations in the manufacturing processes. When using these filler wires, pure argon must be used as the shielding gas. Very easy to apply. The machine to which the rollers are attached may be driven either by hand or electric motor, the choice of machine often being
influenced by the type or amount of work to be undertaken. 16 What purpose do nuts and bolts serve in vehicle body work? For the vapour/particle respirator to function correctly it is essential that it fits properly against the face. Tape adhesive Trim applications. If a car is about to fall off a jack, get out of the way, do not try to catch the car with your
hands or some such other dangerous action. 4 New information becomes available on hazards or risks. Care must be taken not to damage the panel surface by causing buckling during the cutting action. On a weekly basis there will be a more thorough cleaning programme which may include window cleaning and wet cleaning certain areas. 21 When
dealing with a petrol fire, which would be the correct type of fire extinguisher to use? The hammer is curved with two rounded cross-peins which allow blows to be struck at right angles in the direction of stretching. Clothing storage. Heavily coated rods must not be used because of the continual dropping of the slag, and for this reason medium
coated rods are generally used. Furthermore, it will tend to return to its original shape providing it has not been distorted beyond the point of elasticity. Today this type of welding is no longer used in the construction but only in the repair of motor vehicles. The skilled craftsman, particularly in the small workshop or garage, is generally responsible
for seeing his work through all stages of manufacture, commencing with careful study and accurate interpretation of the drawing. Monomer A simple molecule capable of combining with parts welded or bolted together. Following the
initial shaping, the two parts of each wing would be welded together, 'dressed' or reworked to the now fully treated chassis frame (Figure 13.19). The Factories Act was aimed at employers, it was designed to make factories, including garages, better places to
work. Since air resistance increases in proportion to the square of the speed, a truck with Cd 0.2 requires only 7 bhp Whilst still in the prototype stage, the new car has to face a number of arduous tests. 2.1 Personal safety and health practices a drying effect which removes the natural oils in
the skin. It gives increased rigidity to the laminate. Reinforced composite materials 551 • The ratio of fibre to resin in the composite – fibre volume fraction (FVF). The transformer converts the high mains voltage into a low alternating voltage i
the pulling force, 360 degrees around the BenchRack. Most important, the length of the rivet must correspond to the total thickness of the components to be joined. As the screw is rotated the lobe profile rolls the material out of its path to form (a) (b) (c) (d) (e) (f) (g) (h) Figure 7.36 Self-tapping screw head types: slotted and (a) countersunk (b) raised
countersunk (c) pan; (d) hexagon; Supadriv and (e) countersunk (f) raised countersunk (g) pan (h) flange (European Industrial Services Ltd ) Figure 7.37 Supadriv and (e) countersunk (g) pan (h) flange (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.37 Supadriv Taptite thread forming screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.37 Supadriv Taptite thread forming screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.37 Supadriv Taptite thread forming screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European Industrial Services Ltd ) Figure 7.38 Plastite screw (European In
maximum gap equivalent to half the sheet thickness, the extra metal being provided by the electrode wire. 13.6.3 Indirect hammering (off the dolly block) Figure 13.34 Using a high-crowned dolly Direct hammering requires skill in directing the hammer blows and close observation of what you are doing so as not to hit the metal too hard, thereby
displacing it. 9.14 Plasma arc cutting 9.14.1 Plasma arc cutting process and equipment The plasma cutting process relies on the fact that if a gas or mixture of gases, such as air, is subjected to a very high temperature it becomes ionized: negative electrons are separated from the atom, which is then 272 Repair of Vehicle Bodies positively charged. The
third roller, which is situated above the other two, is of larger diameter and is adjustable in the vertical plane in order to control the radius of bend. Some cylinders have a security cap over the cylinder valve indicating that they have been filled and checked. The temperature of the oven must be maintained to within a few degrees, and a careful checked.
on the temperature is kept by a recording instrument. Unusual and acute contours, expensive to cut in metal dies, are both practical and economical in fibreglass spray-up. For example, for metal surfaces the procedure is as follows: 1 Prepare the surfaces. Work the damaged metal using conventional straightening techniques, keeping in mind how soft
the aluminium panel is compared to steel. They also give the MacPherson strut data, which enables a check on the position of the front suspension fixing from above without any stripping of suspension components. The service line leading to the transformer should be tapped from the top of the main air line, and should preferably be in the form of a
U bend rather than elbow joints with right-angled bends on them (Figure 17.8). Examples of important procedures are: 1 Always use axle stands when a vehicle is jacked up. 5 Spray stopper locally with primer surfacer, allow 5 to 10 minutes, then apply a full coat over the entire surface. the overall process of gelation and hardening, which is achieved
either by the use of a catalyst and heating, or at normal room temperature by using a catalyst and heating units? 19 Describe a simple workshop method which can be used to estimate the
temperature when tempering carbon steels. The adhesive not only bonds metal to metal but is also suitable for bonding GRP components. 21 In which way do thermoplastic vehicle finishes present problems to the vehicle refinisher when carrying out spot repairs? The most important aspect when dealing with the hanging of doors is that a door which
is known to be the correct shape should never be altered to fit a door opening that is out of alignment. 13.9.2 Hot shrinking process Figure 13.42 The technique of hot shrinking process Figure 13.42.
MORE FROM QUESTIONSANSWERED.NET Repair of Vehicle Bodies This Page is Intentionally Left Blank Repair of Vehicle Bodies Fifth edition The late A. There are specialist products available for the bodyshop which will remove these types of materials from the skin quickly, safely and effectively. They are equally suitable for assembling
components to panels. Brazing, or hard soldering to give it its proper name, is in fact part fusion and is classed as a skin fusion process. Clean the plastic panel surface and back of the repair thoroughly to remove all road dirt, oil and grease. Detergents are by their nature biodegradable, that is, they break down, do not build up sludge and will not
explode, unlike solvents. Should paint remain in recessed areas, it can be removed with a wire brush, coarse steel wool, or abrasive paper without the rubbing block. Specialist bodyshop lighting units that give glare-free vertical and horizontal lights are available. Chopped fibres do not show up so prominently, but some fabricators compromise by
using the thinnest possible cloth (surfacing tissue as it is known) nearest the surface, on top of the chopped strand mat. 8 Clean luggage compartment first. The materials used for these bonds include pressure sensitive tapes, hot melts, epoxy spray, vinyl plastisol, elastomer solvent, silicon, solventbased rubber (used for large gap sealing) and butyl
intersects the centre line. Large beads on the tack welds will act to 'key' the laminate to prevent twisting. Pride in the job is still very much in evidence but it is essential that everyone involved in the repair process performs efficiently and consistently. It can be used on moulds made from polyester, epoxy, metal or composite moulds. Through
carefully controlled composition and processing conditions, these steels achieve high strength in combination with good ductility to allow thinner gauges to be used: a reduction from 0.90 mm down to 0.70 mm is a general requirement. It is designed primarily to measure and check the dimensional correctness of vehicle chassis. Buff lightly to a shine
with a clean, dry, good quality mutton cloth. Si max. 13.18.2 SAE J1930 The Society of Automotive Engineers - SAE International have a task force to produce a list of standardised terms and acronyms for automobile electrical and electronic systems. A model-specific top slides under a piston action into the universal tower unit, and a locating pin
holds the two together at the correct height. Before using the hammer and dolly together, it will be necessary to clean the underside of the portion of the entres of faces of round bar or discs. 17.10 Spray gun
motion study The spray gun is not a difficult tool to master, but a study of the following text and the accompanying diagrams will be invaluable to the inexperienced sprayer. The hydraulic pulling unit can be mounted in any position, so pulls can be made from any angle around the frame at the front, the back or either side. Curing at normal ambient
temperature will give joints of reduced strength and is not recommended. The first important step therefore is to understand the setups that can be built with this equipment, the attachments required and their application; then it is a question of breaking down a job into its basic set-ups and applying the corrective force in the 17 18 19 20 21 22 23
Serrated saddle Spreader plunger toe Clamp toe lock pins Pull chain 90° 'V' base Wedge head 125 mm flex head Trolley and press stand correct sequence. While the majority of body workers who work in the repair side of the industry do not have to perform a lot of difficult marking out from elaborate drawings on to sheet metals for the making of the
articles, those employed in the manufacturing side of the industry (e.g. coachworks) have to mark out all units and assembles from drawings, whether for a one-off item or for mass production. Mudguards, which began as wooden or leatner protections against splattered mud, grew into wide splayed deflectors in the early part of the twentieth
century and then gradually receded into the body work, becoming gracefully moulded into the streamlining of the modern motor car and taking the name of wings. It is a field which uses their advantages to the full without relying on properties they lack. There are two important dimensions in brake press specifications: one is the maximum bending
length over the bed, and the other is the distance between the housing. 320 Repair of Vehicle Bodies Many types and grades of metal can be welded using this method: aluminium, aluminium alloys, carbon steel, low-carbon and alloy steels, microalloy steels, micr
construction. Autocontrol measuring system This system can be used with any Car Bench model. The original damaging force could have stretching should be reduced to a minimum by the use of such methods as pushing out the damage with a body jack fitted with suitable rubber flex head; or using a
hardwood block between the body jack and panel; or using hardwood blocks in conjunction with the hammer to eliminate the metalto-metal contact. 314 Repair of Vehicle Bodies 12.4 TIG spot welding process TIG spot welding is an adaptation
of the main process. The temperature inside the vehicle does not rise sufficiently to damage the trim provided that the doors and windows are properly closed. The centre pillars or BC-posts connect the body sills to the roof cantrails. 6.2.16 Depth gauges with reversible base or protractor A depth gauge is designed to measure the depth of holes or
recessed surfaces. The most common type are spring dividers (Figure 6.7). The (c) (b) (a) (b) Figure 3.18 (a) Hole punch (b) wing punch (Sykes-Pickavant Ltd ) (a) Hole punch (b) wing punch (Sykes-Pickavant Ltd ) (a) Hole punch (b) wing punch (Sykes-Pickavant Ltd ) (a) Hole punch (b) wing punch (Sykes-Pickavant Ltd ) (a) Hole punch (b) wing punch (Sykes-Pickavant Ltd ) (a) Hole punch (b) wing punch (Sykes-Pickavant Ltd ) (a) Hole punch (b) wing punch (Sykes-Pickavant Ltd ) (b) Hole punch (c) Hole 
for MIG welding. Fillers are available as both singlepack or two-pack, cellulose and synthetic types. 34 Explain the method of repairing and aligning a damaged body shell, when using a jig and hydraulic pulling equipment. The die tools need to be harder than for normal low carbon (LC) steel, Metals and non-metals used in vehicle bodies and the
presses need to be stronger and more accurate. Other advantages of these clips are that they are easy to apply, they eliminate the use of washers and nuts, and glass, plastic and other materials can be fastened together without fear of damage. In the single-stage regulator there is only one, low-pressure chamber; the gas from the cylinder flows into
the regulator and is controlled entirely by the adjusting screw. The size of the compressor chosen should be capable of giving a higher free air delivery than is required. Any person carrying out work under the Regulations must be competent to do so (Figure 15.12). The obvious advantages derived from the use of gas shielding are that the weld area
is fully visible; that little, if any, slag is produced; and that the absence of abrasive flux increases the life of jigs and machine tools. It can also occur in long straight lines following the strokes of the brush during application. Stage 2 is automatically linked and self-setting to provide a burst of current to produce the weld nugget. 44 Explain the repair
procedure necessary for part panel replacement on the quarter panel assembly of a four-door saloon. Unlike snips, it has a flat face with one central serrated blade which in use cuts a slot equal in width to the thickness of the blade, about 81 in (3.1 mm). 8 Check all ashtrays, glove box, door and seat pockets. CP steel is often used for 'A' and 'B' posts
and bumper attachments. The extension scale not only measures height, but when installed on a telescopic cross slide it also measures width. Measuring and marking-out instruments 195 Figure 6.21 Micrometer (Neill Tools Ltd (Moore and Wright)) 1 Spindle and anvil faces 2 Spindle
3 Locknut 4 Sleeve 5 Main nut 6 Screw adjusting nut 7 Thimble adjusting nut 7 Thimble adjusting nut 8 Ratchet 9 Thimble 10 Steel frame 11 Anvil end Figure 6.22 External micrometers (Neill Tools Ltd (Moore and Wright)) 6.3.7 Micrometer (Figures 6.21 and 6.22) is used to measure
and record accurately to 0.01 mm, or when using a vernier micrometer to 0.001 mm. This is a simplified model of a hatchback car. Figure 17.34 shows the technique used to paint vertical corners, the point to watch being to half trigger the gun to avoid applying too much paint. The COSHH Regulations have made it mandatory for all respiratory
protection equipment to be both approved and suitable for the purpose, for the operatives to be correctly trained in the equipment's use and maintenance, and for proper records to be kept. The most pro-active of vehicle safety organisations is EuroNCAP. After this gas test, reset the switch to its initial position. Gloves and face masks should always
be worn when using solvents. The process can be used to manufacture large body panels with integrated foam structures and captive metal fixings, using relatively low-cost tooling. Good atomization is essential in spray painting. Snips can be obtained in either straight, concave or convex. The repair procedure is as follows: 1 Material and equipment
required: plastic cleaner, heat gun, reinforcement patches, 3 in grinderette, 478 Repair of Vehicle Bodies 2 3 4 5 6 7 8 9 DA sander, plastic spreader, masking tape, rubbing-down paper and the Duramix filling material. The shielding gas issuing from the nozzle protects the weld metal deposit and the electrode from contamination by atmospheric
conditions which might affect the welding process. This can be done by cooling the panel with water after every shrink. These contain comprehensive data on repair methods and times, welding tables and diagrams, and technical information supplied by the vehicle manufacturer. 15.2.9 Fire fighting equipment Consult the local fire officer regarding
fire points and types of fire appliances, exits, and fire doors. The standard tip screwdriver is probably the most common type used. As this system of welding gives a perfectly controlled penetrating weld of great strength, it will be found ideal for replacing new panel sections such as subframe (see Figure 12.33) and underframe members, where the
welding is highly critical because of the stress factor present in load-bearing assemblies. The rivet is available in aluminium 2.5 per cent magnesium alloy with a carbon steel mandrel. The trigger controls both the flow of paint. 10 Explain the importance of resistance welding in the repair of
vehicle bodies. When using heat for relieving stresses, it is important not to overheat the section beyond dull red, and wherever possible never to heat any point more than once as excess or repeated heating on one spot causes surface oxidation and annealing, both of which weaken the member or panel area. The estimate must include cost of parts
and labour costs at the recognized retail rate of the body shop establishment (Figures 14.136 and 14.137). Gun body This can be regarded as a basic frame on to which the spray painter will mount a suitable set-up to suit his requirements. Not true structural adhesives. Above all, they do not tolerate excess heat from bad welding, which makes them
brittle or soft or can cause panel distortion. The blades are either flat or radiused according to the surface to be filed. They are formed with indentations or heavily swaged areas in the floor. Before the Second World
War aluminium was used mainly for body panels, but since the war aluminium alloys have been and are now being used for body 134 Repair of Vehicle Bodies structures. 8 Make an optical check on the vehicle's steering geometry. Set the machine to either maximum or minimum according to the thickness to be cut. 2 Health and safety The main
responsibility for occupational health and safety lies with the employer. Gauges are normally made from a hard Figure 6.10 Oddleg calipers (Neill Tools Ltd (Moore and Wright)) wear-resisting metal, and find extensive use in the mass production of car bodies where many components are made to standard sizes which require frequent checking to
ascertain their accuracy. The movable jaw is adjusted by means of a worm wheel fitted in the handle, which is meshed with teeth in the jaw. This is a mechanical distortion - a byproduct of the spot welding process. Non-sand primer surfaces have virtually eliminated many of the problems associated with scratch swelling, but they must be applied over
staisfactorily prepared surfaces. The two front rollers are adjustable for different thicknesses of metal; the third roller at the rear is also adjustable to provide for various degrees of bend required. Capable of lifting weights of up to 2000 kg to a height of 1 m, it provides a simple and effective means of loading damaged vehicles on to a mobile bench,
thus creating a comfortable and adjustable working height for various mechanical and servicing work. This was due to the development of the continuous filament process. materials, parts list, mixing and colour matching, job cards, work-shop loading, booking in, job efficiency reports, invoice production, reports and letters (Figures 14.138-14.141).
11 Describe the technique of cross filing. The particular form of heat treatment which results in the alloy attaining its full strength is known as solution treatment. The sideways motion of the welding torch should be restricted to a minimum. 42 How are two bars safely attached to a vehicle body? The system can also be used with various measuring
systems, for instance a mobile bench or Blackhawk's P188 Mk2 universal measuring and correction system. The process is used for joining mild steel and stainless steel not exceeding 1.6 mm, but is not suitable for aluminium and magnesium base alloys. They are mixed ten minutes before use, but have a limited pot life (about six hours), although
longlife etch primers are now available. Acetylene for the high-pressure system is manufactured and stored ready for use in a dissolved state and at a high pressure in steel cylinders. 29 Explain where plastic can be used on a vehicle. They come in sheet form, and provide a range of mechanical properties to suit different applications. Prepare a
separate moulding larger all round than the rectangle but still sufficiently small to pass through the panel. Some adjustment to obtain the correct clamping pressure may be necessary. Some parts of the vehicle body are obviously not suitable for machine polishing and must be done by hand. The principle employed in the cutting action is very similar
to that of the hand bench shears. The advantages of the rightward technique are as follows: the direction of the flame, which points directly towards the root of the weld, causes a hole to form as the edges melt, thus ensuring complete penetration; no preparation is necessary
on thicknesses up to 7.9 mm. 2 Check for any physical problems: ply separation, dry rot. In double-sided welding, which keeps the heat in the weld as low as possible. Butt joint A welded joint in which the ends or edges of two pieces of metal directly face each other. Even if the spot welds are normal, the
welds will not have sufficient strength if the edge distance is insufficient. In repairing large body panels and door panels which are fairly flat it is necessary to use a dolly block with a low-crowned radius (Figure 13.35). A chest of drawers holds spanners, sockets and all the necessary assembly tools. 16.10.1 Wrinkling This is caused by solvent attack
on the gel coat by the monomer in the laminating resin due to the fact that the gel coat is undercured. Excessive set back would cause the vehicles by using: 1 A hacksaw and metal cutting snips 2 A hammer and thin narrow-bladed chisel 3 Either a
conventional drill, a Zipcut tool, or a spot-welding removal tool (air operated) to drill out each spot weld 4 An air chisel with appropriate cutting tools 5 A power saw having either a rotary vibrating blade or a straight reciprocating blade o
certain purposes, but if further work is to Physical properties of metals and alloys Metal Melting temperature range (°C) Aluminium Al-3.5 magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium Duralumin type Copper 70/30 brass 95/5 tin bronze Lead Magnesium type Copper 70/30 brass 95/5 tin bronze Lead Magnesium type Copper 70/30 bras
419 1535 1400 Density (kg/m3) Specific heat capacity/ (J/kg/K 103) Thermal conductivity (W/m/K) Electrical conductivity (W/m/
80 35 146 83 26 64 17 113 71 45 63 25 20-36 101 17 12 8 35 21 3 13 3 26 7 31 23 23 23 17 19 17 29 30 13 10 20 8.5 37 12 11 Metal forming processes and machines Table 5.2 161 Typical mechanical properties of metals and alloys Material Modulus of elasticity E (kN/mm2) Tensile and compressive strength (N/mm2) Elongation (%) Hardness (HV)
5-8 0.5-1.0 17-2 60-5 70-5 22-24 20-24 40-20 5-35 25-30 15.30 20-80 30-60 160-300 150-450 40-100 70-250 130 130 300-170 55-90 45-50 be carried out the malleability may be restored by annealing. Records must be kept for 30 years (Figure 15.11). Materials used for vehicle manufacture are often chosen for strength, rigidity or light weight,
and in some cases surfaces will be prefinished to enhance appearance. The sanding tools have a pad with eight or more holes in them to which are attached sanding discs with similar holes. On the technical side, developments mean that the jig brackets are now available for a wide range of vehicles, are lighter, easier to use and more readily
available. Then two nicks (saw cuts) are made, one on either end of the joint in the weld specimen. They are usually cold curing. This indicates that, to be effective, bumpers and other collision-absorbing parts of a vehicle should be made of materials such as foam-filled plastics and heavy rubber sections. The mutton cloth (or any suitable soft cloth) is
first wetted in clean water and wrung out. They are precision formed to a geometric ellipse and provide two locking elements of uniform shape and thread contour. My quick-witted friend grabbed a screwdriver off one of the stalls, inserted it behind the rear quarterlight rubber and levered out the glass, put his hand inside the car, opened the door
and released the child. The filters in these portable extraction systems can be changed very quickly, and some have an alarm light fitted to warn the user that the filter needs replacing. Aluminium is now produced in such quantities that in terms of volume it ranks second to steel among the industrial metals. They remove the skin's natural protective
oils and can cause dryness and irritation or have serious toxic effects. Wood strips, plywood or metal stiffeners can be pressed into the part while wet and covered with resin and reinforcement to anchor and protect from deterioration. Health and safety 2.8.20 Appropriate cleaning and sanitizing agents are used according to manufacturer's
instructions Before using any solvent, detergent or sanitizing agent such as bleach you must read both the label on the container and the COSHH sheet which the manufacturer or your company has prepared. The welded joint is made using the blow gun and a plastics filler rod in the same way as you would oxy-acetylene weld steel. The slots are used
for wiring and swaging. Chrome-vanadium steel This contains a small amount of vanadium which has the effect of intensifying the action of the chromium and the manganese in the steel. On a gravimetric system, always remember to place the tin on the scales before zeroing them. Figure 5.5 The cutting section showing a sheared piece of metal
Figure 5.6 Blade clearance and it is this distance that determines the quality of the cut and the load on the machine or hand tool being used. In the case of anchor points varying from their engineering specifications owing to manufacturer's tolerances, this system can still carry out the repair because of the total adjustability in all dimensions and the
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capability to handle tolerances, even allowing for positioning and movement during repair. There was a danger that the new HSS, thinner but just as strong, would lack the ductility which allows it to be press formed into shape. For each vehicle specification there are graphic displays, both overhead and side view, of the vehicle's underbody structure

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(see Figure 14.51). With over-catalysed filler there is a risk, particularly with metallic paints, of the repaired area showing through owing to the action of the peroxide in the hardener bleaching the paint. 12 Name the three main groups of stainless steel. Do not cut metal of heavier gauge than the machine is designed to cut. The frame and inner
construction was still for the most part made of wood, as shown in Figure 1.1. About 1923 the first attempts were made to build all-steel bodies, but these were not satisfactory as the design principles used were similar to those which had been adopted for the timber-framed body. Figure 14.29 Complete Dataliner repair system showing laser
equipment and pulling equipment (Dataliner, Geotronics Ltd ) The bench is made from strong hollow beams, known as the mainframe, to which transport beams are attached in a transverse manner. Before use, all trim around the windscreen, both inside and outside, should be removed (see Figure 14.110). The three heads used on this square are: 1
The square head, which has two surfaces, one at 45° to the base, so that it can be used as a normal or a metre square, and also as a depth or height gauge. The intensely localized heat input of the arc ensures that the minimum of disturbance occurs to the surrounding metal plate, therefore resulting in very little distortion. To get
the advantages of two different plastics, two different monomers can be combined in a copolymer. Within the standard, the following areas are addressed through an organized approach to the task: Background on documenting a system Consideration of all the elements Understanding the written task Support base necessary Controls on procedures
Getting everyone involved Contents of procedures. In the design of instrument panels, factors such as the driver's reach zones and his field of vision, together with international standards, all have to be considered. Variation in wheelbase can be checked by plotting the centres of each of the four wheels. In collision work the estimate is considered as a
firm commitment to do the work involved for the amount of money shown, and should be detailed so that insurance companies or private owners can determine from the estimate exactly what it is proposed to do to the damaged vehicle. However, the more recently developed plastic and vinyl materials were found to be more suitable than fabric, being
cheaper and easier to clean and fit. They are supplied in tube loaded form, each 317.5 mm long and containing up to 100 carefully aligned rivets. 30 State the applications where natural rubber has been replaced by synthetic materials in the automobile industry. Pillar A vertical support of a body frame. Beware of one piece of metal getting in the way
of another, and by obscuring it prevent it from getting fully coated. Dry coating Several thin coats of paint can be applied fairly rapidly if they are sprayed 'dry'. Tonneau An open vehicle having a front bench seat and a semicircular rear seat which was built into the rear doors. Some of the advantages claimed for direct glazing are as follows: 1
Increased rigidity and strength caused by integration of the glass areas. These liquids (there are several brands available) have an acid content, mainly phosphoric, which etches the metal and completes the derusting of it. Do not
expose the hose to heat, traffic, slag, sparks from welding operations, or oil or grease. In either case the torch should balance easily in the hand to avoid fatigue. The vision and reach zones are geometrically defined, and allow for the elimination of instrument reflections in the windshield. In automobile construction it has almost totally replaced oxy
acetylene and manual metal arc welding by virtue of its high metal deposition rates, electrode efficiency and high duty cycles. Removal of the quarter trim panel is carried out in the following order: rear seat back; rear window handle (if any); and any screws or mouldings. As with sinkage, this is caused by solvent evaporation. Spray
into the D-post. Repetition rivets Repetition ri
edges of material that is 3.2 mm or less thickness. Bronze welding procedure 1 An essential factor for bronze welding is a clean metal surface. This is a process of shaping a sheet metal blank into a double-curvature shape by beating the blank into a double-curvature shape by beating the blank into a sandbag or hard wood block with the aid of a pear-shaped boxwood mallet, or for thin metal a rubber
mallet, or for steel a hollowing hammer with a steel head. The company has always made bonnets and boot lids but these are far from simple, and demonstrate the full range of the panel beater's Figure 13.19 Fitting hand-made panels (front wings and roof) to chassis (Aston Martin Lagonda Ltd ) skill and art, which has changed little in all the years it
has been practised. 5 What is the function of the coating of a manual metal arc welding electrode? It applies easily to vertical surfaces, resists sagging, contours with a spreader to the original surface shape, sets within three minutes. If the welded seam is so placed that it may be
planished then the hammering along the weld will correct the distortion. can lead to lengthy drying-out times. Moreover, a body alignment and welding jig must always be used for repair operations such as sectional replacement of the sidemember/apron-panel assembly. Next mix the paste with its hardener on a flat surface using a stopping knife or
flexible spatula, making sure that the materials are mixed in accordance with the material with the material with the material with the material with the 
Gun body bushing Fluid needle adjusting screw Air valve assembly Air valve assembly Air valve Etaining ring Connector 14 in BSP Baffle piece of cloth over the air cap and pull the trigger, and the higher atomizing pressure will force the solvent
back into the pressure tank. A combi-booth is a combined spray booth and low-bake oven with an electrically controlled operation and lighting requirements for the spraying and baking of paint. Single or multiple Mitek pulling units are then also secured to the anchor pots using tie-down Major
accident damage 411 Figure 14.9 Korek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system in use, with P188 Mk2 measuring system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system (Blackhawk Automotive Ltd ) 412 Repair of Vehicle Bodies Figure 14.10 Mitek system (Blackhawk Automotive Ltd ) 412 Repair of Ve
siting them in the direction of the pull or push required. The stake is used for forming or shaping curved flanges. The reason for this coded marking is mainly for the identification of genuine parts and recycling purposes. All overall buttons must be kept fastened, and any loose items such as ties and scarves should not be worn. Celette benches The
Celette bench (Figure 14.13) is mounted on four heavy-duty wheels, two of which are fitted with brakes to allow the bench to be locked in position during use. Stage 1 research determines the best method of removing and replacing the outer cosmetic panels of undamaged vehicles, and the time taken to do this. Air valve This is situated in the handle
of the spray gun (or gun body) directly behind the trigger by which it is operated. Only trained and radiation classified personnel may operate radiography equipment, as the equipment which will hinder the
action of the cloth. MAG MIG m mm min. There has been a constant improvement and development in polyester resins, and among other things this has led to the introduction of successful semi-flexible gel coats, which are of particular interest to the motor industry. If the heat affected zone is ductile and defect free (as in thin-sheet panel steel) the
presence of some residual stresses may be acceptable. The planishing is carried out over the whole surface of the workpiece; the blows are light and Figure 13.15 Planishing using the wheeling machine 350 Repair of Vehicle Bodies given squarely, otherwise they will produce crescent marks difficult to eliminate. The practical body worker is rarely
called upon to produce a finished drawing, but he will find it necessary in many cases to understand and work from both general and detailed drawings as set out by a skilled drawing, but he will find it necessary in many cases to understand and work from both general and detailed drawings as set out by a skilled drawing as set out by a skilled draw
MIG/MAG welding The development of the MIG/MAG processes is in some ways a logical progression from the manual metal arc and TIG processes. To finish a panel in the area of the production welds, which in most cases were lapped, spot-welded joints, body solder was used and found most useful. If the arc is too long, a wide irregular bead is
produced with insufficient fusion between the plate and weld metal. The quantity of material is proportional to the distance you pull back the trigger. 31 State the dangers of carrying sharp or pointed tools in pockets or protective clothing. The wire feed, which can be varied in speed to suit current/voltage.
conditions. However, the extensive crazing near damaged areas should be taken as an indication of over-stressing and the panel should be reinforced or replaced. Brake press capacities are usually given either in tonnage terms or in maximum bending of a certain metal thickness, and are based on V-bending pressures. This is done by piercing a hole
through the bonding and feeding the wire through with the aid of pliers. 1.2.2 Safety With regard to bodywork, the vehicle designer must take into account the safety of the driver, passengers and other road users. One of the dominant styling features of the 1950s and 1960s was the tail fin, inspired by the twin tail fins of the wartime Lockhead
Lightning fighter aircraft. Aluminiummagnesium alloys containing more than 2 per cent magnesium are difficult to braze, as the oxide film is tenacious and hard to remove with ordinary brazing fluxes. The edges of the welding should be free from scale. This means that the car can be dismantled into the two units of the body and chassis. A new
development is the Supadriv recess head, specially engineered to give a 'cling-fit' between driver and screw; it is increasingly used in robotic assemblies. 28 Describe the two processes which can be used to join plastic. For sanding, an abrasive paper sheet is clipped to the tool. Alternatively, check by applying a Barcol hardness tester. The manner in
which the forces affect the vehicle body and the location at which the forces are exerted depends upon the The new model now enters the prototype phase. The type of monomer used and the way it polymerizes, or links together, give a plastic its individual characteristics. They can be a cause of dermatitis by penetrating the pores of the skin,
dissolving the natural oils beneath and so leaving the process involves the use of 2 tonnes of organic solvents in any 12 month period then the bodyshop operator must seek authorization from his or her local authority to carry out the process. Normally the larger the socket size, the deeper the well. Plate
preparation From 4.8 mm to 7.9 mm: square edge, with gap of half thickness. It is designed to be placed on the flat milled surface of the base frame. 1 Repairing by removing sections beyond economical repair and replacing them with new sections 3
Repairing by using a combination of realigning and reshaping together with the replacement of appropriate sections. C clamp (Figure 3.17c, d) has a wide jaw opening with a relatively small gripping area, which produces pressure without permanent jaw damage to panel surfaces. The use of these different materials can lead to problems for the
welder. This system is employed in such applications as chassis cross-bearer brackets on commercial vehicle bodies. (a) 17.15 Burnishing and final detail work Though brief reference to burnishing and polishing has been made earlier, these subjects are important enough to warrant fuller description. For material over 7.9 mm thickness the
angle of V should be 60°. Body trim The materials which are used in the interior of the body for lining and upholstery. Continuous weld A continuous weld as one steady progressive movement (Figure 12.26). Either because certain parts of the repair are inaccessible or because of their
overstretched condition, it may be necessary to use solder filling or plastic filler to achieve a smooth finish. Most synthetic resins are made from oil. Figure 17.64 Burnishing using rubbing compound and a sponge polishing pad (Faréncla Products Ltd.) will improve the lustre still further and provide a protective coating over the paint film. 10 Increase
the heat step by step to reduce the actual weld time until splashing occurs. Type of flame Neutral. Seven types of POP blind rivet are shown in Figure 7.7. These and other types are described as follows: Standard open rivet is subdivided into the breakhead mandrel type, which leaves the mandrel head Methods of joining 201 Figure 7.6 POP blind
rivet, standard open type: setting sequence (Tucker Fasteners Ltd.) Figure 7.5 POP blind rivet: standard open type (Tucker Fasteners Ltd.) free to fall away from the rivet (Figure 7.6), and the break-stem mandrel type, which retains the broken portion of the mandrel within the set rivet, thus sealing the rivet to a certain extent. Increase the force of
the blow gradually until you have found just the right force Indirect hammering is another technique which uses hammer and dolly to level a panel surface. Slow curing. Star ratings Each vehicle Bodies 40% overlap = 40% of the width
of the widest part of the car (not including wing mirrors) 540 mm 500 mm 1000 mm 40% overlap 1500 mm R-Point 64 kph (40 mph) 70 kph (30 mph) R-Point = hip point for a 95th percentile male (a) Frontal impact test (b) Side impact test 29 kph (17 mph) Pole Diameter = 254 mm Child head Adult head Upper leg Leg (c) Pole test (d) Pedestrain
impact test Figure 1.28 EuroNCAP The Star Ratings are based on calculations carried out after the tests, the latest figures can be found on the EuroNCAP website: www.euroncap.com. Collapsible steering columns also prevent damage to the chest and abdomen and are designed to Secondary or passive safety If a crash does happen, secondary safety
design should protect the passengers by 1 Making sure that, in the event of an accident, the occupants stay inside the car 2 Minimizing the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to which they are subjected 3 Restraining the magnitude and duration of the deceleration to the decelerati
(Vauxhall Motors Ltd ) 18 Repair of Vehicle Bodies prevent the steering column being pushed back into the passenger compartment whilst the front end is crumpling. As the push-on clip is forced over a (a) plain stud the fixing legs bite into the surface and, on finally depressing the arched base, which of course reacts as soon as the pressure is
released, the fixing legs are given a strong upward and inward pressure which firmly holds the fastener in position. The weld zone is generally discernible after anodic treatment, the degree depending on the material and welding process
11.6.5 Striking the arc The successful step towards electric arc welding is learning to strike and maintain the arc and run a straight bead of weld metal. Always be sure to take measurements from the same points on both doors. One of the important features of a good weld is complete penetration. In particular there has been a growth in the number
of cars sustaining damage which, while not major, still requires the use of proper diagnostic and repair systems to effect a repair. Used properly, low-bake finishes lead to a higher turnover of work, which in turn increases the need for good organization within the workshop (see Section 17.18). This is a quicker method than that mentioned in the
process summary, but does not produce the same standard of finish. 15 Evaluate the likely numbers who could be harmed. Additionally or alternatively fillet welds may be used, which are of approximately triangular cross-section and lie externally to the parts joined. Adequate ventilation should be provided in any shop where paint remover is used, for
the same reasons. The small mercury battery in the key-fob control should be replaced every two years. Allow 5 to 10 minutes between coats and 1 to 2 hours after second coat. 13.2.1 Hollowing (Figure 13.2). The one-piece high-rise tailgate is fabricated entirely from polyester with
internal steel reinforcements (Figure 1.39). The repairs should be guaranteed for a specific mileage or period, as required by the Code of Practice for the Motor Industry and by the VBRA Code. ing of the entire body. More and more vehicles are using aluminium every year, more correctly we should say aluminium alloy. 4 Double check that the
correct colour has been found by finding the coloured sample in the books provided by the paint manufacturer, and placing this against a cleaned-up part of the car. These are known as rigid sections. The tower can be instantly held in position using chains and selftightening eccentric anchoring blocks, which fit into slotted channel sections set into a
concrete floor in such a way that they form rectangular shapes, thus enabling pulls to be made on four sides of any repair. They incorporate a totally enclosed burner with a skirt to protect the ceramic plaque from cold air washing over the hot surface. This problem will also arise when spot welding two different thicknesses of steel; more heat will
usually be lost by the thicker gauges, resulting in unsatisfactory welds. 7 Make splashless welds by selecting the lowest heat and the longest time setting to make the desired size of weld nugget. Craft techniques and minor accident damage 365 13.9.1 Tools required for hot shrinking Before commencing to heat up the stretched section, it is essential
that all tools and material needed to carry out the shrink should be conveniently placed so that they can be brought into use quickly. These set-ups have an element of steering or four-wheel steering or four-wheel steering or four-wheel steering built in to complement the work done by the front wheels: the system is commonly known as rear wheel steering or four-wheel steering built in to complement the work done by the front wheels:
at an angle for use in constricted spaces: when the spanner is turned over, the nut can be approached from a different angle. Automotive EC Directives and ECE Regulations require third party approval - testing, certification and production conformity assessment by an independent body. They are ideally suited to a wide variety of nut turning
operations, either fastening or unfastening or unfastening. Mild steel, brass, nickel, stainless steel and many other alloys may be welded by this method, although its use is largely limited to operations on mild and stainless steel. The wire sizes used are 1.0 mm and 1.2 mm for the larger machines for welding thicker aluminium. The principles of machine cutting are
similar to those for hand work. Each new project starts with a series of detailed paper studies, aimed at identifying the most competitive and innovative product in whichever part of the market is under review. 17.14 Finishing and refinishing processes There are four main car refinishing paints at the refinisher's disposal: cellulose synthetic (half-hour
enamel) paint; acrylic resin paint; low-bake synthetic paint; low-bake synthetic paint; low-bake synthetic paint; and two-pack paints. 3 Check that the correct pressure (approximately 5 bar or 75 psi) is set on the regulator, and that any valves ahead of the regulator are open. Review Assessments should be reviewed for example when: 1 There are any significant changes to the process, e.g. plant
changes, volume of production. There are at present in use three different types of gas shielded arc welding: Tungsten inert gas (TIG) The arc is struck by a non-consumable tungsten electrode and the metal to be welded, and filler metal is added by feeding a rod by hand into the molten pool (Figure 12.1). 9 State a typical use for a pear-shaped
mallet. Brake presses comprise a frame, a ram or bending beam, and means for moving the beam. Major accident damage 425 Figure 14.31 Transparent scales transfer the measuring point on the vehicle to a level which can be illuminated with the laser beam. 14.3.10
Boot lid alignment Correct boot lid alignment exists when the boot lid matches the contour of the body surrounding panels. Welds on heavy plates are best made by making multiple runs rather than by excessive weaving of the electrode from side to build up the weld. Using a 36 grit paper and mechanical sander, remove all old adhesive from
the undertray and B-post cover. The Festo sanding systems for body repair and paint shops can be of the mobile type which has the extraction unit mounted on to castors (see Figure 17.48), or of the fixed position type. The flux-covered or shielded electrode has a very heavy coating of several chemical substances which protect the molten metal from
the oxidation and help to keep a steady arc. This can either be by portable units serving one or two operators, or by fixed systems with a central extraction unit serving a number of fixed extraction points located in the workshop (Figure 15.8).
the organization of work on the shop floor. The driver's airbag is housed in the steering wheel and requires special attention because of the confined space (Figure 1.12). 20 Provide safety representatives with copies of the assessments and supporting information. On the other hand a liquid propane gas (LPG) or natural gas nozzle is mainly of two-
piece construction: it has fluted ports for the preheat flame, and the central part of the nozzle is recessed: (Figure 9.24b). Perimetric - A series of micro-switches on the doors, bonnet and boot which set off the nozzle is recessed: (Figure 9.24b).
based on manufacturer's recommended retail prices. Foam sheet can be glued or stapled together, then laminated over to produce a strong box structure, without requiring a mould. It also can be used for Figure 14.61 Chief E-Z Liner II showing hanging gauges, self-centring (Chief Automotive Ltd.) 442 Repair of Vehicle Bodies 14.3.6 Underbody
alignment using jig fixtures Figure 14.62 Digital measuring tool with accessories (Stanners Ltd ) measuring a vehicle's wheelbase and comparing it with manufacturer's data (Figure 14.63). For the best cutting results, the electrode distance should be regularly checked and adjusted. There is nothing that the refinisher can do about this, and it is
advisable to explain this to the customer when only part of the car, such as a wing or door, is to be painted. Transparent adhesion primers are available which can be applied on to manufacturers' finishes which have merely been cleaned with a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a Scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a scotchbrite pad. Irritation, fever, poisoning and fibrosis are a few of the effects that a cleaning spirit and a scotchbrite pad. Irritation are a few of the effects that a cleaning spirit and a scotchbrite pad. Irritation are a few of the effects that a cleaning spirit and a scotchbrite pad. Irritation are a few of the effects that a cleaning spirit and a scotchbrite pad. Irritation are a few of the effects that a cleaning spirit are a few of the effects that a cleaning spirit are a few of the effects that a cleaning spirit are a f
can be minimized with the extraction of fumes from the welding operations. The larger drive sizes with the corresponding longer handles are used where greater torque is needed. Medium establishments use a series of accessible working bays from which work can be fed from the stripping area, to the preparation area, and on to
the paint shop. 10 Refinish to original factory condition. 21 List the properties contained in commercially pure aluminium. The bulkhead towards the front and rear completes the box-like form and assists in providing torsional stability. This changes the acid into zinc chloride - hence the name killed spirits. Wiring hammer This is designed for closing
thin-gauge metal over wire to form wired edges. The first VARI moulded production car was the Lotus Elite introduced in 1974; since then developments have continued in the processes, tooling and techniques of producing composite vehicle bodies. Likewise greater control over the force of the blow is necessary. Nowadays a polyvinyl butyral (PVB)
self-bonding plastic interlayer is used; no adhesive is necessary and the edges do not need sealing, making it quite practical to cut to size after laminating. Some have a copper coating to keep their surfaces free from oxides or rust, but uncoated rods are equally efficient provided that they are clean. The 1930s saw greater emphasis on streamlining
design. These transport beams with chassis clamps are first positioned under the vehicle, which is raised from the floor by the use of a high-lift trolley jack. The flat panel and the return sweep are both shapes that need careful repairing to avoid stretching of the metal. The driver's position was only partially protected by the roof whilst the rear
compartment was totally enclosed and very luxurious. 14 Explain the advantages of the Taptite screw system. 17.14.2 Cellulose synthetic (half-hour enamel): complete respray from bare metal The process summary is as follows: 1 2 3 4 5 6 7 8 9 10 Spray a thin coat of etching primer, mixed 1:1 with activator, thinned to 20-25 seconds viscosity. The
same is true of the attaching members for the front wings, front bulkhead and floor assembly, as these constructions give great strength and stability to the overall body structure. It is usually possible to check these bonds both visually and physically for fractures and breaks. The main purpose of wheel alignment is to allow the wheels to roll without
scuffing, dragging or slipping on the road. (Figure 13.72) Figure 13.72 Laser point and shoot digital thermometer (Courtesy of POWER-TEC ®) • • Digital thermometer strips - These are placed on the panel, their plastic backing strip holding them to the panel and allowing reading to be observed whilst work is taking place. Clean any excess rust-
proofing fluids off the car body with the recommended solvent, and remember to always clean the gun thoroughly after using the sealant or other heavy-bodied products. To achieve the necessary return it is therefore absolutely essential to use the site, and the expensive equipment required for vehicle repair, to the fullest extent. The bar code reader
is shown in Figure 14.144. Time is always an important factor in the repair of collision damage; however, the majority of car owners are not willing to sacrifice quality of repair for speed of repair to proceed, and the insurance company's assessor is the only person authorized to allow the repairs to proceed.
holes for the rivets are punched or drilled; and the workmanship involved in the riveting of the joint. This begins with the laying in of various different sound insulations, for there must be sufficient clearance for the jaws to fit over and around
the head of the nut or bolt. The cutting medium is provided by a heated blade which is placed under the edge of the glass and pulled around the perimeter, melting the bonding to release the windscreen. Incorrect toe on turns would cause excessive tyre wear. Care should be taken that the rivet head is spread evenly in all directions and not bent over
in one direction only. This fault is rarely experienced when a PVAL film is correctly applied. Once the base and activator have been mixed together they should on no account be returned to the tin of base. However, these clips, unlike the nuts, are not pitched to follow the helix of a thread, and the two sheared arms are of equal height. Laminates A
material composed of a number of layers. Etch primers have a fairly high water absorption characteristic and should be coated with surfacer or filler after the appropriate drying time, to avoid moisture absorption from the surrounding atmosphere. These 418 Repair of Vehicle Bodies features include a hydraulic adjustable platform and an integral
gauges. Figure 13.13 Planishing using a steel stake Figure 13.14 Planishing using a hammer and dolly block In some cases the three techniques can be used together; for instance a panel can be planished using a stake and then minor rectification carried out using hand
dolly and block. If the holes in the air cap become blocked with dried paint, a stiff brush moistened with solvent will usually remove the obstruction. 3 Oxygen must not be used in place of compressed air. After the filler is applied and allowed to set, it can be shaped to the contour of the panel using a plastic filler file with an abrasive paper backing, or
sanded using a sander (Figure 13.48). The drive screw turns clockwise drawing the tapered nose portion of the Nutsert back into its outer shell and thus causing the material is applied to a metal panel on a vehicle body undergoing repair
it prevents the transfer of heat past the Cold Front barrier, giving complete protection to glass, rubber, plastic, paint and any material likely to be damaged by close proximity to the high temperatures which are generated during the processes of welding, brazing or soldering. 6 With the aid of a sketch, explain the difference between a single- and a
double-crowned panel surface. This is an adaptive (self-setting timing) in-process control unit which operates in several stages. Spray gun fluid tips should be of the smaller types (say 1.25 mm diameter) to avoid flooding the job. The hollow is then almost filled by applying polyester resin and chopped strand mat, continuing to build it up until it is
nearly flush with the original surface. Bonds metals particularly well. Upgrading of existing bodyshops to comply with the Act The engineering controls that the EPA imposes upon equipment are very significant, particularly regarding spray booths if emission exceeds the 2 tonnes VOCs limit. If excess pressure builds up, the arrester acts by completely
sealing off the gas supply. 6.3.1 Marking-off table This is made of close-grained cast iron, rigidly constructed and supported on very substantial legs. This tank is heated by gas burners and, except for its open top, is enclosed with the burners in a firebrick structure which conserves the Metal forming processes and machines heat. 9 List three safety
measures to be observed when using a treadle operated guillotine. Crevices and motifs may be lightly brushed to remove polish. The stiffness and stress can then be computed from its geometry, and calculations made of the load bearing of the structures using finite-element methods (Figure 1.27). Never use a regulator on any gas except that for
which it was designed, or for higher working pressures. (See Figure 4.1.) Single-sided zinc coated steel Free zinc is applied to one side of a steel sheet by either the hot dip or the main floor. 14.4.14 Valeting of repaired vehicles After repair
work has been completed, the vehicle should be presented to the customer in a first-class, clean condition. Basic elements affecting the driver's relationship to the instrument panel controls, instruments, steering wheel, pedals, seats and other vital elements in the car are positioned for initial evaluation using the 'Manikin', which is a two- and three
dimensional measuring tool developed as a result of numerous anthropometric surveys and representing the human figure. As well as removing fire risks they also evaporate at a much slower speed; hence they remain wet for a longer period and so have better penetration properties. Modern automobiles must be not only of high quality but also
durable and economical, as perceived by their purchasers. In certain cases, therefore, it can be more economical to repair a damaged panel than to replace it because of the time and labour cost involved for the amount of work over and above that required to repair the part. Consequently quality control is no longer the operator's responsibility.
Pascal's law Pascal discovered that the pressure in a body is equal in all directions. An adjustable measuring rod is the main tool involved (see Figure 17.75). Automotive finishing and refinishing The answer came with the development of cellulose lacquer which, though not a complete answer, was nevertheless an extremely fast drying material which
allowed for several coats to be applied in one day (speed, of course, being the main criterion). Rubber specifications have been built on the basis of the properties of material which has given satisfaction. Whilst the air is flowing, check that the pressure is 3.5 bar (50 psi). The engineer assessor then agrees the cost of repairs, particularly the labour
charges, with the repairer while inspecting the vehicle, and decides whether or not damaged parts shall be repaired or replaced. At the latch end of the door a tapered interlock bar has been designed so that during side impact the load path of the low mounted side intrusion beam is through the latch and hence into the main vehicle structure. The
bumper has a non-textured painted finish, which will be reinstated. 13 Name the constituents of a brazing rod suitable for brazing low-carbon steel. Figure 14.18 MUF 61 Bodymaster jig lift with Cobra 3 puller and MZ brackets (Celette UK) arrow which corresponds with arrows on the sheet (see Figure 14.18). The technique of planishing is a very old
and established craft in the history of hand-fabricated metal articles. They are generally solvent and heat resistant and offer excellent flow properties (Owens-Corning Fiberglas) Glass fibre fabrics are available in a wide range of weaves and weights. See 12.13.3. 4.5 Stainless steel The discovery of stainless steel was made in 1913 by Harry Brearley
of Sheffield, while he was experimenting with alloy steels. The setting-up procedure is as follows: 1 With the equipment switched off, check that the electrode tips are aligned and correctly shaped. A condition of these instructions is that the repairer is restricted to repairing the damage as seen and estimated for. 3 Mount the welding wire reel on the
reel holder, roll off the tip of the wire and insert it into the inlet between the feed unit. Ultrasonic waves will then penetrate out through the unsealed area, including the front windscreen, wiper spindle and washer jet fitment, roof seams, bulkhead seams and grommets, A-post area, door seals, front wheel arch seams and heater
air intakes, to the receiver. The weld is started at the left-hand end of the joint and the welding torch is 260 Repair of Vehicle Bodies moved towards the right, the welding torch preceding the filler rod in the direction of travel. Figure 12.18 Range of MIG welding
torches, air and water cooled, 180-600 A (Murex Welding Products Ltd ) The primary purpose of the shielding gas used in MIG/MAG welding is the protection of the molten weld metal from contamination and damage by the oxygen, nitrogen, water vapour and other gases in the surrounding atmosphere. This measuring tool is used for comparative
measurements when checking a vehicle for damage and when estimating a repair. So, components which are going to take structural loads within the vehicle or be capable of withstanding impact, such as a bumper assembly, need some form of reinforcement. It provides a shut face for the front door, a position for the door lock striking plate and
fragments consist of very small comparatively harmless particles (Figure 14.104). This steel is used by many of the major manufacturers such as Vauxhall and requires special repair techniques. Processes: flame brazing, silver soldering, aluminium brazing, silver soldering, aluminium brazing, silver soldering, aluminium brazing, silver soldering, aluminium brazing, silver soldering.
until they are tight. National legal requirements determine the positions of lamps, direction indicators and other safety-related items, while the building, internal draughts, etc. To minimize the risk of damage spreading, the
shell and it must undergo a further process to soften it; this is known as annealing. Start with roof panel. Figure 9.14 Section through a welded joint Most welded assemblies are made by butt joints in which the ends or edges directly face each other. When paint is a
finishing material the gloss will be impaired. 34 With the aid of a sketch, show how a body jack can put a door panel in tension. The 12 removable ramp sections are made from lightweight alloy and fitted in the tracks on the side of the bench. To recoup the high capital outlay in such units it is essential that they should be used at full capacity for the
whole of the working day. Refinishing area This is where the vehicles are repainted and baked to original factory condition. This gives the necessary adhesion and clarity to the interlayer, which is not transparent until bonded to the glass. A more recent development is the Taptite high performance thread forming screw which has a thread like that of
a conventional machine screw (Figures 7.37, and 7.38). 234 Repair of Vehicle Bodies 37 Explain where quick-release fasteners would be used on a vehicle body. As this equipment can be used both to weld and to spot weld, it is widely employed as a means of welding in new panel assemblies. 11.4 Electrodes used in welding: BS coding Figure 11.6
Welder wearing headshield and protective clothing (Murex Welding Products Ltd ) Gloves (Figure 11.6) are another important item for arc welding. Alloys of the hiduminium class may be artificially age hardened when stable, but low
viscosity when stirred or brushed. 5 Once all cylinder surfaces remain wetted after the water spray is discontinued, check using the bare hand that the cylinder remains cold for 30 minutes. (b) When not sprayed, heat to 60 °C without thinner. The transparent scales are hung under the vehicle in accordance with information on the data charts (see
Figure 14.31). Materials include a wide range of aluminium alloys and zinc-plated steel. Glare and burns 1 The electric plasma arc should not be observed with the naked eye. It is a very hard steel screw designed for joining metal to metal and is used for joining metal to metal and is used for joining metal pressings and exterior fittings. Protective clothing worn in the paint shop by the
spray painters should be either good quality washable nylon garments, anti-static, and complete with hood, elasticated wrists and ankles; or low-linting 60 Repair of Vehicle Bodies disposable coveralls, which offer a liquid barrier protection from splashes, airborne dusts and paint overspray. The air cap of this gun is not designed to create a vacuum,
and the fluid tip is flush with the front of the air cap (Figure 17.13). One of the most significant advantages of resistance spot welding production rate with the minimum of operator participation. One major difficulty has been to ensure and measure resistance to weathering; rubber is subject to oxidation by ozone in the atmosphere
and this results in cracking. If you get a carrier bag from the supermarket and warm it slightly it will become soft and pliable. Figure 6.9). The styling team may
consider the transverse engine as a means of reducing the space occupied by the mechanism of the coaxial joint plus adhesion is sufficient to hold components together. 16.9.1 Accident damage assessment All damage assessment All damage assessment and the coaxial joint plus adhesion is sufficient to hold components together.
stressed Moderately stressed Lightly stressed. The control monitors what the welding gun is doing, and uses the information to take the decision by computing variables such as electrode tip wear, spot-weld pitch, voltage fluctuation, changes in metal thickness, and the presence of scale, dirt and rust. 2.8.9 Visitors are alerted to potential hazards The
best policy is not to let customers into the workshop - many garages have a notice to this effect on the workshop door. To eliminate snagging on the edge, always hold the exposed part of the lance at right angles to the hole. However, when these members are made from high-strength steel, heat must not be used because of its weakening effect; the
metal must be repaired in a cold state. The Draw aligner pivots in the sideways direction and is locked in the required position by a peg. When the centre line and datum are aligned and the correct length is achieved, the vehicle structure is then in total alignment. If the pressure from either the acetylene or the oxygen regulator is excessive, the
result will be a fierce or harsh flame which is very difficult to manipulate, especially when welding panel steel with the neutral flame. 2 The 'glass powder', or frit as it is termed, is then fed into a continuous melt furnace or tank. 28 When, and how, would a pin welding gun be used in repair work? 4.6 Aluminium In the present-day search for greater
economy in the running of motor vehicles, whether private, public or commercial, the tendency is for manufacturers to produce bodies which, whilst still maintaining their size and strength, are lighter in weight. Apply pressure to both pieces of metal and press the switch to carry out the weld. Explain its function in welding. Aluminium-silicon alloys of
nominal 5 per cent, 7.5 per cent or 10 per cent silicon content (Table 8.4) are used for brazing aluminium and 1.5 per cent manganese. This is generally done by applying pressure to the damaged member or members. Case hardening the outer case or shell articles, which is accomplished by
inducing additional carbon into the case of the steel by a variety of methods. 7.8.3 Achieving good results with adhesives Many applications require no preparation. Tables 4.5, 4.6, 4.7 and 4.8 show the characteristics and properties of aluminium alloys. 3 Clear lacquer engine if required to enhance and preserve appearance. In the integral body the
floor pan area is usually of heavier gauge metal than in the composite body, and has one or more box sections which may run across the floor either from side to side or from front to rear; this variety of underbody construction is due largely to the difference in wheelbase, length and weight of the car involved. 10 What is
meant by the principle of shearing metals? When used to force dry two-pack materials, the drying times claimed are quite extraordinary: for example, a complete respray can be dried in 5 to 10 minutes, and minor touch-ups in 1 to 2 minutes. 3 Listed carcinogens are in use. Applied with a spray pistol Suitable for underbodies, wheel arches, front and
rear aprons, sills, new parts, repair sheets. Tack welds, particularly on thin sheets, should be placed much closer together than is the usual practice for welding mild steel. If the weld is performed correctly, the section where the bond is made will be as strong as the base metal itself. 3 Transparent and translucent doors and partitions (use of safety
material and marking). Remove plastic sheeting. To use a trammel, one leg is placed at the centre point of the weld into the material and the amount of weld spatter that is formed around
the finished weld. A synthetic resin stopper should be used and, when hard-dry, wet flatted with P360 wet-or-dry paper. Some of the coating also forms a slag over the molten part, which also serves as a protection against oxidation. 6.2.15 Gauges Whereas measuring is the establishing of the actual size of a component, gauging is the positive
comparison of the size of a component with a standard. These lines will indicate if any variation has occurred in the diagonal measurements. 4 Can anything be divided or moved to prevent such spread? Colour crayon - The area to be heated is given an outline mark with a crayon which changes colour at a given temperature. 35 Explain why a careful
study of accident damage is necessary, before any stripping or repair is carried out. Heat balance In the resistance welding of panels of the same thickness and composition, the heat produced will be evenly balanced in both panels, and a characteristic oval cross-sectional weld nugget will result (see Figure 10.13). Final colour coating is now begun
alternatively spraying and rubbing each coat of paint until the finishing overlay lacquer can be applied (around 12-14 coats of paint). 27 Illustrate a tool which could be used in the removal of damage from a double-skinned section. Filler materials can be dispensed either from wall mounted, air operated filler dispensers or from portable dispensers.
The cutting oxygen stream is bled off inside the torch through a lever operated valve (Figure 9.22). The prototype will also be placed on a computer-linked simulated rig to monitor, through controlled vibrations, the stresses and strains experienced by the driveline, suspension and body. Consolidation and air removal are then effected by manual
means. 34 With the aid of a sketch, outline two methods of limiting distortion when welding thin sheet metal. Adhesives used in vehicle body repair Weatherstrip adhesive Bonding rubber weatherstripping to door shuts, boot lid. Celette UK Bodymaster 2000 drive-on repair system The Bodymaster 2000 drive-on system is easy to operate. AC
alternating current This offers a good compromise between plate heating and the cathodic cleaning effect and is used with aluminium and with manganese alloys. It is not a friction terminal. Inertia is the resistance of a body to stop doing whatever it is doing. The electric motor provides a good constant-speed drive for the generator and is not
affected by the load imposed upon it. Vehicle electrical circuits operate at a safe 12 V or 24 V on HGV/PSV applications. The heat treatment of metals is of major importance in motor body work. Colours and fabrics are tried out on this mock-up until the interior styling is complete and ready for approval. 173 2 Check on the path of the swinging
counterbalance weight, warning anyone working close by of your intentions to use the machine. Anaerobics, epoxies and the toughened variants take longer to harden. The gas will start to flow from the nozzle (3.5-4.1 bar). The torch may be held in either one of two ways, depending on which is the more comfortable for
you. Strength of glass fibre reinforced plastic laminates in any direction is dependent on the orientation of fibre reinforcement to that direction (Figure 16.25). 12 Give two reasons why cellulose-based paints were replaced by stoving synthetics for mass production finishing on new cars. Records of tests and repairs must be kept for five years. It will
be useful for the professional practitioner whether working on current models or restoring vintage or classic cars. Various dollies are shown in Figure 3.38 A range of adjustable wrenches (Facom Tools Ltd ) The barrel-shaped socket fits over and around a
given size of nut; inside it is shaped like the ring spanner, having a set of teeth to grip the points of the nut. These fillers are used in the body repair trade as an alternative method to body soldering. This dual-purpose material is based on a special moisture cured polyurethane with an accelerated setting time. Figure 10.18 CEBORA spot welder (Mig
Tig Arc) A pincer-type welding gun with a powerful weld transformer (to maintain the very short weld times) is fitted with a strong pressure system to deal with the majority of work, which can be approached from two sides in pincer-type fashion. The H is always followed by two or more digits, indicating the final degree of strain hardening. In all,
there have been many developments since the days of the coach painter and his homemade paints. That is, the retained austenite is transformed into martensite by the increasing strain during the stamping or other forming process. Use recommended sealers to seal between the glass and the weather strip or the body. The hammer is made with either
flat or crowned faces. When producing glasses to a particular size, however, the glass and vinyl interlayer are usually cut to size first. 5 Provide support throughout the whole procedure. Door alignment is checked by making a visual close inspection of the door and its relation to the surrounding body panels. Follow the manufacturer's instructions for
changing the cartridges when spraying over a continuous period (Figure 2.7a, b). When it is considered that the hinge mounting points are correct, the doors should be hung in their respective positions and all screws or hinge fixing bolts placed loosely to allow the door to be realigned according to the car manufacturer's adjustments. 4 Greasy
overalls should never be worn. Many body components are manufactured in a variety of plastics. 4 Where appropriate, a letter H indicates a hydrogen-controlled electrode. This force is similar to the pressure used to make water flow in pipes. This table will help guide readers who are using the book as a course text or reference, with links to the
underpinning knowledge and skills as well as to the material included in the NVQ assessment. 17 After sheet metal has been work hardened, describe which process will allow further working of the sheet metal. Then cut a piece out of the scrap bumper which will just fit into the hole. 2 When the mound of material begins to warm up, it becomes
saturated with heat. MIG: spray pulse, aluminium, nickel, copper alloys Helium TIG: all metals, especially copper and aluminium. It is unusual for this to extend more than about 8 cm from a break, and the easiest way of checking the exact limits is to shine a powerful lamp through the laminate. As these steels have a different character from low-
carbon steel (mild steel), which still accounts for 60 per cent of the body shell (see Figure 10.11), they cause repair system that can be mounted to any jig frame by using an adaptor. Resistance welding is extensively used for the mass production assembly of the all-steel body and
its component sheet metal parts (see Figure 10.1). The grooving tool is then placed over the interlocked edges and hammered. A passenger car side impact test aimed at reducing chest and pelvic injuries will need to be disconnected. Heavy pressure is not required when polishing with a
machine. This tool is used largely when beating the surface on overstretched panel areas which have to be hot-shrunk in order to return them to their normal contours. 12 Describe the likely damage that would occur to a panel made from GRP and which had been subjected to a heavy blow. Always consult your owner's manual. Wheelbase The
distance between the centre lines of the front and rear wheels of a vehicle. 3 Pressure gauges should be calibrated up to 40.0 bar. The greatest percentage of steel used in motor bodies is in the form of coil, strip, sheet or plate.
furnace and then hammered until a homogeneous material results. In the case of the sanders, a series of holes in the pad itself is used Figure 3.65 Bonded windscreen electric cutter (Fein/George Marshall Ltd ) 3.25 Dust extraction for power tools Built
in dust extraction should be a must in any new equipment programme, for it is essential that airborne dust levels in body shop are reduced to a minimum for the safety of the body shop employees. 3 Name three types of metals used in making solid rivets, and state a property which they all have in common. Stage 2 research is more advanced; it
relates to vehicles that have been subjected to controlled structural damage, and is concerned with the repair methods and times associated with such damage. They will give opacity to castings and laminates, produce dense gel coats, and impart specific mechanical, electrical and fire resisting properties. Rest area (and arrangements to protect
people from the discomfort of tobacco smoke). The common causes of this fault are low resin controlled. 29 Explain the type of gases used in plasma arc cutting. Breathing resistance is minimal, offering cool and comfortable use. Carefully
angle water jet away from the vehicle interior. In an impact without the head protecting airbag, a driver's head could hit the pole with sufficient force to cause a fatal head injury. If a fire does start, do not attempt to put it out with water unless it is a catalyst. Tempering of the casing may then be carried out in the normal way. Owing to the awkward
 Craft techniques and minor accident damage 355 shape of some panels they cannot be flanged in the swaging machine and so must be processed by hand, using either a stake and mallet or a hand dolly and mallet and finishing off with a planishing hammer. For standard SVA, all the inspections are undertaken at selected testing
the Vehicle and Operator Services Agency (VOSA), an executive agency of The Department for Transport. The width of lap is the distance from the centre of the rivet to the edge of the plate. The cellophane is then supported by sheet metal, hardboard or card which can be fastened to the moulding with adhesive tape and struts fixed to hold it to
contour. Any additional damage disclosed when dismantling the vehicle must have a separate estimate submitted, and work cannot be carried out on this damage until the extra estimate has been agreed and the necessary work authorized by the insurance company. The coverage may vary from colour to colour. Characteristics: distinctive fish-like
offensive smell. The actual swaging is done by attachments fitted on to the ends of the shafts, and the shape and form of these attachments can be varied as is shown in Figure 5.19. Steering between 1890 and 1906 was operated by a tiller (Figure 1.3).
at the front and rear ends as a direct result of the built-in safety characteristic of deformation of structures. Figure 17.6 Single-acting two-stage compressor When selecting an air compressor When selecting an air compressor that will be required to operate the various tools throughout
the workshop, such as rubbing-down tools and spray guns. In some cases this can be done by adjustment; in other cases, where these assemblies are fully welded, Figure 14.77 Upper body measuring system measuring
damage 449 hydraulic equipment must be used. 14 Apply protective wax coating by hand, ensuring total coverage of all panels. The sliding can be controlled by adding elements to the steel such as niobium or titanium. Zipcut spot-weld remover (Figure 3.13) is used with an electric or air drill, and is ideal for removing
spot welds on all areas of bodywork and subframes. Worn ends should be cut back and refitted with the appropriate hose and connections and clips. Power saws can also be used in the removal of damaged sections: either the rotary saw with a vibrating blade, or the straight reciprocating blade (see Figure 14.97). With the increasing emphasis on
performance with economy, computers are used to obtain the best possible compromise. In most cases this is not possible, which means that the doors have to be held open whilst at the same time endeavouring to keep alignment correct while the bolts are tightened. They will protect the eyes and face from flying molten particles of steel when gas
welding and brazing, and from the harmful light rays generated by the arc when MIG/MAG, TIG or MMA welding (Figure 2.5a, b). During the late 1930s glass fibre became available on a commercial scale and of a quality and smallness of diameter which enabled it to be manufactured into textile products. In the field of mechanical fasteners, the
modern motor vehicle uses special types of spring-clip fasteners in ever-increasing quantities. Pilot holes may be punched, drilled, rim extruded or moulded when using selftapping screws. These lock into tie-down boxes to locate the vehicle uses special types of spring-clip fasteners in ever-increasing quantities. Pilot holes may be punched, drilled, rim extruded or moulded when using selftapping screws.
not only contribute to the bending and torsional stiffness of the vehicle but also provide rigid attachment points for seat runners, lower seatbelt mountings and door hinges. The pad is covered with a lambswool disc or foam pad which must be kept clean at all times (Figure 17.49). Hammers are available for light or heavy shrinking, according to the
depth of the serrations. Right hand means that the lower blade is on the right-hand side of the metal being cut. Some filler coatings in particular are porous and so they tend to absorb the binder or medium of finishing coats, thus reducing their effectiveness as a glossy finish. The glass shall be sufficiently resistant to conditions to be expected normal
traffic, and to atmospheric and heat conditions, chemical action and abrasion. Before cutting away any damaged section, or before ordering replacements, the repairer should ascertain the proposed method of repair and the positioning of joint lines. S max. By using this type both hands are free for control over the welding equipment. 1.5.1 Outer
construction This can be likened to the skin of the body, and is usually considered as that portion of a panel or panels which is visible from the outside of the car. However, some articles are so shaped that oversprayed areas are difficult to avoid. Type 6082 is a heat-treatable medium-strength allow which combines good mechanical properties with
high corrosion resistance. Regular inspections of all equipment as outlined in the safety practice code are now a legal requirement. The modern system of supplying the refinisher with colour formulae is in the form of microfiches, which require a microfiches, which require a microfiche viewer or reader. This incorporates the front suspension pick-up points, engine mountings and
front energy absorbing structures. Figure 8.1 Capillary attraction through a soldered lapped joint 8.3.1 Solder is an alloy of lead and tin, and is used with the aid of a soldering flux. Box drawing Metal forming processes and machines Figure 5.23 Metal flow during drawing Figure 5.24 Drawing operations 181 182 Repair of Vehicle Bodies
consists basically of forming at the straight sections and drawing at the corners. When there is too much drop, the welding machine cannot supply enough current for welding machine cannot supply enough current for welding. This surface is termed the 'master' or 'face' side. General workshop equipment 15.5.2 Dust and fume extraction and arrestment systems) Hoist (wheel-free type)
Headlight focusing equipment Axle stands and trolley jacks Folding crane (1 tonne) Battery charger (portable) Parts trolleys Masking machine Filler dispensers Wet and dry vacuum Valeting machine Polisher Wax injection equipment
Vehicle moving skates Benches (mobile). If these facts are not known, considerable time could be spent checking the wrong areas of the vehicle. 4.4.1 High-strength steel have been introduced into automotive production slowly only because of the need for specialised press tools to form body panels from this stronger material. 30
Why should you not smoke or drink alcohol when working as a vehicle repairer or refurbisher? This is to spread the force of the pressure evenly over a larger area. Each provides a particular combination of properties, some being designed for corrosion resistance, some for heat resistance and others for high-temperature creep resistance. Always use
new wipers and cloths when carrying out aluminium repairs. The temperature at which this change in the structure of the steel starts is 700 °C, which is known as the upper critical point. This is accomplished by the friction and roll action of the workpiece as it passes
between the two steel rollers. As part of the process of repairing vehicle bodywork, old layers of paint can be removed with this sander. The common metals differ quite a lot in their degree and rate of work hardening. The feet should be protected from sparks, slag or cut material falling on them. It should be remembered that curing is itself a heat-
producing process. Insurance company assessors and RAC/AA engineers will probably also require entry to the workshop as well as some customers who are concerned about their vehicles. The outer skin, or panels, of a body is made from light-gauge metal, placed over a framework of heavier, stiffened metal which is reinforced with various types of
supports and braces. Wet flat with P600 grade paper, rinse, dry off and tack off. It must be remembered that certain special rivets and fasteners can only be used by their appropriate setting tool. The Health and Safety at Work Act (HASAWA) 1974 is a major piece of occupational legislation, which requires the employer to ensure, as far as is
reasonably practicable, the health and safety of all staff and any other personnel who may be affected by the work carried out. Sealing compositions, rubber-based compositions and Metals and non-metals used in vehicle bodies 143 SEALANT, ADHESIVE AND
ANTICORROSION CLASSIFICATION CHART Item Required Properties Applications Brand Names Thermosetting sealant of sheetmetal seams (drip rails, floor, body side panels, trunk, etc.) Spotwelding locations Body sealant 3M PartNo. 8531 3M PartNo. 8646 Spot sealer Gluing places that cannot
be spot-welded, such as roofs Sealing for gromments, packing and metals Two-agent denatured epoxy adhesive (MZ 100320) 3M 8513 Grommeted Windshields Sealer (Black) (For Europe) 3M PartNo. 8121 (Except for Europe) 3M PartNo. 8150 (Except for Europ
fluorocarbon resins and other substances with highly absorbent surface) Wax injection Rocker panel primer Underbody anticorrosion agent Underbody Agent 
running Highly solid, no volume shrinkage Non-running • Electro-conductive, and spotwelding can be done after application • Excellent water resistance • No rubber swelling • Non-drying • Quick drying (10 seconds to 3 minutes) • Colourless and
transparent after drying • Non-running, good adhesion • Thick application possible • Good low temperature performance Problem areas requiring body sealing Undercoating agent Tectyl 506 Te
7103 (Water basis) Tectyl 506T Tectyl 506T Tectyl 506T Tectyl 506 Tectyl 506T 
equipment Performed strip Hand or palette/putty knife Zinc-rich primer Brush or spray Panel edges Seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer Bonded joints Panel edges Seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand) Between panels Structural adhesive or seam sealer light Applicator gun (hand
semi-structural Caulking gun synthetic-resin-based compositions. 4 Explain the method and name the tools used in fabricating by hand an aluminium component with a high-crowned surface. Permissible stresses in this alloy can be as high as 200 N/mm2 under static loading conditions, although some reduction below this would normally be made for
transport applications where there is a considerable element of dynamic loading. It is suitable for corner and angle work and is easy to handle because of its fairly small weight of 2 lb 14 oz (1020 g). The wheel arch panels (9) themselves seal the rear road wheels from the body. It is not possible to remedy crazing by simply resurfacing with a further
layer of resin. Every vehicle presented a different problem but, equally, every body shell had certain points which always could be relied upon to be accurately controlled during factory products. Figure 12.1 TIG welding
equipment AC/DC (Murex Welding Products Ltd ) The following should also be noted: Gas tungsten arc welding (GTAW) This is the terminology used in America and many parts of Europe for the TIG welding process, and it is becoming increasingly accepted as the standard terminology for this process. Planning permission to erect commercial
buildings must be obtained before building work commences; failure to do so may result in heavy fines and the possible destruction of any unauthorized building. The most important points about overhead welding are to obtain the cylinder is
made, the method of construction, its test pressure, the maximum permissible filled pressure and the method of regular testing (Figure 9.6). However, the body design of this car had to be changed over its 19 year production span to reflect changes in customer taste. It has more than twice the proof strength of normal austenitic stainless steels whilst
providing improved resistance to stress corrosion cracking and to pitting attacks. This resulted in a change in glazing methods, with laminated glass being increasingly secured by the process of direct glazing. The proportions of this mixture, together with the existing workshop conditions, dictate whether it is cured at room temperature or at higher
temperatures and also the length of time needed for curing. Both ends are the same size. Also light grinding of the weld or parent metal surface to remove spatter may be required before testing. A severely damaged inner panel such as a wheel arch can be cut out using the oxy-acetylene torch. This paint is particularly suitable for use on rough
surfaces where heavy coatings are required to level up the surface as would be the case should burnishing compounds be used with machines. In addition
to damage as a result of a collision to the outer panels of the body, the inner construction which is attached to the outer panel is prevented from being restored to its original contour; hence the inner construction must be restored to its original shape and position either before
or at the same time as the outer panel metal is corrected. The majority of plastics employed in vehicle manufacturing are thermoplastics. First connect the chain to the damaged part of the car, then hold the chain tightly in the direction you wish to pull and adjust the pulling unit or ram to the measured angle. With a mobile jig, repair can be
accommodated in the 6 metres 3.6 metres floor space of a panel bay. Some interior applications include fabric on trim and door panels, headlinings, carpets, and sound deadening panels. Type 6063 is also a heat-treatable alloy but of somewhat lower strength, and is used mainly in applications requiring good surface finish or where the parts are
required to be anodized. The exact percentage of these metals used varies according to the hardening processes to be used and the properties desired. 19 Explain the use of captive nuts in vehicle assembly. Most of the conventional methods of space heating can be found in bodyshops, ranging from portable gas fired units through wet systems to
radiant systems. The secret of this equipment's success lies in its anchorage to the car, using body anchor clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.3) or right-angled clamps for those with horizontal pinch welds (Figure 14.4).
wet-on-wet process. A good butt joint is achieved by cutting through. The plates should be sweated on with a layer of body solder about 3 mm thick, using the minimum of heat, and quenching with a wet rag to prevent distortion. Often, too, the prototype of a component ultimately to be made in quantity by stamping or pressing is hand made to allow
minor modifications to be studied before mechanical production begins; the part produced by panel beating is used as the pattern for press or stamp tools. The steels are hot rolled for chassis and structural components, and cold reduced for body panels. When dry, wet flat with P1200 grade paper, burnish and polish. A popular material for formers is
a paper rope, made of paper wound on flexible wire cord. To install or remove either, the pliers are needed to overcome the powerful spring pressure. The deep penetration characteristics of this welding process enable spot welding of widely differing metal thicknesses to be performed successfully, together with multisheet thicknesses. 5 Give
training, information and instruction to employees on its use and how to look after it. Excessive distortion is checked by the flats and, after welding, the smooth curve of the cylinder can be restored with a mallet. Filler is a heavy-bodied material used for levelling defects which are too deep to be filled economically with surfacer. It is made from
readily available raw materials, and is non-combustible and chemically resistant. The bath is usually composed of equal parts of sodium nitrate and potassium nitrate and potassium nitrate contained in an iron tank. Because the base blocks, incorporating unified brackets, are fully adjustable, they give total accuracy in all measurement readings. The friction grip version
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offers good retention without paint damage where corrosion resistance is paramount. However, small flats may occasionally prove to be of assistance in the welding of thin sheet metal. 6 Do thoroughly wash contaminants such as used engine oil from the skin as soon as possible with soap and water. This need usually arises when Hammers (Figure
3.26) are still the most important forming tools as far as the body worker is concerned, and from the commencement of his career he should attempt to acquire a skilful hammering technique. Always wear a clean set of overalls and gloves when working on aluminium bodies cars. T651 2024 B 0.50 1.2-1.8 0.10 - 0.25 - 0.15 0.05 0.15 Rem. Manual side
mirrors are much easier to replace — pop off the mirror panel, remove the screws to take off the broken part and screw on the new piece, according to Family Handyman. The gas flow required varies with current setting, shroud size, material being welded, and type of weld joint. Fit these wheels to the shafts and line them up by slackening the
locking screw and adjusting the small lever at the rear of the frame until the wheels engage centrally with each other. A window installed between the work area and the reception area allows customers to view tasks being carried out. This has the effect of shrinking or reducing the circumference of the blank, thus forcing it down and around the
stake. Gas welding processes are so called because the welding heat is provided by a flame produced by the combustion of a mixture of gases. Slow curing times This has important consequences for later production processes, as wrinkling is not limited to the flange area as in cupping, and tearing on the combustion of a mixture of gases. Slow curing times This has important consequences for later produced by the combustion of a mixture of gases.
failure is not limited to the bottom of the panel as in cupping. The number and abbreviation letters identify a classification of plastics. Make sure that the ledges are fully coated; not all of these are visible from underneath, so check them when the vehicle is back on the ground. Self-tapping screw A screw that cuts its own threads into a predrilled hole
This is usually found on the wall near the machine. The bumper is allowed to cool, and the welded area can then be sanded down with an 80 grit disc before being passed on to the painter (see Figure 14.123). Opacity is also reduced and when sinkage takes place as a result of solvent evaporation, the particles tend to stick through the top skin of the
paint film, causing the finish to have a seedy appearance. A coating of oxidation is formed within a period of two hours even in a well heated dry workshop. Table 8.1 Zinc chloride (killed spirits) This is made by dissolving pure zinc in hydrochloric acid until no more zinc will dissolve in the acid. It consists of two legs riveted together at the top, one of
which is ground to a point while the other is turned inwards or outwards at its tip. Evaluate the risk (risk is the likelihood that a substance will cause harm in the actual circumstance of use) 1 How is the substance will cause harm in the actual circumstance of use) 1 How is the substance used? 4.8 Rubber The value of rubber lies in the fact that it can be readily moulded or extruded to any desired shape, and its elastic
quality makes it capable of filling unavoidable and irregular gaps and clearances. Electrolytic copper is the best as it gives longer life and holds the solder well on the working faces, and forged soldering bits are far better heat retainers than cast copper bits as they are less liable to crack at the tips. These would have been less if refinishing shops
were equipped with equipment similar to that of the vehicle makers, allowing them to use the same finishing materials. Renew the hose as soon as it shows any sign of damage. Rules for nozzle selection To minimize operator error when processing enclosed sections, always use the flexible or rigid lances first. Thin sheet metal edges can be fused
together without additional filler metal being added. This crease or set in the metal should be made gradually, the tool being hammered while tilted very slightly in the direction and improved arc stability whilst transferring metal
between the electrode and the parent metal. 116 Repair of Vehicle Bodies 3.23.6 Small angle grinder (Figure 3.59) is sometimes known as a mini-grinder or a grinderette. Not suitable for loaded joints or harsh environments. These devices find great use both in the spray shop and in the repair shop when carrying out welding
(Figure 2.8a, b). 23 State where resistance seam welding could be found on a vehicle body. Pressure is applied by closing the pump handle. From the reverse side of the panel it will be seen that a rib has been formed, which will in effect give strength to the damaged area should this be required. The lower wheel
also revolves but has a convex curved face and is made interchangeable so that different shaped lower wheels, from nearly flat to full curved, can be used. 8.3.4 Soft soldering process Soldering is a process of joining two lapped metal surfaces together by fusing another metal or alloy of a lower melting point in between them in such a way that the
melted metal bonds firmly to the other Figure 8.2 Soldering bits Soft and hard soldering methods 239 two. Scuttle panel The panel between the bonnet and windscreen. Water Water is the most widely used extinguisher agent. This rule applies to most solid fuels although the degree to which oxygen content must be reduced 2.2.3 Fire risks in the
workshop Class A fires: wood, paper and cloth Today wood is not used in cars, although there are exceptions. Magnetic particle method Surface defects in mild steel and low-alloy steels may be revealed by this method. The front edge of the boot floor is reinforced by the rear squab panel and the rear end by a cross member of some form (8). Heat
treatment Medium- and high-carbon steels, such as those used in many body working tools, can be hardened by heating to a fixed temperature and then quenching. One is to extend the repair to a natural break in the car body lines and refinish the entire panel. 14 What is the purpose of a marking-off table and a surface gauge? However, above a
certain intensity of load (the elastic limit) the metal will remain distorted when the load is removed. When the speed is too fast, the molten pool solidifies rapidly and impurities are retained in the weld. The big environmental advantage is that by reducing the weight of the vehicle the fuel efficiency is increased; a 10% weight reduction typically gives
an 8% reduction in fuel usage. Water-based paints are applied in the normal way, but care must be taken with the volume of paint delivered. It is advisable to keep the temperature below 160 °C. The spun warp threads are wound onto a giant roller and the weft threads are well as well
assembly is then placed into a wet layer of spray-up material. Manual metal arc welding 305 (a) (b) (b) (a) (c) Figure 11.15 Basic joint types: (a) fillet (b) butt (c) Lap (BOC Ltd.) Strength and loading conditions: (a) butt weld (b) fillet weld, load carrying area shaded (BOC Ltd.) Figure 11.15 Basic joint types: (a) fillet weld, load carrying area shaded (BOC Ltd.) Figure 11.16 Static loading conditions: (b) butt (c) Lap (BOC Ltd.) Figure 11.16 Static loading conditions: (a) butt weld (b) fillet weld, load carrying area shaded (BOC Ltd.) Figure 11.17 Basic joint types: (b) butt (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (a) butt weld (b) fillet weld, load carrying area shaded (BOC Ltd.) Figure 11.18 Static loading conditions: (a) butt weld (b) fillet weld, load carrying area shaded (BOC Ltd.) Figure 11.18 Static loading conditions: (a) butt weld (b) fillet weld, load carrying area shaded (BOC Ltd.) Figure 11.18 Static loading conditions: (b) butt (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (a) butt weld (b) fillet weld, load carrying area shaded (BOC Ltd.) Figure 11.18 Static loading conditions: (a) butt weld (b) fillet weld, load carrying area shaded (BOC Ltd.) Figure 11.18 Static loading conditions: (b) butt (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (b) butt (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (b) butt (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (b) butt (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (c) Lap (BOC Ltd.) Figure 11.18 Static loading conditions: (c) Lap (BOC Ltd.) Figure 11.18 Static loading c
static strength is a primary criterion in the selection of joint design. The use of computers or CAD allows more flexibility and saves a lot of time compared with the more conventional drafting systems. Alternative parts A database of insurance industry approved parts, mainly Veng and Unipart, which may be used instead of the original equipment
manufacturer (OEM) parts database. Metal that has not been excessively hammered, displaced or stretched will have a tendency Figure 13.36 The technique of indirect hammering Craft techniques and minor accident damage 361 to return to its original contour of its own accord. Certain stakes are used only occasionally, and to maintain a bright
smooth surface they must be given a coating of light oil from time to time. Automotive finishing and refinishing 3 4 5 6 7 8 9 10 11 12 13 14 Apply thin coat of etch primer to bare metal, thinned 1:1. Rubber boots will give protection from acids or wet conditions. Gas
welding A fusion welding process which uses a gas flame to provide the welding heat. Briv is installed from one side of the workpiece with the use of a mandrel loaded into the Avdel power tool. A wider insert will result in lower stress per inch at the load transfer point. Most companies have a designated first aider who is trained to deal with accidents
and emergencies. Like all businesses, body repairers rely heavily on their most valuable asset, their staff, for survival and success in their specialist field. To use the equipment, first position the earth clamp, making sure of a good connection. The old tungsten filament lamp has given way to quartz-halogen lamps which provide much better
illumination. Consequently bending processes are becoming very sophisticated. 2 Explain the importance of the choice of site in locating a new workshop. Those subject to the duty of care must try to achieve the following four things: 1 To prevent any other person committing the offence of disposing of 'controlled waste', or treating it, or storing it
without a waste management licence; or breaking the conditions of a licence; or in a manner likely to cause pollution or harm to health. The stoving schedule recommended is 40 minutes at 91-93 °C, during which the car body attains a metal temperature of 80 °C for 30 minutes. The electrode is brought straight down on the plate and instantly
withdrawn a distance of Figure 11.11 Scratching method of striking the arc 11.6.7 Welding currents may vary from 20 to 600 A. 4 When using a treadle guillotine make sure that any assistant or onlooker has not got his feet under the treadle. The cowl is sometimes called the fire wall because it is the partition between the passenge
and engine compartments, and openings in the cowl accommodate the necessary controls, wiring and tubing that extend from one compartment to the other. The machine is based on the principle of shearing metal, and this is done by a pair of very narrow blades, one of which is usually fixed while the other moves to and fro from the fixed blade at
high speed. Although the arrangement of the control unit may vary for machines made by different manufacturers, most consist of a wheel or lever control which selects the correct current for the right size of electrode and thickness of plate being welded. The hand-held type of welding screen is of course fully adequate from a safety point of view but
only leaves one hand free. It is able to cut from straight lines to tight curves. Also the more couplings there are in the installation, the greater is the risk of air leakage with a consequential drop in pressure. Again the high strength is triggered by applied strain. To extend the life of the nylon tube, the sides of the lance should be held away from the
edges of the hole as it is entered or withdrawn. 5.3.2 Angles and flanges A further method of giving strength to metal is to form angles or flanges along the edges of sheets (Figure 5.3). Major accident damage 487 Figure 14.138 Customer's estimate (Bodymaster UK)
Major accident damage 489 Figure 14.140 Vehicle job card (Bodymaster UK) Major accident damage, and if the vehicle for the inspection of the damage.
In use, the centre point of the circle to be scribed is lightly marked and is used for the static position of the pivot leg, while the other leg is rotated to scribe the circle. They may be gently curved, semiwrapped round, or fully wrapped. The wheel-free system allows the vehicle to be moved easily lengthways and sideways for easy bracket or sill clamp
location. In every case where there is Health and safety (a) 65 (b) Figure 2.8 (a) Airstream welding helmet (powered respirator in use in welding the carried out and action taken to minimize hearing damage. They will secure blowmoulded or glass-
reinforced plastic, rubber and plywood to metal panels or sections up to 13.5 mm thick. 13 Explain each of the appropriate tools needed to carry out the repair (c) the repair techniques required
(d) the alignment and final check. Reinforced composite materials 567 stand at least overnight, or longer if the weather is particularly cold. At the same time as the exterior model is being made, the interior model is also being produced accurately in every detail (Figure 1.17). As a result the system is suitable for the repair of passenger vehicles, vans
four-wheel-drive vehicles, and light commercial and chassis-based vehicles. The unit is mounted on a stand with a flexible support lever which makes it possible to locate the heating module in any position without locking devices
(see Figure 17.61). Equipment must be protected by the correctly rated fuse. Angle templates are useful when bending in the bending machine to check the angle of bends so that they are constant. Tin the soldering iron Dip the heated copper bit into flux to obtain a complete coating of flux on the surface faces of the bit, then rub the fluxed portion of
the bit on a piece of solder to obtain a film of solder over the copper surface or working faces of the soldering iron. to which the vehicle and Mitek power unit are secured by the use of tie-down chains, can be fitted into any workshop floor, usually to form a working bay ranging from 12 anchor pots to as many as 28 according to the type of repairs to
be carried out. Plastic filler should not be used in this case because the moisture would seep through, parting the filler from the panel. 9.11.3 Nozzles A number of different designs of nozzles are available to suit the various combinations of fuel gases and torch design. 12.5 Equipment used in TIG welding Figure 12.6 Principles of the TIG spot-welding figure 12.6 Principles of the TIG spot-welding figure 12.7 Equipment used in TIG welding Figure 12.8 Principles of the TIG spot-welding fig
process The equipment required for TIG welding (Figure 12.1) consists of a welding torch equipped with a gas passage and nozzle for directing the shielding gas (argon), a pressure reducing regulator and flow meter, a power unit and a supply of cooling water (Figure 12.7) if the
welding 316 Repair of Vehicle Bodies Figure 12.7 Gas, water and power supply for TIG welding torch is water cooled. Self-tapping screws are particularly useful to the body engineer and trimmer since no access is needed to the rear side of the work, it being necessary simply to drill the requisite size of hole and drive the screw home. The advantage
of the method is that materials which would normally require flux can be welded without it; therefore cleaning of the weld is minimized and the effects of distortion are greatly reduced. Thin thermoplastic items which will melt without a great deal of heat being applied can be welded using a soldering iron (without the solder). If this is not attained,
small hammer marks can be removed by smoothing off with emery cloth glued to a piece of wood and used like a file. This can be done by holding the dolly block under the low area and tapping down the adjacent high spot with a planishing hammer. Resistance is measured with an ohmmeter. These compressive stresses
could cause wrinkles at the edge of the blank and cup, and to prevent this a blank holder is added around the punch. However, the shrinking operation is drawn out by quenching than by additional spots. When the wire speed becomes too
great in relation to the voltage, knocking or stubbing will be felt in the welding torch, because the wire travels to the bottom of the molten pool (Figure 12.21). Most prosecutions by the Heath and Safety Executive (HSE) are under the and safety at Work Act; this is because it is a catch-all. Planishing should leave the metal with a dead
smooth surface. When this certificate has been signed by the vehicle owner, it releases the insurance company from any liability in respect of the claim for damage caused by this particular accident. Unlike the DC generator, the AC transformer has no moving parts and for this reason is usually referred to as a static plant. The actual smoothing with
the planishing hammer and dolly should never be started until the correct shape is formed in the panel. The content gauge on the acetylene regulator is calibrated up to 40 bar, whereas the working pressure gauge is calibrated from 0 to 2.5 bar (Figure 9.9). Its function is mainly to hold the weight of the moving parts when the clutch is disengaged. If
a wrought alloy is to be welded containing less than 2 per cent alloying element, then silicon-type electrodes are used. They are sometimes called prying spoons because the spoon end is used in the same manner as a dolly in conjunction with a hammer. When using a particular brand of paint, the operator should always follow the maker's instructions
as to viscosities, drying times and temperatures. After being stabilized with ammonia, natural latex is shipped in liquid form to this country from Malaysia, Indonesia and other rubber producing countries. Therefore no mechanical clamping mechanisms are involved. The texture and colour will allow you to identify GRP and carbon fibre materials. 2
Consult safety representatives about the appointment of competent persons. The curved torch carries the current contact tip at the front end through which the feed wire, shielding gas and cooling water are also brought. These machines are powered by compressed air or an electric motor, and are held in the hands during the cutting operation. It is
connected to the front end assembly and forms the front door pillar or hinge post. Many irregularly shaped panels are formed by drawing, but the simplest drawing operation, that of cupping, more easily illustrates the theory of drawing 200 A, you will need
an induction ammeter which clamps over the starter cable without making electrical contact. 28 Explain how crack propagation is achieved in structural adhesives. The ram is designed with a snap-on 374 Repair of Vehicle Bodies 5 2 3 1 4 7 6 10 8 9 11 12 18 19 13 17 14 16 15 21 20 22 23 24 Figure 13.50 Body jack kit on a mobile trolley (Blackhawk
Automobile Ltd ) 1 2 3 4 5 6 7 8 Slip lock extension Pump 10 tonne ram 10 tonne short ram Wide-angle wedge head Pull plates Pull ram Midget ram 9 10 11 12 13 14 15 16 Pull rings Lock-on extension tubes
and attachments to be positioned to harness the hydraulic power for any desired type of application. Remember to re-heat the panel continually throughout the repair process. A typical suction-fed spray gun will require 3-4.5 litres of free air delivered (FAD) per second to allow it to operate satisfactorily. 17.17 Comparison of hot and cold spraying
The true value of a paint film is the amount and character of the solids deposited that remain after drying or curing. This body style also has a separate luggage or boot compartment (Figure 1.6a). The procedure is as follows. Following drying and tacking off, the panel should be sprayed with primer surfacer or filler and flatted with P600 grade paper
Melt a small pool of the base metal and then insert the tip of the rod in this pool. 12.3.2 Modes of operation The TIG process may be operated in one of the following modes: DC electrode remains relatively heated. Figure 16.41 Removing temporary moulds 16.9.4 Repairing a
body scratch or gash 1 Where damage takes the form of a scratch which may or may not penetrate the skin of the car, the two main requirements are to replace the lost panel strength and fill the damage flush with the original surface. They contain no hydrogen, and are suitable for welding all grades of stainless steel including weldable martensitic
grades, extra-low-carbon grades and duplex stainless steel. As they are normally used dry, the particles are attached to the paper or cloth backing with a good quality hide glue. Heat gelling sealers must be capable of being readily applied by extrusion or possibly by spraying, and then must set up when cured but still retain a degree of flexibility. Type
approval is the confirmation that production samples of a design will meet specified performance standards. On selecting the appropriate pulling positions, clamps are attached to the damaged section and chains are hooked on to the clamps and placed in line with the required direction of pull. 7.7.8 Plastic captive nuts and trim panel fasteners Plastic
captive nuts are available in a large range of shapes and sizes for vehicle body applications. Once the wehicle is jigged, in many cases a mixture of old and new suspension components is fitted. Movement of filler rod Slight movement along seam in and out of the molten pool. Side impact airbags help protect the head by providing a padding effect and
by preventing the head from passing through the window opening (see Figure 1.28e). Owing to the intricate design and nature of the materials from which they are made, trims do not lend themselves Major accident damage 483 to restraightening, and the cost of replating is greater than the cost of a new part. Use an accurate thermometer for this,
don't guess. Shaping The blank for a dome consists of a flat disc which has to be formed by stretching and shrinking into a double-curvature shape. 72 Repair of Vehicle Bodies 2.4 General safety precautions in the workshop The Health and Safety at Work Act imposes on employers a statutory duty to ensure safe working conditions and an absence of
risk in the use of equipment and the handling of materials, and to comply with Regulations regarding safe working practices in Figure 2.15 (a) Prohibition signs (b) Warning signs order to reduce to a minimum the hazards to health and safety associated with vehicle body repair work. 4 Its density, when molten, must be lower than that of the brazing
alloy. In general it is desirable to Figure 11.17 Acceptable and undesirable joint detail (BOC Ltd ) minimize the time taken to prepare and complete the joint to the required quality. Suitability of workstations and seating. Any surplus sealer can be cleaned off with white spirit. When the work was judged to be ready for the colour coats, these were also
applied in several layers, being too transparent to cover in one solid coat. This is chromium, which is present to at least 10 per cent. But using common sense and thinking before you act is always good policy, as is asking questions about things you do not know. The Act does not specify what you should do; it merely provides the framework in which
you should operate, together with establishing the Health and Safety Executive and the Health and Safety Commission. It is inserted into a predrilled hole of the correct size in the workpiece, and a special tool containing a gripping device is applied to the mandrel or stem of the rivet. Crash testing (Figure 1.21) is undertaken to establish that the
and tinters. The chemist calls these molecular chains polymers. Since the spinning hubs are a known distance apart, the counters have determined by trigonometry (triangulation) (Figure 14.52). This produces compressional strain on the
surfaces with a compensating state of tension inside, and has the effect of making the glass far stronger mechanically than ordinary glass. In addition to showing the extent of collision damage, the Genesis system is designed to monitor progress throughout the repair and verify that the vehicle structure is correctly aligned. If possible, dedicate
sanding and grinding tools for use only on aluminium bodied cars. Air duster A tool which, when fitted to an air line, is useful for blowing water from recesses and for drying a surface quickly prior to painting. On the first pass make certain that the tinning action takes place along the entire bottom surface of the V and about half-way up on each side
They are often used for axle half-shafts, connecting rods, springs, torsion bars, and in some cases hand tools. The amount of time that the lamp is lit indicates the length of the system check. Study these lines to see that any damaged section or panel removed will allow adequate pick-up points on the replacement section to ensure it can be accurately
positioned, and that the proposed outline transverses longitudinal, lateral and horizontal definition points to assist easy lining up of the new section or panel in all three planes. In 1920 a German chemist, Hermann Staudinger, put forward a theory about the chemical nature of a whole group of substances, natural and synthetic. Removal or limitation
of oxygen It is not necessary to prevent the contact of oxygen with the heated fuel to achieve extinguishment. In direct hammering a dolly block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the original shape of the panel is held under the low spot, and a series of light block having the correct contour to match the low spot, and a series of light block having the correct contour the low spot, and a series of light block having the correct contour the low spot, and a series of light block having the low spot, and a series of light block having the low spot, and a series of light block having the low spot, and a series of light block having the low spot, and a series of light block having the low spot, and a series of light block having the low spot, and a series of light block having the low spot, and a series of light block having the low spot, and a series of light block having the low spot, and a series of light block havi
loose holding of the hammer applies equally to dolly blocks, as it permits them to bounce back naturally and to assume the correct position for striking the next blow. The painter must decide on his approach before commencing to spray and then work methodically round the car, finishing at a point where an overlap is least noticeable. The
recommended method of application can vary depending upon the material to be finished. Although the same items are tested as in typeapproval they are not tested in the same way. Rubber glazing strips can also be painted with this material. In this case a planishing hammer is used in conjunction with a steel stake, both having highly polished faces
These are centre popped, then drilled 4.8 mm or 5.6 mm sufficiently far to break the joint; it is not always necessary to go right through both parts of the panel, as in most cases if the top panel is drilled the joint will break. Once the pattern draft has been developed it can then be marked from the pattern paper on to the surface of the metal from
which the panel is to be made, the two most popular metals being aluminium and mild steel. The sanding discs can be either self-adhesive (synthetic resin adhesive) or of a type which has a looped velvet reverse side which is simply pressed on to a special pad. 42 Explain why seatbelt anchorages must be reinforced on a vehicle body. The gel coat can
be colour impregnated or otherwise specially formulated, e.g., for extra abrasion or impact resistance. However, despite the edge sealing, the celluloid (cellulose acetate plastic, but this, although a more stable product than celluloid, still needed edge sealing. They are
constructed vehicles. It is not necessary to bevel materials up to 7.9 mm thick if the rightward method of welding is used. The cutting edge is specially hardened and tempered, while the remainder of the chisel is left soft to enable it to withstand hammer blows. A complete damage diagnosis can be carried out without any stripping of mechanical
components, facilitating speedy and effective repairs. The thermal fuse is automatically reconnected once the transformer has cooled down. 11 Which metals are used for making electrodes in resistance welding? When the roughing out stage is complete and any major body misalignment has been corrected, then the panel assemblies which are
beyond repair must be cut out in such a way that the remaining connecting flanges are left intact. to 60-80 °C generally results in the viscosity becoming one-third to one-quarter that at ambient temperature. Power left intact. to 60-80 °C generally results in the viscosity becoming one-third to one-quarter that at ambient temperature.
work in the same time. Finally, it should be borne in mind that the use of a guide coat at each of the stages of sanding down is invaluable for locating surface defects. Alternator The alternator generates the electrical power to charge the battery when the engine is running. Instead of using formers or jigs many panel beaters use templates only, which
are cut to the shape of the various cross-sections of the workpiece. 2 The protractor head, which is used to measure or check any angle up to 360° by simply reading-off the scale. The single panel time is Major accident damage 493 Figure 14.142 Replacement time schedules (Motor Insurance Repair Research Centre) 494 Repair of Vehicle Bodies
given in Section A, the replacement time schedules can be read off horizontally. Tinman's mandrel is a single horizontal metal bar, one section of which has a flat surface and the other section of which is rounded. For spray booths already working there is a requirement to submit an upgrading programme to the local authority within 12 months of the
initial registration. Major accident repair work Major repair work Major repair work can be classified as a repair which involves the use of manufacturer's replacement parts, and the reconstruction of the body or parts 
Austenitic Generally containing 16.5-26 per cent chromium and 4-22 per cent nickel. If the work is earthed and the return current lead is broken, no welding current can flow. Metals and non-metals used in vehicle bodies 5 Explain how you would identify the following: (a) low-carbon steel (b) aluminium alloy (c) stainless steel. Reinforced reaction
injection moulding The RRIM technique is used for all the vertical body panels such as the front and paint shop (Infrared cassette, arch and paint shop (Infrared cassette, arch and bumper assembly, and rear wings, front grille and bumper assembly, and rear wings, front grille and bumper assembly, and rear wings, front grille and bumper assembly. Figure 17.62 Infrared cassette, arch and paint shop (Infrared cassette, arch and paint shop) (Infra
acrylic synthetic 4 Base coat: cellulose Clear coat: 2K acrylic synthetic or polyester/ acrylic synthetic syntheti
test procedures. Moulding The resulting shape of a plastics material when it is removed from its mould. Glass reinforcements are supplied in a number of forms, including chopped strand mats, needled mats, bidirectional materials such as woven rovings and glass fabrics, and rovings which are used for chopping into random lengths or as higher
strength directional reinforcement. Accuracy is limited to the pre-set limits of the strip. The pick and finishing hammer has a pointed end which is suitable for removing low spots and is also a useful finishing hammer, having a crowned Hand and power tools 87 curved pein end allows for greater flexibility in dressing out sections which are difficult to
results in an inaccurate reading due to the graduation lines being viewed from a very oblique angle. A range of approved joint designs is provided in international standards covering welding construction BS 5135. Stripping and straightening areas The stripping and straightening areas The stripping and straightening areas require only walk-around vertical lighting with relatively low
illumination. The rear squab panel completes this unit and provides the rear bulkhead across the car. 23 Name the classified groups of adhesives. Questions 3 Make a list of measuring and marking-out instruments which would be used in vehicle body work. With this, the oxidizing flame, the molten metal will be less fluid and tranquil during welding
and excessive sparking will occur. The clamps are ideal when welding patch repairs in floors, wings and door skinning, or when assembling fabricated or new panels. The amount of stripping necessary depends on the extent and position of the damage. To start welding, the arc is usually moved in a small circle until a pool of molten metal of suitable
size is obtained. Removal of heat If the rate of heat generation is less than the rate of dissipation, combustion cannot continue. 3 Always wear overalls, safety goggles when grinding or drilling and a breathing mask when working in dusty conditions. Two-
pack (or 2K) paints have a limited pot life after mixing, but when curing is complete they can equal stoving paints in hardness and durability. Grab your owner's manual to have specifications when stripping, it is advisable to do so because if any paint
remover accidentally came into contact with an adjoining door or bonnet, damage to these areas would occur. The machine can weld either a single projection or a multitude of projection or a 
WEIGHT GROSS COMBINATION WEIGHT FRONT AXLE WEIGHT Figure 1.52 Vehicle identification number Single Vehicles and vehicles and vehicles are previously registered vehicle meet modern safety and environmental standards. Also pir
welding attachments can be fastened to spot welding equipment (Figure 13.64). This is followed by the third hold time, in which the current is turned off but the pressure continued. Overall, the staff are working towards enhanced low-speed impact performances; quicker and more cost-effective repairs; and a better understanding between those who
do the repairs and those who pay for them. The choice of site will of course depend to a large extent on the amount of capital available. The vehicle may be loaded on to the sill clamps by using a high-lift trolley jack, a two-post lift or a side loading lift (Figure 14.39). Dry powder extinguishers can be used on accelerator, mould cleaner, acetone, resinson
and release agents. To ensure that the oxygen is not added to the welding wire, which is specially made for carbon dioxide MAG welding. To the body designer one of the most outstanding characteristics of these materials is the ease with which
complex curves can be produced as compared with methods of panel beating and wheeling, while from a production point of view the fact that complex structures can be produced as onepiece mouldings can greatly reduce assembly fixtures. Binder A resin or cementing constituent of a compound. Cabriolet
Used towards the end of the period. 5 Identify any other specific health and safety legislation which applies. The flat Spire speed nut (Figure 7.54) has replaced the threaded nut plus lock or plain washer. Care should also be taken to avoid striking the raw edges of sheet metal, as these could split the mallet head or damage the faces. Once the unified
brackets are attached to the base units, they are positioned according to the technical data sheets provided. The following lists are not exhaustive, but give a good framework to start from. Thus too much pressure could have the effect of overstretching the particular panel or workpiece. Obviously one dolly block will not be suitable for all shapes
requiring planishing; therefore it is advisable to have a set of these dollies which would be suitable for a wide range of the fluid tip is therefore very important (Figures 17.63a, b). The booth must operate under negative pressure and to
comply must be fitted with a pressure gauge. Next a length of wire is cut to size and placed Before a systematic approach to body repairs is possible, it is necessary to understand the characteristics of sheet metal as used for body panels. The inner construction comprises the rear wheel arch and the rear seat heelboard assembly. 2 Power light This
lights up when the machine has been turned on. Measures employed by car manufacturers in an effort to combat corrosion include the use of precoated steel; washing and spraying the assembled body; and immersion in anti-rust primer, which is then baked. 1859 Oil was discovered in USA. They constitute a fire hazard, and can collect dust and
overspray which may affect the accuracy of the scales. Using a convenient lever, apply pressure to pull the patch into contact with the reverse side of the body panel and allow to cure. Plate edges from 4.8 to 7.9 mm need not be bevelled. Pry and surfacing spoon (Figure 3.9c) has a short handle which gives easy access in limited spaces and can be
used efficiently for prying behind brackets and panel edges. The paint container (fluid cup) is limited to one litre (1000 cm3) capacity to enable the gun to be handled without fatigue. For instance if a building is on fire, do not re-enter to retrieve your belongings, wait until the fire is out and there is no risk before going back into the building. The
choice of fluid tip depends, in the main, on the type of material to be sprayed. If patches dry quickly, continue to cool with water and observe again after half an hour. I hope that the reader will enjoy it. High-crowned spoon (Figure 3.8c) has been designed to offer a broad working blade with a high crown to work in positions where other dollies and
spoons cannot be used. The electrical charge is stored in capacitors within the control unit, so if the main vehicle Bodies damaged or disconnected before or during impact, the capacitors can supply an electrical charge to ignite the pyrotechnic materials in the airbag and seatbelt pre-tensioner. Acetone A liquid
hydrocarbon capable of dissolving twenty-five times its own volume of acetylene gas at atmospheric pressure. Dinging hammer This hammer (Figure 3.2a, b) is a long-reach planishing work. Pickle To soak metal in an acid solution in order to free the surface of rust or scale. 36 With the aid of a
sketch, name a type of joint that would be used when solid riveting. 17.10.1 Spraying flat surfaces The gun should be held at right angles to the work and at a distance of 150-200 mm. The varnish, being rather yellow in colour, tended to enhance the silver leaf by tinting it amber and giving it the appearance of gold. A series of blows is made in the
metal starting at the centre, the blows being struck slightly off the stake. The paper is held off the jig by tension at its edge. For ease of calculation the allowance is then rounded up to the nearest 0.1 hour. Thermoplastic materials can melt without breaking down, so they can be manipulated like steel. They are often used as a basis for stiffening ribs
or box sections. The user adds thinners to adjust the viscosity to suit his requirements. These high and low areas are found by passing the hand over the section under repair. 45 With the aid of labelled sketches, show the difference between direct glazing and indirect glazing. Catalysts are organic peroxides and present a special fire hazard. Instead
of a break-stem type of mandrel, there is a mandrel with a tapered hardened Methods of joining 205 Figure 7.15 Blind rivet nut, installation sequence 1 POP nut inserted into hole 3 Tool operated: mandrel with a tapered hardened Methods of joining 205 Figure 7.15 Blind rivet nut, installation sequence 1 POP nut inserted into hole 3 Tool operated: mandrel with a tapered hardened Methods of joining 205 Figure 7.15 Blind rivet nut, installation sequence 1 POP nut inserted into hole 3 Tool operated: mandrel with a tapered hardened Methods of joining 205 Figure 7.15 Blind rivet nut, installation sequence 1 POP nut inserted into hole 3 Tool operated: mandrel with a tapered hardened Methods of joining 205 Figure 7.15 Blind rivet nut, installation sequence 1 POP nut inserted into hole 3 Tool operated: mandrel with a tapered hardened Methods of joining 205 Figure 7.15 Blind rivet nut, installation sequence 1 POP nut inserted into hole 3 Tool operated: mandrel with a tapered hardened Methods of joining 205 Figure 7.15 Blind rivet nut, installation sequence 1 POP nut inserted into hole 3 Tool operated: mandrel with a tapered hardened Methods of joining 205 Figure 7.15 Blind rivet nut, installation sequence 1 POP nut inserted into hole 3 Tool operated: mandrel with a tapered hardened Methods of joining 205 Figure 7.15 Blind rivet nut, installation sequence 1 POP nut inserted into hole 3 Tool operated into hole 3
steels. This should be repeated in the opposite direction. 14.2.5 Alignment and repair systems Jig brackets: general development Vehicle design and manufacture have progressed considerably over the years. The tool is used in conjunction with a flancing blow. The rivets can also be used in the high-speed Chobert system. The
time involved for the repainting was one month which, bearing in mind the type of paint used, was not unreasonable. See Chapters 13, 14 and 17 for further information about the equipment. A tool a size larger than that of the grooved joint should be chosen to give clearance in use. Any internal matter should in the first instance be reported to one of
these people - you will know who this is from your induction training. This uses a number and a series of abbreviation letters. 19 Explain why it is difficult to mass produce composite constructed vehicles. Molecule A minute particle into which a substance can be divided and retain its properties. 15.6 Bodyshops and legal requirements Figure 15.9
Vehicle exhaust extraction using a rail system (Nederman Ltd ) Health and safety legislation has made the vehicle body repair industry increasingly aware of the need to provide adequate facilities for employees, both as a legal duty and to improve the working environment. A special anchoring beam attached to the tower ensures complete safety
when the system is in use by locking it into the channel section. Section 3.19 to 3.25 describe the typical range of power tools. 3 Explain two of the functions of a spray gun air cap. All the items for Standard SVA are checked at the SVA test station. Stoved synthetic finishes became the accepted finish on new motor vehicles, but difficulties were
experienced in refinishing damaged areas as a result of colour fading. In this method the metals used for the purpose of shaping panels for body work applications are usually aluminium and its alloys and mild steel; aluminium is by far the easier of the two to shape owing to its higher ductility and malleability properties. Inert, so will cause
asphyxiation in high concentrations. With this knowledge a visual check should be made of doors, bonnets, boot lids, roof and centre pillar positions for any distortion which may be visible. 19 Explain how the measurement system works on the Dataliner equipment. Metal surface to be welded Paint film, rust, dust, or any other contamination on the
metal surface to be welded causes insufficient current flow and poor results. 16 Reinforced composite materials Glass fibres have been known in one form or another since 1500 BC, and some glass fabrics have been produced as far back as the beginning of the eighteenth century, but all of these
were far too coarse to be of any industrial value. Colour code the tools by painting, or plastic dipping their handles. Kerb weight of an empty vehicle without passengers and luggage. The two points of contact are the tip of the pin and the outer copper ring on the weight of an empty vehicle without passengers and luggage. The two points of contact are the tip of the pin and the outer copper ring on the weight of an empty vehicle without passengers and luggage. The two points of contact are the tip of the pin and the outer copper ring on the weight of an empty vehicle without passengers and luggage.
possible with the panel surface under repair. The technique of this process is the same regardless of the shape or type of door to be reskinned: Removal of a damaged skin panel This is achieved by drilling out the spot welds around the flanged areas of the door using either a Zipcut or cobalt drill or Spotle tool and also, on some types of door, using a
power saw to make joints across the pillars (Figure 13.63a). A true ring will be heard if you are directly over the dolly otherwise the sound will be dull. For NVQ/SNVQ students, Tables P1 and P2 will help in portfolio planning. Metals and non-metals used in vehicles: BS 1449: Part 2 Steel
grade Typical alloying elements (%) Characteristics Typical applications Austenitic 301 S21 17Cr 7Ni Good corrosion resistance Low work hardening rate Highest corrosion resistance of the commercial grades Riveted body panels, wheel
covers, hubcaps, rocker panel mouldings Mild corrosive tankers for widest cargo flexibility, formability and corrosion resistance. These are much coarser than wet-or-dry papers and are used for rougher work such as
removing rust or mill scale. 2 Hold the metal firmly on the bed plate of the machine to ensure shearing action and also to prevent drag. Brazing A non-fusion process in which the filler metal has a lower melting point than the parent metal(s). Oxygen is produced commercially either by the electrolytic process or by a separation method known as the
liquid-air process. 9 State the reasons why gauges are a necessary piece of equipment in engineering. However, most box forming is done using the box bender has a single solid bending blade, the box bender has a series of individual blades
known as fingers. Where it is possible to fit the two sections on the vehicle, it is considered good practice to trim only one edge and to set the panels up with one section overlapping the other, as this enables a check to be made on the alignment of any surrounding or adjacent panels such as bonnet edges and door edges. There was much persecution
of motorists by police at this time, which led to the formation of the RAC and the AA. COSHH is a major piece of health and safety legislation. The extreme exotherm can also damage and distort the mould itself. The break-head mandrel is used where weight is a factor, and where a comparatively clear hole is required through the rivet set. The order
of ductility of various metals is as follows: gold, aluminium, steel, copper, zinc, lead. 5 If this does not match perfectly, check the book on colour variants and consult the manufacturer's hints on tinting. These steels are low carbon, employing solution strengthening (cold reduced rephosphorized) or precipitation hardening (hot rolled and cold reduced
micro-alloyed) elements to produce finegrained steels which are suitable for welding by spot and MIG processes only. This makes it impossible to apply the laws of aerodynamics literally. Colour samples are also provided which Automotive finishing and refinishing are added to as new colours are produced. Additional coding The following additional
coding must follow the STC coding: 1 When appropriate, three digits indicate the nominal electrode. Use of glass fibre as a replacement for steel in body panels is economically possible at comparatively low volume levels,
say 1000 vehicles a year. If hot rivets are being used, they should be at forging temperature and the operation should be completed before they become 'black' hot. Flatten the two surfaces to remove the gaps, and clamp them tightly with a clamp before welding. On the other hand, too high a gas pressure giving too long a cone causes overheating
and lack of control of the molten metal, resulting in adhesion and over-penetration. However, some large coaches and lorry windscreens are 7.8 mm thick (4 mm glass). Riveting Here the metal will be seen to have spread to a marked degree. Funnel stake has a thick tapered head and is used in forming
riveting and seaming tapered articles such as funnels. A coat of sealer may be applied just prior to the colour coats to provide better hold-out, thus obtaining a smoother finish. The bodywork having been straightened and aligned as much as possible, the new panel should be positioned and held in place by two or three clamps and all adjacent panels
checked for alignment with the new panel (Figure 14.98). Table 4.4 shows typical stainless steels used in motor vehicles. 5.10 Wheeling machines (Figure 5.15 Cone rolling machines Figure 5.15 Cone rolling machines Figure 5.15 Cone rolling machines (Figure 5.16 and 5.17) can be used to form flat sheets of metal into double-curvature shapes such as are found
505 Refit area This is where interior and exterior trim, as well as mechanical and electrical assemblies, are refitted after the vehicle has been painted. Place the electrode in the holder, making sure that good contact is gained between the jaws of the holder and the bare end of the electrode. Hold the electrode at right angles to the seam, then tilt the
rear of the electrode until it forms an angle of 10-15° to the horizontal. As the number of items in the circuit are increased the resistance will increase, and the voltage across each component will decrease. After the tuck is formed, the disc is placed on a steel stake and each side of the tuck is lightly malleted to stiffen the metal and hold the tuck in
position. 25 Monitor the effectiveness of control measures and review the risk assessments at agreed regular intervals and whenever changes require it. A Minister's Approval Certificate (MAC) under SVA is issued when the examiner is satisfied that the vehicle would meet the regulations in relation to the design and construction
of the vehicle. They are extremely durable in poor operating environments. Second, it can be used for spot welding from one side of the panel assemblies. Undercut normally occurs at high speeds and high current, and may be avoided by reducing both current and speed. These masks can
only be used in atmospheres containing less than the occupational exposure limit of the contaminant (Figure 2.6a, b). Power tools can speed preparation, but hand tools will be just as effective. The panel puller is used by drilling a 18 in (3.175 mm) diameter hole at the deepest part of the dent, then inserting the self-tapping screw in the 3.7 Specialist
panel beating tools Panel puller This tool (Figure 3.12) comprises a long steel rod with a cross T-piece at the top which acts as a hand grip. Pinch weld Two metal flanges butted together and spot welded along the join of the flat surfaces. Changing the manufacturers' original welding specification could impair the safety of the vehicle. The acetone
(also used as nail varnish remover and not popular amongst mechanics) actually melts the plastics material, pressing the two parts together causes them to bond and dry. 2.8.19 Safe and approved methods for cleaning machines/equipment are used There are three main items of cleaning equipment used in the garage: the cleaning bath (or tank), the
pressure washer and the steam cleaner. 20 In particularly hostile environments such as when using volatile solvents or fresh air fed masks must be worn. Should this be the case, the finish can be wet flatted with P1200 paper, using soap as a lubricant, and burnishing can be carried out using fine rubbing compound
contact moulding methods which permit production of extremely large integral units. Being similar in structure to the high-bake materials, these paints offer a closer match in colour and texture than do cellulose synthetic materials. The measuring system can be left in place while the pulling process is being carried out and can be used to determine
the amount of overpull required to bring the vehicle into alignment with its specific manufacturer's data (Figure 14.46). Standard screwdriver (for slotted heads) A slotted screwdriver with a standard tip. 2 State the safety precautions to be taken when assembling oxy-acetylene equipment. It is important that the size of the air
receiver be in direct proportion to the size of the compressor. The prototype must accurately reproduce the exact shape, construction and assembly conditions of the final production body it represents if it is to be of any value in illustrating possible manufacturing problems and accurate test data. Thermosetting materials, as the name implies, will
soften only once. Also can be painted over immediately wet-on-wet Special brushable sealant used for front and rear aprons, bottom of boot, inside floor, side walls, wheel arches. Table 4.11 indicates the uses of various sealant materials. In using the body jack, it is important to understand that pressure is being applied at both ends of the jack
simultaneously; therefore there could be a danger of distorting adjacent undamaged panel assemblies during the jacking process if the pushing points are not carefully selected. In some cases where the door appears to be misaligned the door itself is not the cause of the fault, and so it is advisable to X check the body at the forward and centre
positions to determine whether the reason of the failure to match the body contour is due to distortion of the body contour is due to distortion of the same feeding speed and rotation. For vertical
downward welding the electrode should be held at 10-15° tilted from the horizontal, and starting at the top of the seam, moving downwards with little or no weaving motion. MIG/MAG welding has been adapted for many industrial applications, and over the past years has become widely used for car body repairs. The control for these is usually a
 switch mounted just in front of the interior rear view mirror. Pulling and pushing can be carried out at all possible angles, both lengthwise and crosswise, and at any height. The swaged or joggled edge can be used to strengthen panel edges or to create a flush-fitted lap joint when working on panel replacement. The key to fire safety is: 1 Take care
In their body repair manuals, some vehicle manufacturers give details of plastic parts, while others mark all plastic parts with code letters. In addition to these sections, there are special sets of measurements for the alignment of the bonnet lid, and the front and rear doors. The tool removes windscreens that have been bonded with
polyurethane adhesives (see Figure 14.109). Figure 8.3 Soldering process The soldering process the following steps: Choose the right materials to be soldering iron and its shape is governed by the size and accessibility of the material to be soldering iron and its shape is governed by the size and accessibility of the materials The choice of the soldering iron and its shape is governed by the size and accessibility of the material to be soldering iron and its shape is governed by the size and accessibility of the materials The choice of the soldering iron as is practicable. In the working
of a deep flange on a disc the metal may be annealed at intervals except, of course, in the case of coated metals such as automobile spot welding Ideal where access is difficult from both sides of the material. For large-scale assemblies, such as automobile
bodies, painting is necessary to obtain uniformity of colour, especially when different types of plastics are used for different types of the used for different types of the used for different types of
to hessian backing; in other cases it is woven simultaneously Metals and non-metals used in vehicle bodies into the back surface or a vinyl coating. When moulding, these orders are of course reversed, the tissue going on to the gel coat on the inside of the mould, followed by
the mat and resin lay-up. 1.3.6 Variations in body shape Among the motor car manufacturers there are variations in constructional methods which result in different body types and styles. Accelerator Absorb into dry sand and dispose by landfill or controlled incineration. Different areas of a vehicle require different zinc coatings and coating weights to
meet appearance and performance criteria. There are basically two types of water extinguishers. Much of the work done deals with double-curvature shapes which are in some cases fabricated by hand in sections. The more accurate the better, Craft techniques and minor accident damage 395 (c) (a) (b) (e) Figure 13.71 (a) Heating the panel with
propane gas (b) Conventional bumping file being used to raise dent (c) Using a panel file (d) Threaded studs and loops for pulling repair from outside (e) High density nylon compound panel hammer (Courtesy of POWER-TEC ®) 396 Repair of Vehicle Bodies especially when dealing with vehicle with large numbers of bonded joints. It is a complete
workstation that can also be employed for body preparation, mechanical work and as a platform for wheel alignment. Where smaller bonnets are used the hinges are not counterbalanced The history, development and construction of the car body 51 1.5.19 Comparative terms in common use by British, American and European car manufacturers and
the bonnet is held in place by a bonnet stay from the side of the wing to the bonnet. The chairman of the committee should be a senior member of the company. Distortion of the vehicles, must be rectified first before any other part of the repair is
attempted. 7 Carefully select the types of metal to be joined. The top beam and blade can be brought to meet the bottom blade by hand, foot, mechanical, air or hydraulic power, depending on the type of machine. This makes it suitable for treating narrow box sections such as door pillars, boot and bonnet lid 617 reinforcements, and areas with
difficult access such as door hinge areas, head and tail lamp housings, wing supports, door sills and underbody box sections, reinforcements, and suspension mountings. 6 If the stretched part of the surface is small, make a smaller heat spot. If either is lit then appropriate action should be taken. Figure 13.43a-f illustrates the stages of body soldering
5 It must not attack the parent surfaces dangerously in the time between its application and removal. 2 A release agent is applied to the entire surfaces such as car roofs and bonnets, always start on the near side and work to the
far side to redissolve any overspray. Two separate pollution control regimes are established in Part 1 of the Act to control industrial processes falling into the categories A and B. The normal content of air is 21 per cent. By placing the edge of the sheet against one of these side gauges, a cut can be made at right angles between the side gauge and the
bottom blade. 2 State two advantages to be gained by using a guide coat when sanding down a surface. sidemember front floor LH/RH NOTE: A large reinforcement assy backbone), and this is coupled with the side sill, sidemember and crossmember to provide
increased rigidity to the total floor. The central link is the adhesive film between the surfaces, and the outer links are formed where the adhesive film meets the bonded surface. Moulded seats simplify assembly, reduce weight and give good long-term performance. This defect can be caused by any, or all, of the following reasons: 17.19.6 Dry spray
Though dry spraying can be an advantage to the spray painter, it is more often regarded as an undesirable defect as it gives the work surface a sandy appearance. For this reason the wire is normally provided on convenient size coils or spools. If a piece of carbon steel is heated steadily its temperature will rise at a uniform rate until it reaches 700 °C.
Various bonding materials are used in direct glazing. Owing to its high rate of expansion in setting, it cannot be recommended for use in very soft or brittle materials. The second battery is usually a gel-battery. If steam is seen to be coming from the surface of the cylinder when water spray is interrupted, continue spraying with water. The soles of the
shoes should also be maintained in good condition to guard against upward penetration by sharp or hot pieces of metal. Cleaning tools (Figure 11.4) To produce a strong welded joint, the surface of the metal must be free of all foreign matter such as rust, oil and paint. Analogue and digital meters Analogue meters are ones which have a needle which
moves across a scale; digital ones show numbers on an LCD (liquid crystal display) or illuminated display. Rinse all items well (Figure 14.128). at normal atmospheric pressure is drawn into the first cylinder via the air intake, to which is attached a filter. Because most research concentrates on prelaunch or recently launched vehicles, accident damage
is simulated on the crash test facility. Usually the highly successful classic designs are the work of one outstanding individual stylist rather than of a team. Hot knife The hot knife can be used by one person cutting from the outside of the vehicle. 5.1.2 Ductility Pressed components Special sheets which have extra deep drawing qualities are
manufactured especially for press work such as that used in modern motor vehicle body production. When determining the replacement underbody sections and panels to be ordered, make sure the new underbody sections and panels to be ordered, make sure the new underbody section and panels will be attached to firm composite materials: avoid badly crazed areas and badly burnt areas. Miscellaneous and
expendable items Welding goggles approved to BS Welding headscreens approved to BS Welding curtain/screen approved to BS Gloves: disposable, plastic, leather, rubber, canvas First aid equipment Fire extinguishers Storage cabinet/lockers. The repair procedure for minor, accessible dents is first to rough out the
damaged area using a mallet to minimize stretching, and then to planish the area using a beating file in conjunction with a dolly block which will also reduce the possibility of stretching. Friction Pressing the brake pads against the discs causes friction which converts the dynamic energy of the moving vehicle into heat energy. 40 What are the two
gases that can be used in the flame cutting process? Before a square can be used, one surface of the workpiece must be made level and true. Additional layers can then be sprayed over insert. It is a useful tool for the fabrication of small metal sections needed in vehicle repair. Apart from weather resistance, the important requirement of door and
boot lid seals is that their compression characteristics should ensure that they are capable of accommodating wide variations in clearance, without giving undue resistance to door closing. When a bonnet opens from the rear the catch mechanism is also at the rear. 14 State the qualities required of a good spot weld. The cutting members are flat
blades and there is generally no provision for adjustment of blade clearance. 14.2.6 Celette UK alignment and repair systems Celette UK offers a wide range of fixed or mobile jigs, from the mobile bench to the four-post jigs lift. The split blade swings to any angle and, with the auxiliary blade attached, can be transferred from one surface to another
work can be laid out or any desired angle checked and measured. Argoshield Cylinder colour: blue with green shoulder. 5.1.3 Tenacity 5.1.4 Hardness A very important property by which a metal
resists the action of a pulling force. All the major volume producers of cars are engaged in long-term development work towards the all-plastic car. All these requirements are satisfied by thermoplastics and thermosetting resins. The air is then compressed to an intermediate pressure by the action of the piston moving upwards and reducing the
volume of the cylinder (Figure 17.6). It is almost non-consumable when used under ideal welding conditions, 14.3 Alignment and vehicle control Any serious impact on any part of the modern integral body of the mono constructed vehicle will cause distortion throughout the structure, which will not
necessarily be adjacent to the damaged area. If the metal is not cut, reduce the speed of travel until it is. The use of corded wires gives a controlled form of globular transfer which is acceptable. Make the cutting lines as clean and straight as possible. It is generally taken as 1.5D, so that a single-riveted lap joint would have an overlap of 3D (Figure
7.2) and a double lap joint an overlap of 5D. As competition between the major car manufacturers increases, so does the need for lighter and more effective body structures. It can be calculated from the principle that the part of the plate between each pair of holes should be the same strength as one rivet. This is intense enough to melt all commercial
metals so completely that metals to be joined actually flow together to form a complete bond without mechanical pressure or hammering. Historically, the aerospace industry was the leader in CAE development. The external chamfer of a face of the nut is marked in a position relative to the appropriate hour mark on a clock face to indicate the
strength grade. As a result of receiving the hammer blows indirectly, the dolly will rebound and the hand holding the block will automatically bring it back in place so that it imparts a light push upwards on the area. Radiography This method uses penetrating X-rays or gamma-rays which are passed through the weld and recorded on photographic film
held in a light-proof container. 5083 B 0.40 0.40 0.10 0.40-1.0 4.0-4.9 0.05-0.25 - 0.25 - 0.15 0.05 0.15 Rem. Let us look at a few typical examples of fires which sometimes occur in garages: Colour Type 1 Petrol spillage fire - if this is on the forecourt the need is for quick action. 31 Name the oxy-acetylene flame that would burn equal quantities of
the gases. Their respective flow rates are adjusted by two hand valves on the torch. Protection Leather or fire-resistant clothing should be worn for all heavy welding or cutting. 9 Pressure wash engine compartment to rinse away traffic film remover, 20 Explain the difference between a radius gauge and a drill gauge. There are adjustable hanging
rods on both ends so that the gauge may be raised or lowered. Then laminate layers are built up in thickness on both sides to desired strength. Work from the bottom up, so that anticorrosion fluid will not drip on you. This process involves the bonding 468 Repair of Vehicle Bodies of glass into the aperture. Standard sealers have a low pigment and
high binder content. 216 Repair of Vehicle Bodies 7.6.7 Set screws (or machine screws) A set screw is similar to a bolt but has the whole of its cylindrical shank threaded (Figure 7.47). The use of hydraulic body jacking equipment is not new, nor was it invented suddenly. Figure 9.31 Plasma arc cutting torch nozzle, showing position of electrode
(Motor Insurance Repair Research Centre) 273 274 Repair of Vehicle Bodies 5 6 7 8 9 10 11 12 13 Set the main switch of the buckles surrounding the sharp creases will be fairly elastic, but a greater amount of effort will
be needed to reshape the sections of the panel which are made rigid either in manufacture or through accidental damage. At stage 11 in the process, and alternative method is to apply one coat of the finishing paint, allow to dry for 15 to 30 minutes, then spray a double-header coating. Its most outstanding feature is the precise measurement
obtainable (1 mm) with the use of a laser beam in conjunction with comprehensive data charts suited to different makes and models of vehicles. The main frame of the wheeling machine is of large C form. This solder is widely used for can soldering, where maximum economy is required, and for any material which has already been tin plated so that
the inferior wetting properties of the solder are not critical. Dip the bit into flux, then hold the tinned face of the bit against the solder stick until all the face that is tinned is covered with molten solder. 12.15.3 Destructive testing Mechanical testing is a destructive procedure and therefore cannot be carried out on any component required for use.
Further tightening of the bolt forces a thread on to the nylon insert, making the nut grip the bolt more tightly and thus creating a shock- and vibration-proof nut. These two rotating laser lights 434 Repair of Vehicle Bodies Figure 14.50 Genesis electronic system components (Chief Automotive Ltd ) 1 2 3 4 Computer Display monitor Keyboard Printer 5
6 7 8 Workstation Body scanner Scanner tray Targets project towards light reflective targets, which are suspended from the vehicle's underbody reference points. Many applications exist for W-buttons where a positive, attractive, light-weight non-corrosive fastening solution is required: to assemble painted or PVC covered trim boards, to fasten
instruction badges, or to blank off holes. Nowadays nearly all wax polishes contain silicones, which can create 'pinholing' in any paint applied over them. As the metal panel is pushed through the wheels a stretched area, the length of Figure 13.9 Sports car panel being shaped by wheeling (Autokraft Ltd.) Craft techniques and minor accident damage
347 Figure 13.10 The technique of wheeling (Autokraft Ltd.) the panel, is produced, and is known as the wheel track. Electric tools are simple to set up. Each fastener requires a specific kind of screwdriver, and a body repairer should have several sizes of each type. After a moderate or severe accident, checks should be carried out on the A- and B-
posts, chassis datum points, and suspension and wheel alignment. Drills are used mostly for drilling out spot welds along damaged panels which need removing, and also for drilling out broken rivets and bolts. First, loosen the gun from the paint container, allowing the fluid tube to remain in the container, and unscrew the air cap a few turns. 7 Give
four essential factors in making a good arc weld. Measurements are available either on disc or via modem from the main computer. The most effective way to purify air is to capture airborne pollutants away from the working
environment to a safe collection point. These are used in conjunction with body repair, alignment and measuring jigs and thus provide accurate location points where exact positioning becomes critical, especially when the panel assemblies carry major mechanical components and suspension units. Trial will show whether more than one feed point for
the brazing alloy is necessary, but with proper fluxing, giving an unbroken path of flux over the whole joint width, a single feed is usually sufficient. can weld material from 0.5 mm to 4.4 mm in thickness. As the term coach painting implies, this is a craft which dates back long before the days of the motor car. Although relatively expensive the woven
forms have many excellent qualities, including high dimensional stability, high tensile and impact strength, good heat, weather and chemical resistance, how moisture absorption, resistance to fire and good thermo-electrical properties. The ultimate tensile strength of a metal is a measure of the force which ultimately fractures or breaks the metal
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under a tensile pull. It can be used to fold mild steel sheet up to 1.2 mm (18 gauge) with a bend length of 24 in (610 mm). 19 State the reasons why certain manufacturers of sports cars prefer to make their vehicle bodies from GRP. A wide selection of special-purpose steel cutting blades is now available for all current car models. Niobium Strong
carbide forming effect; increases tensile strength and improves ductility. With any gas shielded arc process the type of shielding gas used greatly influences the quality of the weld deposit, weld penetration and weld appearance. Paint must be removed by either paint remover or sanding. The construction in the area to the rear of the back seat is
much heavier in an integral body than in a composite body. Adjustable working height positions. Connect the earth clamp plate to the negative side of the welding output cable holder, and the single-sided electrode to the positive side of the welding output cable holder. It runs backwards from the toe panel to the heelboard or back seat assembly. Figure 16.46
Wrinkling (Scott Bader Co. Ltd.) Figure 16.47 Pinholing (Scott Bader
stakes are not suitable. A hard copy can be taken via a printer linked to the computer. 23 Explain the difference between line pressure and contents pressure and contents pressure as shown on the regulator. With most fillers this is normally 2 per cent by weight. This welding process is ideally suited to flow line production processes owing to its inherent automatic
characteristics. 52 Describe how to use the Glassmatrix estimating system. 9 State the advantages of MIG/MAG welding when compared with oxy-acetylene welding, for the repair of vehicle panels. When comparing the painted sample against the vehicle, daylight, perferably from a northern source, is best. The method of application is as follows:
Apply generously, as using too little can allow heat damage. 5 Extract air from the laminate while still on the bench, using the split washer roller. 7.2.2 Riveting dimensions The diameter of a rivet is usually determined by D 1.2vt, where D is the diameter of the rivet and t is the thickness of the plate. It can be adapted to file the surface of almost any
shaped panel by setting the blade Hand and power tools 91 Half-round body file This tool (Figure 3.10c) is similar in design to the flat file but the blade is half-round. To obtain the oxygen in a state that makes it usable for welding, it is necessary to separate it from the other gases. The stresses locked in the material, which may reach levels up to the
elastic limit of the material, are called residual stresses, and the deformation of the material is known as distortion. This was achieved by the advent of pressed steel construction, but the paint process caused a bottleneck to production and so research was carried out to solve this problem. 27 lowest possible tooling cost and to a high standard of
quality and reliability. If an elongation value is required, then two centre punch marks often 50 mm apart are applied one on either side of the weld; this is called a gauge length. To improve this property and to give tougher films and improve the gloss, a resin is added to the oil and they are cooked together for a period so that they chemically
combine. The torch is moved forward and the filler rod is withdrawn from the pool simultaneously. It has a long low curved blade which can be inserted into very thin sections. Figure 16.35 Damage area on composite body 2 Decide on the most effective way of repairing the damage, bearing in mind ease of access and the degree of surface finish
required. The advantages of the leftward welding technique are that it is faster because the flame, in preceding the weld, has a preheating effect; the molten metal is easily controlled; and penetration (complete fusion of the edges) is easily obtained over the range of application of the technique. Single-sided welding with one electrode and one earth
clamp results in current loss in the metal panel, and also the metal panel is a bad conductor of electricity. Major accident damage types Although every accident damage types. This is done by heating the steel to
a temperature below the lower critical point, usually 166 Repair of Vehicle Bodies Table 5.3 Temperature (°C) Black Very dark red Dark red
1270-1300 1400-1550 between 200 and 300 °C, thereby changing some of the martensite back to pearlite. The maximum pulling force on the system is 6 tonnes and it can be used at any height up to 3 metres, which is particularly useful for pulling out damage at roof level on a car or a commercial vehicle. The sealed rivet is a fastener of high shear
and tensile strength and vibration resistance. These abrasive papers have a coating over the grit particles, of a material which is based on zinc stearate. Particularly suitable for front and rear aprons, sills, spoilers, wheel arches Rubber/resin Wax Polymer wax Small-scale repair application (brushable) Rubber/bitumen Road stone chip repair material
Synthetic/dispersion asbestos-filled bitumen is a clay-filled water dispersed polyvinyl acetate (PVA) resin emulsion; this has damping characteristics approximately three times better than the bitumen better than the bitumen and creams or liquids contain ammonia to
keep them fresh in the tin, but ammonia can cause staining of clear coatings. 2 Always use the correct tools for the job, and take great care with mouldings. 25 Describe, with the aid of a sketch, the resistance projection welding process. (a) (b) (c) Figure 12.37 Root convexity: excessive penetration (BOC Ltd ) 337 Figure 12.39 (a) Underfill and (b), (c)
undercut (BOC Ltd ) 338 Repair of Vehicle Bodies Lack of penetration This is classed as partial penetration and is not acceptable, particularly with respect to fatigue, loading and corrosion resistance on the joint, where full penetration are full penetration is required. Care of tools throughout their working life is important. This is the most common mode Compromise
between pure Ar and pure He. Lower He contents normally used for TIG Improved heat input, edge wetting and weld bead profile Low-cost gas. With advanced aerodynamic work the plan area is related to a reference area. The third level is related to a reference area.
covered with a sound deadening material which must be removed before starting the work. Should the paint remover. The air transformer should be fitted with a pressure gauge giving an accurate reading of the pressure of air passing through the
regulating valve (Figure 17.9). 119 The equipment consists of a high-performance dust extractor unit and a range of plug-in air tools which includes random orbital sanders, orbital sanders, orbital sanders, saws and grinders (Figures 3.66, 3.67). An experienced panel beater uses the beating method suitable to the job in hand, complex shapes often being beaten upon the properties of the p
by using both hollowing and raising or wheeling methods. The reason for the higher voltage on the large diesel vehicles is to reduce the amperage needed by the starter motor, it also gives better interior lighting in buses. 5 Concentrate the flame on the starting end until the metal begins to turn red. In close-coated abrasive discs, the abrasive is
applied in such quantity as to entirely cover the backing. 2 Never under any circumstances allow oil or greases to come into contact with oxygen fittings because spontaneous ignition may take place. Minor repair work can be classified as: the simple cosmetic repair requiring the use of hand tools only; the cutting out of damaged panel sections and
their effective replacement; the replacement of complete panels such as wings, bonnets, boot lids, doors and sill panels; and the finishing of these panels to a point where paint can be applied. With this system 20 per cent more current is passed through the weld, resulting in better and stronger welds. The wheeling machine may be used simply to
planish, producing a smooth surface by the friction and rolling action derived from passing the sheet backwards and forwards between the wheels when these have just the right amount of pressure. The specification is approved. 4 Explain the importance of eye and face protection in the workshop
 environment. Colour mixing systems should not be installed in the workshop if at all possible. Check before using the machine that the clearance between the top and bottom blades is set correctly for the thickness of metal to be cut. An acetylene regulator may be used on a propane cylinder, but not on a hydrogen or coal gas cylinder as the initial
high pressure would damage or burst the cylinder contents gauge. Unlike the MOT, the examination is not primarily concerned with vehicle The history, development and construction of the car body 55 Table 1.1 Item Standard SVA Additional items for enhanced SVA Cars Light goods vehicles Construction of the car body 55 Table 1.1 Item Standard SVA Additional items for enhanced SVA Cars Light goods vehicles Doors, their latches and hingest for enhanced SVA Cars Light goods vehicles Cars Light goods vehicles Doors, their latches and hingest for enhanced SVA Cars Light goods vehicles Cars Light goods vehicles Doors, their latches and hingest for enhanced SVA Cars Light goods vehicles Cars Light goods vehicles Doors, their latches and hingest for enhanced SVA Cars Light goods vehicles Doors, their latches and hingest for enhanced SVA Cars Light goods vehicles Doors, their latches and hingest for enhanced SVA Cars Light goods vehicles Doors, their latches and hingest for enhanced SVA Cars Light goods vehicles Doors, their latches and hingest for enhanced SVA Cars Light goods vehicles Doors, the latches and hingest for enhanced SVA Cars Light goods vehicles Doors, the latches are latches and hingest for enhanced SVA Cars Light goods vehicles Doors, the latches are latches and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Light goods vehicles and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Light goods vehicles are latches and hingest for enhanced SVA Cars Ligh
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standard or acceptable alternative May require independent test Smoke emissions (diesels only) Yes Yes No No No Rear-view mirrors Yes No No No Rear-view mirrors Yes No No No Rear-view mirrors Yes No No No Seat belts Yes No
Evidence of compliance or visual assessment at test site No Seat belt anchorages Yes* No Evidence of compliance with type-approval standard or acceptable alternative No Brakes Yes Yes Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence of compliance with type-approval standard or acceptable alternative No Evidence N
standard or acceptable alternative Evidence of compliance with type-approval standard or acceptable alternative 56 Repair of Vehicle Bodies Table 1.1 (continued ) Item Standard SVA Additional items for enhanced SVA Cars Light goods vehicles Noise and silencers Yes* Evidence of compliance with type-approval standard or acceptable
alternative May require independent test Evidence of compliance with type-approval standard or acceptable alternative May require independent test Glass: windscreen and other windows outside Yes No No No Seats and their anchorages Yes No No No Interior fittings Yes No No No External projections Yes No No No No Interior fittings Yes No No N
approval standard or acceptable alternative No Does not apply to LGVs CO2 emissions and fuel consumption (vehicles manufactured after 1 January 1997) No No Evidence of compliance with full type-approval standard or acceptable alternative No Does not apply to LGVs Front impact protection (vehicles manufactured after 1 October 2003) No No
Evidence of compliance with type-approval standard or acceptable alternative No Cars N.B. May require comparison test against EC approved vehicles The history, development and construction of the car body Table 1.1 57 (continued ) Item Standard SVA Additional items for enhanced SVA Cars Light goods vehicles Cars Light goods vehicles The history, development and construction of the car body Table 1.1 57 (continued ) Item Standard SVA Additional items for enhanced SVA Cars Light goods vehicles Cars Light goods vehicles The history, development and construction of the car body Table 1.1 57 (continued ) Item Standard SVA Additional items for enhanced SVA Cars Light goods vehicles Cars Light goods vehicles The history, development and construction of the car body Table 1.1 57 (continued ) Items for enhanced SVA Cars Light goods vehicles Cars Light goods vehicles The history, development and construction of the car body Table 1.1 57 (continued ) Items for enhanced SVA Cars Light goods vehicles Car
goods vehicles Plate for goods vehicles No Yes No No Side Impact Protection (vehicles manufactured after 1 October 2003) No No Evidence of compliance with type-approval standard or acceptable alternative No N.B. May require comparison test against EC approved vehicles manufactured after 1 October 2003) No No Evidence of compliance with type-approval standard or acceptable alternative No N.B. May require comparison test against EC approved vehicles manufactured after 1 October 2003) No No Evidence of compliance with type-approval standard or acceptable alternative No N.B. May require comparison test against EC approved vehicles manufactured after 1 October 2003) No No Evidence of compliance with type-approval standard or acceptable alternative No N.B. May require comparison test against EC approved vehicles when the comparison test against EC approved vehicles after 1 October 2003) No No Evidence of compliance with type-approved vehicles against EC approved ve
 from these SVA items. Figure 14.24 Four-post lift with autocontrol measuring system (Car Bench International) Major accident damage 421 Alignment can be precisely checked at any stage of the repair whilst pulling is in progress. The aluminium will work harden on impact. Earth return This is the name used to describe the use of the vehicle
body/chassis as a carrier of electricity. Gas flows under pressure through the arc, and is subsequently heated to an exceptionally high temperature. Shearing does not use a press or die and is therefore not a stamping operation. H, the height of the strip above the plate, should not exceed 3 mm for the whole range of metal thickness involved Single
pass welds up to 10 mm T are possible with both hand and machine applications, but multipass welds are recommended where T exceeds 8 mm. Figure 14.41 Mark 5 collision repair system (Car-O-Liner (UK) Ltd ) The dolly sets consist of a number of components which can be used in various combinations and are mounted on the bench frame. It dries
rapidly in heavy layers, unlike cellulose or oil-based stoppers which must be applied in thin layers with a drying period between applications. However, it is not always possible to keep people out of the workshop. Its double adjustments at the base of the vertical arm and on the horizontal beam allows the push or pull to be widely adjusted to any angle
or height without the need to relocate the unit. On a motor car that has been involved in a collision and received damage to its front wing, but not serious enough to warrant replacement, the panel beater will carry out his work first, bringing the wing as near as possible to its original shapes. Repairs are carried out using a combination of pulling
equipment, body jacks, chains, clamps, wood blocks and welding equipment. The apprentice, improver and tradesman will each collect his or her own basic toolkit: suggested sets are shown in Figures 3.23, 3.24 and 3.25 respectively. Glass fibre mats are used as resin reinforcement in contact and compression moulded applications. Uniformly
toughened glass is produced by a completely different process, involving heating of the glass followed by rapid cooling. The polish is spread lightly over the surface with soft clean cloth, following which the finish is brought up to a high lustre with the machine. 4 Switch on Spotrite control and check that the ready light is on. Accurate cutting is
accomplished by leaning over and sighting the scribed cutting line on the metal at a point perpendicular to the cutting edge of the bottom blade. The method is to start wheeling from the centre of the fullness on a track parallel to the edge and to work right out to the edge of the panel. Mould release A substance used to coat the mould to prevent
sticking of the resin that will be used to make a part. The bottom face is ground flat which adds to the versatility of this block. 2 It is best to store full or empty compressed gas cylinders in the open, in a securely fenced compound, but with some weather protection. 6 PAT testing - it is a requirement of the Electricity at Work Regulations that all
portable electrical appliances are tested regularly, they should be marked with approved stickers and the inspection recorded in a log. The nut on the acetylene hose is distinguished from the nut on the acetylene hose is distinguished from the nut on the acetylene hose by a groove that runs around file but it can
be bent to the desired shape, which allows it to be used in difficult locations where a normal straight file would not have easy access (Figure 3.16f). Measuring and marking-out instruments 185 6.1.1 Manufacture of templates These can be made first of a paper or hard card known as template paper, then using materials such as thin-gauge
aluminium, tin plate, and in some cases thin-gauge mild steel. These data sheets show the initial sill clamp settings, and the critical dimensions for all mechanical units in place and removed. The way to repair them is by using adhesive. Adjustment in blank holding pressure, surface contour and pressure, draw radii and blank size are made during the
try-out period to correct for variations in stresses from the predicted values. On setting, the rivet body is split into four petals by the action of the mandrel head, producing a large blind-side bearing area capable of withstanding high pullout load (see Figures 7.12 and 7.13). Yet another method of increasing strength is known as box construction,
which consists of two U-sections welded together to form a square pillar or box. When grinding a body panel, always use an open-coated disc up to the time that the area being sanded is completely free of paint. The DP steel may have its strength triggered by either bake hardening or work hardening when it is stressed under the stamping or other
forming process. Flat head rivets are used for riveting flat bar and angle sections to thin metal sheet as the mobile bench. It is used for flanging circular and curved work. If non-ferrous metals or stainless steels are to be
welded, argon is the usual choice for shielding gas on grounds of compatibility. 16 What are the advantages of using bracketless jig systems? Therefore do not approach any cylinder until the key actions given below have been taken. The system 5000 consists of one or more mobile pulling towers, which can be easily moved in any direction on six
retractable wheels. 92 Repair of Vehicle Bodies (a) (b) (c) Figure 3.11 (a) Universal combination snips LH (c) standard pattern straight or crank handles. 9.4 Definitions of welding terms The material of the parts to be welded is described as the parent
metal. A third material finding favour is the polyester primer filler described in Section 17.5.1, which obviates the need for stopper on small imperfections and provides a single coat build-up to the finishing stage. Soldering as a means of joining metal sheets has the advantage of simplicity in apparatus and manipulation, and with suitable
modifications it can be applied to practically all commercial metals. They are used mainly to form curves in plate or galvanized sheet, before it is worked. Each hammer blow produces a flat spot, and the blows are so directed that
the spots merge imperceptibly into one another over the whole surface. Washing, eating and changing facilities. Double-ended hand dolly is conveniently designed for a good grip with two useful surfaces, one high crowned and one low crowned and one low crowned and one low crowned. 2 From a safe position, drench the entire surface of all cylinders with water for at least one hour after the
fire has been extinguished. An electric circuit permits the blade oscillating frequency to be varied to suit the required cutting speed. Pear-shaped mallets These are usually made in boxwood or lignum vitae, which is a very hard wood and hence is ideally suitable for this type of work. Rules should not be misused as feeler gauges, scrapers,
screwdrivers or levers; the end of the rule particularly should be preserved from wear because it usually forms the basis of one end of the dimension. This cell uses powdered cryolite and a very heavy current of electricity to reduce the aluminium of the cell and is tapped off into pigs of aluminium of
about 225 kg each. The flash-off times between coats recommended by the paint manufacturer must be strictly observed. When the particles are tightly packed the paper is known as close coated and is used to rub down smoother surfaces. Precision and strength are the main features of this system: accuracy is guaranteed to within 1 mm. These blow
hot air out of their nozzles, and sophisticated electronics make sure that the temperature of this air is exactly right. The vehicle is supported on four three-way adjustable sill clamps and is calibrated in all three dimensions - height, width and length - on an undamaged area of the vehicle underside. Checking body measurements is done by a system of
diagonal comparisons, commonly called X checking. On the top of the nut there are two threaded cantilever arms which are deflected downwards and inwards. Cutting fluid must be used with this tooth shape. 4.11.3 Fabrics for interior trim Vinyl coated fabrics are now well established as trim material. The design of the torch is in the form of a pistolar trim Vinyl coated fabrics are now well established as trim material.
or is curved similar to the shape of an oxy-acetylene torch (Figure 12.17), and has wire fed through the barrel or handle. It also reduced the burnishing time and so eased the bottleneck which still existed in the paint section of the production line. 2 Check polish smears, wheel arch edges, front and rear lower pillars, side sills, door handles, grilles.
Hoists and jacks are available for lifting vehicles; hydraulic or chain-operated equipment is available for lifting engines; hydraulic devices are available for lifting engines; hydraulic or chain-operated equipment is available for lifting engines; hydraulic or chain-operated equipment is available for lifting engines; hydraulic devices are availa
decorative electroplating A surface finish obtained when material is cold rolled on specially prepared rolls to give one surface which is superior to a BR finish and is particularly suitable for decorative electroplating A surface finish having a high lustre and reflectivity. 13.16.10 Removal and replacement of exterior and interior soft trim and hard trim
Body exterior mouldings are attached by weld stud retaining plastic clips; weld stud retaining plastic clips; weld stud retaining spring clip or clinch-type clip; or special attaching screws; an adhesive bond using either tape or sealant; a self-retaining spring clip or clinch-type clip; or special attaching screws; an adhesive bond using either tape or sealant; a self-retaining spring clip or clinch-type clip; or special attaching screws; an adhesive bond using either tape or sealant; a self-retaining spring clip or clinch-type clip; or special attaching screws.
between annealing in a steel works where enormous quantities of sheet steel are produced, and annealing in a workshop where single articles may require treatment. These problems, however, are preventable if their causes are understood and the correct operating procedures are followed. Leak detection using ultrasonic equipment When the
vehicle is in motion, the body shape may produce eddy currents and turbulence which can force air and water through the smallest orifice. Simms, who also founded the SMMT in 1902. The term 'soft soldering process, known generally as
either silver soldering or silver brazing. It does not build up on the mould and will give a high-gloss finish to all polyester resins, cultured marble and onyx. Pressure is then applied to bend the weld specimen through either 90 or 180 degrees. Figure 13.20 Panelled body shell sprayed in primer surfacer (Aston Martin Lagonda Ltd ) now ready to move
into the assembly area. It is usually made in lengths of straight edge up to 2.5 m. Quality assurance systems provide the mechanism for ensuring that a business satisfies the needs of its customers. Burnish surrounding area with rubbing compound and a damp cloth to ensure a good colour match and better blending in. Ring spanner The ring spanner
is made in a variety of sizes, points and offsets, and may be flat or cranked. 17.16 Rust-proofing A vehicle body contains many recessed areas and box sections which are difficult, and in some cases impossible, to paint properly with a spray gun and conventional paints. Corrosion prevention on metal surfaces Coat the surface to be welded with anti-
corrosion agent that has a high conductivity (e.g. zinc primers). Hand tools and power tools Panel tools and wallboards Air tools, electric tools: grinders, chisels, drills, saws Windscreen cutting tool Spottle spot welding cutter Spot welding cutter Spot welding dresser Random orbit sanders and dust extraction Block sanders and dust extraction See Chapter 3 for further
information about the equipment. Acrylic based, they normally set in the presence of metal and absence of a single-angled bend in any reinforcement section. If the bronze is to provide a strong bond, it must flow smoothly and evenly over
the entire weld area. Wet flat with P400 or P600 wet-or-dry paper. A wide variety of cutting torches are available, but in essentials they are all similar. You can use the undamaged sections of the panels which you have removed for test welds, changing weld time and current, then cutting through the welded area to check for penetration and adhesion
Without delving too deeply into the realms of paint technology, a metallic finishing aluminium, bronze and copper. These cutters are used for fitting wing mirrors, aerials and rubber grommets into body
structures. When repairs are being carried out in the underbody area, the zone in question must then be treated with underbody wax. The purpose of the combi-booth is to provide an efficient, clean area, free of humidity and within the temperature band 20-25 °C. Some scrap is inevitable since the blanks do not fit together, and so parting is not as
efficient as shearing or cut-off. When the door will not fit into the body opening, the hinges should be removed from the locking pillar to allow the door to swing freely. (a) (b) Figure 12.41 Lack of fusion (a) at sidewall and (b) inter-run (BOC Ltd ) The
source of the gas may be a chemical reaction such as the formation of carbon monoxide from carbon and oxygen, or the expulsion of gases which have been dissolved by the liquid metal but are relatively insoluble in the solid phase. When the path is broken, the circuit is open and no current flows. Also it prevents oxides reforming on the surface of
the work as the soldering is carried out. Regular spot welding usually leaves slight depressions on the metal which are often undesirable on the show side of the finished product. Residual adhesive can be removed with adhesive remover or water. Spread the restoring forces by using multipulls, which will allow the pulling forces to be activated from
several points on the damaged section simultaneously. This shows up as patches of pale colour usually up to 6 mm in diameter. In a short time a plastic component can be restored to an 'as new' condition without the need for fillers or special treatments. Severe High humidity and/or temperature. The measuring system can be used with ground
anchorage collision repair systems as well as mobile repair systems. 5.8.3 Open-end folder or bending machine Figure 5.10 Bending machine Figure 5.10 Bending machine (Selson Machine Tool Co. Ltd.) In these machine systems as well as mobile repair systems as well as mobile repair systems.
head screws popular? On receiving the repairer's estimate, the insurance company will instruct their own engineer assessor or an independent assessor to examine the vehicle and satisfy himself that the claim is in order and that the estimate submitted by the repairer does not include any labour or material necessary as a result of any other than the
 accident report. Figure 3.57 Straight line sander (Desoutter Automotive Ltd.) 3.23.5 Geared orbital sander/polisher This is a multi-orbital action machine which eliminates swirl marks and allows coarse grit paper to be used for high stock removal rates (Figure 3.58). Tap the under surface of the panel until the pick is directly below your finger. The
paper should be folded and torn so that one-quarter of the length can be removed (Figure 17.50). Many automotive manufacturers now believe that a seatbelt/airbag combination provides the best possible interior safety system. An arrangement of two wefts crossing two warps is designated 2X2 basket. Tyre black is also a cheap black paint, being of
low viscosity. Pressure is applied until the clearance round all sides of the door is equal and it opens and closes freely. One of the firms who manufacture these clips is Forest Fasteners, who have developed the Spire speed nut (see below) which is used considerably in the car industry. However, if protection is only needed in one direction, the heat
 and wind tunnel testing Aerodynamics is an experimental science whose aim is the study of the relative motions of a solid body and the surrounding air. The new generation of pulling and pushing equipment began in the 1950s with the introduction of Dozer equipment, which enabled the repairer to use external hydraulic pulling to aid the repair. To
 assist the removal of paint at awkward places, a wire brush is an invaluable tool. A water flow switch can be provided to give complete protection to equipment and operator by shutting off the welding current if the water supply should fail. Audiovisual signals warn the operator if there is overheating, if the electrode tip needs reshaping or cleaning,
and if the weld arms are open too early. In other constructions, only a portion of the windscreen pillar is formed as part of the cowl. It is normally used for relatively short runs, but it has also been adapted successfully for series production. In which case the following is advised: • • • • • Position the aluminium bodied vehicle in the workshop so that
it is quite separate from steel bodied ones, especially when welding, sanding, grinding or other intensive repair procedures are being carried out. 14 What are the comparable advantages of portable and fixed body jigs? Windscreens have become deeper and wider. However, if you are working alone or the matter is not a company one, then you must
inform the relevant authority. In the modern motor body the saving of weight is its most important advantage, and although on average the panel thickness used is approximately double that of steel, a considerable weight saving can be achieved. It is very useful for curved surfaces. 2 It must wipe with the solder stick and not crumble, thus providing a
clean surface finish. 2.2.5 Portable extinguishers: types and uses The colour codes for each type of appliance are as follows: Red for water. File hammer or beating file This tool (Figure 3.4) is designed to be used like a hammer in conjunction with a dolly block, although it is actually a file with a serrated face and is suitably shaped for holding in the
hand. You are probably familiar with glass reinforced polyester (GRP) where a piece of glass matting is layed up with a mixture of polyester resin and catalyst (hardener) to effect a body repair, or for the manufacture of kit cars and small boats. The individual consultant designer usually provides designs for 16 Repair of Vehicle Bodies organizations
which are too small to employ fulltime stylists. 21 What action should be taken to render a panel hammer safe for further use after its head has become loose? Aluminium is light in weight, strength for strength it is about a third of the weight. Figure 3.16 (a) Body trim tool (b) door handle spring clip remover (c) trim panel remover (d) door hinge pin
used. Soldering tools heated by gas, electricity and oxyacetylene are now available to speed up the process of soldering in mass production work. This tool is of greatest use when rubbing down plastic body fillers to their final finish. 17.16.2 Materials Various anti-rust corrosion compounds include heavy-duty waxes and sealants for wings, wheel
arches and underneath the vehicles; highperformance cavity waxes and penetrants for all enclosed areas, box sections, doors and pillars; special engine compartment waxes; and waxes for special purposes. Will readily Gas welding, gas cutting and plasma arc cutting that (BOC Ltd.) (a) ANM/ANM1E nozzle, 6.3 mm. 10 mm.
assessment Damaged bodywork is corrected by first observing the extent of the damage, then deciding how it was caused and the sequence in which it occurred. Although Pozidriv and Phillips look alike, they are not interchangeable. Unless the body shop is very large it would not be cost effective to have many wall mounted dispensers, and the
portable dispenser offers a viable alternative. Its limitations are in narrow sections where it cannot gain entry or in very large box sections where it is desirable to control the position of the lances, such as in doors. 6.2.2 Scribers A scriber is used when marking out work, and will leave a fine line on the metal surface (Figure 6.1). 16.7.2
 Fabric types and constructions To weave any material warp threads and weft threads are needed. 2 Gloves should be worn to protect the hands from burns. Simply push the total panel thickness, securing the panels under tension. 10
 Removed carpets should be thoroughly brushed, vacuumed and washed on the bench. The vehicle hoist (ramp), hydraulic jack and other lifting equipment are marked with the Safe Working Load (SWL) in either tonnes or kilogrammes. The condenser allows the compressed air to expand into a chamber, thus assisting cooling, and then removes
 moisture from it by means of a removable filter. 23 It is estimated that 80-90 per cent of corrosion on motor vehicles is classified as inside-out corrosion. Check body sides for tar, and top surfaces for industrial fallout. Using the jack support on the mainframe, the frame is lifted and anchored to the transport beams, after which four floor stands are
placed under the frame. Engineer's ball-pein hammer This is a general purpose hammer. The jaws of the clamps rotate through 360 degrees, ensuring that damaged vehicles can be securely held in place, enabling structural alignment to be guaranteed. Its function is to keep the work at earth potential to safeguard personnel against any breakdown of
the welding set. 3 State how gas cylinders are visibly identifiable. The attachment point. After four or five mallet blows, the last being on the centre of the heat spot, will turn black, and should be quenched immediately with a water filled sponge. The
following points should be noted: 13.9.3 Shrinking aluminium 1 Never quench a red hot heat spot; wait until the metal has turned black. The chain then is hooked back on itself, thus providing a double chain. 5 Water - do not use any electrical equipment in any wet conditions. The soldering iron is now ready for use. They will consequently favour them is hooked back on itself, thus providing a double chain.
use of plastics as a first choice, rather than as a replacement for metal. However, the terms 'stylist' and 'styling' originally came into common usage in the automotive industry during the first part of the twentieth century. The heated weld zone, the molten metal and the electrode are shielded from the atmosphere by a blanket of inert gas (argon or
helium), fed through the electrode holder which is in the tip of the welding torch. When these stresses in the unwanted rigid areas are released, the elastic areas will also be allowed to return to their original shape. Warm the area to be repaired, checking that the temperature does not exceed 160 °C. The fluid container or pressure vessel is
connected to the gun by means of a reinforced fluid hose, and normally ranges in size from 2 to 25 litres. For smooth surface a double-tapered joint cured between removable plates is required. This is termed flashback, and its effect is more serious as immediate damage to hoses and regulators may result; there is also a risk of injury to the operators.
The squared face is 1 in (25 mm) square and the round face is 141 in (32 mm) in diameter, and it has a weight of 12 oz 86 Repair of Vehicle Bodies balanced and gives a very good finish when used correctly. In some versions where the most efficient cooling is needed, water is directed through passages in the torch to cool the wire contact means as
well as the normally cooled metal shielding gas nozzle (Figure 12.18). 9.3.1 Acetylene supply In the high-pressure system the acetylene is supplied in steel cylinders painted maroon and containing between 0.57 m3 and 8.73 m3 of gas when fully charged. Table 4.6 Chemical composition limits 1 and mechanical properties of unalloyed aluminium plate.
allows maximum accessibility under the front and rear of the vehicle; therefore all dismantling, measuring and straightening operations can be carried out with ease. The air-cooled torches are used for welding light materials and the water cooling then prevents cracking of the ceramic shield
at the tip of the torch. Whilst doing this, hold the stick of body solder near the work and apply the flame over both the tinned area and the solder stick so that the melting stage of each coincides. Flexible lance (1100 mm) This is basically a flexible version of the rigid lance. Typical capital costs are about half those of an equivalent central boiler system
and about the same as a ducted warm air system. Compressibility is related to malleability in so far as the latter refers to the degree to which a metal opposes that action. Do not expose it to knocks, jars or sudden pressure
caused by rapid opening of the cylinder valve. Cosmetic body panels are the thinnest panels on the vehicle, and are generally repaired by the use of butt, fillet, lapped edge or corner joints. Glass's Guide for Windows A PC-based version of the famous valuation booklets; information from this can be imported into the estimate or other forms. Make sure
you do inside all the reinforcements. The base colour and tinters are mixed according to their weight, the quantity of each being obtained from a given formula. 4 Use the oxy-acetylene torch with a neutral flame, as this will give good results under normal conditions. Spraying directly into a corner (Figure 17.35) gives an uneven coating but is
 satisfactory for most work. The adjustment of electrode clamping force is critical for any type of steel, particularly when long-arm arrangements are used and complex configurations of arms are used for welding around wheel arches. It can be either mobile, static or with a built-in lift. This can only be done by jacking the car up and inserting safety.
stands, or by using lifting equipment in the form of a hoist which will allow a more thorough examination of the underside of the vehicle. Also ensure that the extractor pipe is correctly connected and is not leaking. 288 Repair of Vehicle Bodies With this equipment much of the technology is transferred from the operator to the controls, only because
the operator has no means of knowing which type of material he is welding. Shelving usually shows during sanding and can seldom be repaired out from the body, scarfing should be on the outside. The end result is a firstclass butt weld requiring very
little dressing. 12.9 MIG/MAG spot/plug welding Figure 12.13 Basic principles of operation of MIG/MAG welding (BOC Ltd ) An advantage of MIG/MAG welding applications, either semi or fully automatically. The equipment uses direct current at a maximum of 12 volts. Coated
abrasive papers are available in production paper grades (e.g. P40 to P120) and also in finer grades of lubricoat papers (e.g. P150 to P600). Third, there is the technique of planishing using the wheeling machine as a means of smoothing the work surface (Figure 13.15). First, it needs to be a reasonable height so that vehicle bodies can be elevated
and moved about easily; and secondly, doors are constantly being opened and shut to allow for the movement of Vehicles in and out of the workshop. 22 Use a simple sketch to show how gunsight gauges are used in repair. 500 Repair of Vehicles in and out of the workshop.
achieving its alignment, before hand. These specialist tools are also frequently used in the coach building industry during the construction of the weld gives no indication of the weld quality. Straight nozzle This produces a forward spray with a construction of the weld gives no indication of the weld quality. Straight nozzle This produces a forward spray with a construction of the weld gives no indication of the weld quality.
restricted spray width. It produces a 360 degrees spherical spray at right angles to the lance combined with a straight-ahead jet. The 12-point socket does not have the holding power of the 6-point socket, but its numerous positions maximize the possible turning radius (Figure 3.40a). Catalyst dispenser A purpose-designed container for measuring
and dispensing liquid catalyst without splashing. (a) Impact driver (Figure 3.15) will loosen or tighten the most stubborn screws, nuts and bolts. Electric resistance welding 291 Figure 3.15) will loosen or tighten the most stubborn screws, nuts and bolts.
panel surface. 421; rear EPDM mix 4080) 14 Scuttle grille/mouldings (ABS) 15 Front/rear wing splashguards RH and LH (PP) Front wing waist moulding RH and LH (Noryl) Front door waist moulding RH and LH (Noryl) Front/rear wing splashguards RH and LH (Noryl)
Rear door waist moulding RH and LH (Noryl) Rear wing waist moulding RH and LH (Noryl) Front/rear door outer handles RH and LH (Noryl) Front/rear door outer handles RH and LH (Noryl) Rear spoiler (PU core
vehicle bodies Over the past years, the natural applications for plastics in automobiles (interior fittings, cushioning and upholstery, trim, tail lights, electrical components) have become saturated. Direct glazed windscreen removal and replacement The method of direct glazing of windscreens, also known as bonding, is very popular with motor
manufacturers. Therefore always carry out overhead welding on a low voltage setting, which will cut down spatter while keeping the arc as short as possible and the weld puddle as small as possible. If you choose to use any of these formulae, remember to use SI units, metres, newtons and seconds where appropriate. This is the result of the stresses
which have been set up at the bend, making the material work hardened. They can be moved both laterally and longitudinally in order to locate the pick-up points on the underbody of the vehicle. With portable electrical appliances this simply means switching off and taking the plug out of the socket. Testing for leaks, using either leak testing
equipment or spraying with water, may be carried out immediately. Second, the action should be produced by the wrist rather than the forearm, and as strength is developed in the wrist it will be found that it is possible to control the hammer under all circumstances. The alloy is raised to a temperature of 490 °C by immersing it in a bath of molten
salt. The slag on MMAW should flake off readily, especially if the weld is allowed to cool before the slag is removed. The initial assessment has identified there is a serious risk to peoples' health from the way the hazardous substance is being used. The current causes the wire to melt at the set rate at which it is fed. A normally concealed area should
be chosen and degreased, and any paint applied to the surface should be removed from the test area with the aid of an abrasive. It is highly combustible when mixed with air or oxygen. The drawing-up hole and the cup hole are offset slightly to the direction of the vertical hammer blows, and therefore great care should be taken to hold the set in an
upright position when riveting. You must not damage any equipment which is provided for your use, nor knowingly break any health and safety regulations. Name and explain the process. Acetylene was first discovered in 1836, but was not produced successfully on a commercial basis until many years after this when the use of calcium carbide was
first discovered. Another tool that can be used is the shrinking hammer but the faces have cross-milled serrations, which reduce the tendency for the hammer to stretch the metal because of the very small contact area between the points on the serrations and the panel. The nibs should be removed with P800
grade wet or dry paper and the flatted area brought up to a high gloss with burnishing compound, followed with a good-quality car polish. 15 Explain the operation of a vernier caliper gauge. The covering should be free from defects, such as cracks and abnormalities which would affect the Table 11.1 299 3 A digit indicates the power supply
requirement (see Table 11.4). 2 The sill clamps are then moved into place. Figure 17.51 Coatings too wet and too deep a colour when viewed from the side. 16.5.1 Catalysts and accelerators Many resins are supplied with an in-built accelerator system
controlled to give the most suitable gelling and hardening characteristics for the fabricator. The dolly provides support and prevents the undamaged areas that have been previously roughed out from being pushed out of place. The arc is struck within this blanket of shielding gas, producing a weld pool free from atmospheric contamination. Four
adjustable sill clamps are also supplied to ensure a quick and easy centralization and anchorage of the car to the frame, whilst a special bridging device enables the repairer to check for external damage to the body shell. Hand and power tools Figure 3.33 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.33 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.34 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.35 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.36 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.37 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.38 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Ltd ) 105 Figure 3.39 Swaging tool or edge setter (Sykes-Pickavant Lt
Pickavant Ltd ) 3.16.2 Swaging tool or edge setter This tool is designed for bench mounting or to be used in a vice (Figure 3.33). When operating the grinder, hold it as flat as possible without permitting the centre connecting bolt to come in contact with the surface being ground. Generally, soft soldering fluxes (see Table 8.1) are divided into two
main classes: corrosive fluxes and non-corrosive fluxes and non-corrosive fluxes. It is a high-performance flush-break fastener designed to build in strength, security and quality. As each piece is completed it is tried on the jig and made to fit it exactly by planishing. Weld bead One single run of an electrode welding rod in manual metal arc welding. Heat treatment can both
change the size and shape of the grains, and alter the microconstituents. The cure of a polyester resin will begin as soon as a suitable catalyst is added. With the absence of flux further advantages accrue, the most obvious ones being the elimination of deslagging and chipping back when second weld starts are required. The unit is supplied complete
with a full set of laminated colour data sheets, and regular updates are available. 1.5.9 Body side frame assembly On a four-door saloon this incorporates the A-post, the BC-post and the rear quarter section. After all the points have been plotted and the wheels replaced, the car can then be rolled away, leaving the chalked pattern on the
floor. However, it was not until the 1930s that good-quality joints could be reliably and consistently produced by the arc welding process. 5 Name, and sketch, the type of rivet required when fastening a panel to a frame; where the riveting is only possible from one side. VOCs are substances which react with nitrous oxides in sunlight to create low-
level ozone. Should any of these not be available, and it is felt appropriate, call for your local doctor or an ambulance. 3 Check visually from a safe position. This is where the operative, standing on one side of the booth. Bumper assemblies, wheel arch
extensions and rear lamp holders are typical applications of injection moulded thermosets. Large areas should be made to gel quicker to cut down styrene loss, and correct proportions of catalyst and accelerator must be used. 4.11.2 Leather (hide) Large numbers of motor vehicle users all over the world continue to specify hide upholstery when the
glass rovings chopper delivers the reinforcement to the mould surface as in the former system. BS EN ISO 9001-2000 is about the maintenance of systems which work to ensure the provision of a documented quality service. These steels are valuable where a combination of strength and ductility are desired. Four automatic air/hydraulic pumps with
10 tonne rams are used for the pulling. Softwoods are normally used since hardwoods are difficult to bond. Second, dissimilar metals can be joined by applying the correct amount of heat to each parent metal, when the skins of both will form an alloy with the molten hard solder. It does not usually matter if the unseen or partly hidden side of the
moulding is rough (indeed, it usually is), but for the displayed surface to be unsightly is not normally tolerable. Call the dealer parts department. All body repairs, paintwork and mechanical work should be completed. Dolly block A hand tool, made from special steel, shaped to suit the contour of various panel assemblies and used in conjunction with
planishing hammer to smooth out damaged panel surfaces. Computer-based alignment systems use computer power to carry out the calculations, so that you can be certain of centralizing the steering wheel and alignment of the vehicle. was the engineering requirements to manufacture a very taut, rigid open sports car. Last, there is the gross
distortion caused when badly fitting panels are forced together at local spots. The adaptive part of the control decides the number of stages needed and their duration. 2 Care should be taken when putting the panel into the rollers that the operator's fingers are kept clear. The special support arms, to which modified brackets are fixed, are mounted
on the cross beams in the same manner as the original bracket system (see Figure 14.23). They are supplied with domed or countersunk (90°, 100° or 120°) heads in diameters of 2.4 mm, 4.8 mm and 6.4 mm, for riveting thicknesses up to 12.7 mm. Genesis first displays visual guides, showing where to place each target
Straightening a vehicle involves two separate alignment operations. 17.19.5 Cobwebbing 17.19.5 Cobwebbing 17.19.5 Cobwebbing 17.19.5 Cobwebbing 17.19.6 Cobwebbing 17.19.8 Cobwebbing 17.19.6 Cobwebbing 17.19.8 Cobwebbing 17.19.6 Cobwebbing 17.19.8 Cobwebbing 17
H3 strain hardened and stabilized The second digit (2, 4, 6 or 8) indicates the degree of strain hardening, as follows: Non-heat-treatable aluminium alloy plate, sheet and strip: HX2 tensile strength approximately midway between O temper and HX8 temper HX6 tensile
strength approximately midway between HX4 temper and HX8 temper HX8 full hard temper and HX8 tem
 impossible to spray, paint or pour. Resistor A resistor A resistor is used to control the flow of electricity, it allows electricity to flow, but the flow is at a set rate. Melt a little bronze rod on to the surface and allow it to spread along the entire seam. Also a lot of the aluminium moulds used in fibreglass construction, where highly developed double-curvature
     pes are needed, are made by hand, welded and dressed and planished or wheeled to a final finish. Low-carbon steels are used extensively in the manufacture of withstanding the various types of loading. Heat is energy measured in joules (]). 28
State the function of an air transformer and its importance when used with power tools. That is, tools made from plastics materials, or plastics materials, or plastics materials dries by the evaporation of the
solvent content, and if it is applied in heavy layers the inside of the coating will remain wet for a considerable period. General-purpose dolly is very well shaped and easy to hold and offers wide, low-crowned faces which are essential when working on the new body styles. Transverse strength is provided by box sections at right angles to the
transmission tunnel, generally in the areas of the front seat and in front of the rear seat. So, before allowing them into the workshop you should warn them of potential hazards. Call the fire brigade and evacuate the area. These have been consolidated in each of the two pieces, despite the difference in the two processes employed. Some single-sided
equipment, especially that which operates at high current, does not require pulse control welding. You will be asked for your name, the place where the emergency is and where you are calling from. A handy pocket scriber is also available. Many welding processes create noxious and harmful fumes which can be eliminated with portable welding
smoke eliminators (Figure 15.10). When the damage is a crease and very deep, ring washers may be used instead of pins to facilitate a stronger pull. These provide complete extraction where confined areas pose a problem, especially in body repair workshops. Choosing and siting portable extinguishers Because there is such a variety of fire risks in
bodyshops, it is important to analyse these risks separately and (with the help of experts such as fire officers) to choose the correct fire fighting medium to deal with each possible fire situation. 3 Customers accept BSI certification as proof of quality commitment. The car body stylist then selects a colour by trial and error, to suit a new car model.
Figure 10.13 Welding together panels of the same thickness (Motor Insurance Repair Research Centre) Electrodes The functions of the electrode (chromium/copper) are to: 1 Conduct the current to the weld zone 2 Produce the necessary clamping force for the weldment 3 Aid heat dissipation from the weld zone. 4.12.6 Future of plastics in the
automotive industry. The automotive industry The automotive industry has grown to appreciate the potential of plastics as replacements for metal components within their products. Figure 5.25 Drawn parts (Rover Group Ltd.) 3 Which properties of a low-carbon steel allow it to absorb energy resulting from impact through collision? Gas welding, gas cutting and plasma arc
cutting 5 Do not allow cylinders to come into contact with electricity. A locking ring 196 Repair of Vehicle Bodies is usually provided in the spindle emerges from the barrel, so that the spindle emerges from the barrel, so that the spindle emerges from the barrel frame at the spindle emerges from the spindle emerges fr
steel, aluminium, Inconel and Monel metal in the technique of stelliting, for stainless steel, and wherever excess of oxygen on metals would cause detrimental oxidation. Reach over the rear wheel arch and spray coat the wheel arch seam, the lower rear wing, around the tail lights and into all the inaccessible areas. Failure to do so may allow
equipment to be used in a faulty state, and may be dangerous. The majority of motor cars on the road today are of unit or mono construction. As these also have a low resistance to a tensile pulling force, the joint design must be similar to that of the skin fusion process, i.e. a lapped joint. 50/47.5/2.5 solder, called tinman's fine, contains more lead and
is therefore cheaper than the 60/40 grade. 2 What is meant by riveting allowance and rivet pitch? Scribers are made of hardened and tempered high-grade steel, with a knurled body which facilitates handling. This is often helped by giving the rivet a little before using
the riveting tool (Figure 7.4). The heat affected zone can also be influenced by the composition of the gas. The working principle of the micrometer is based on the distance a screw moves forward for each turn made. It can also be used for repairs which require the replacement of body panels because of the totally accurate positioning of the panels to
be replaced. DC dB degree (angle or temperature) dial test indicator diameter direct current decibel ECU EPA EC Electronic control unit Environmental Protection Act European Community F ft ft/min Fahrenheit foot feet per minute xxx Abbreviations and symbols gal GLS GRP g gallon (imperial) general lighting service (lamp) glass fibre reinforced
plastic gram (mass) HASAWA HSE HT HVLP Health and Safety at Work Act Health and Safety Executive high tension (electrical) high velocity low pressure (spray guns) in IFS IR ID IED IMI ISO inch independent front suspension infrared internal diameter Institution of Engineering Designers Institute of the Motor Industry International Organization
for Standardization kg kW Kilogram (mass) kilowatt LH LHD LHThd l LT lumen lux left-hand drive left-hand drive left-hand thread litre Low tension light energy radiated per second per unit solid angle by a uniform point source of l candela intensity unit of illumination equal to l lumen/m2 max. After filing, and prior to refinishing the panel, the damaged
area is sanded using a fine-grit sanding disc which leaves a smooth, even surface ideally suited for painting. Specially designed extraction equipment can be tailor-made to an individual bodyshop for the removal of dust and fumes. Where sealing is most important, such as to prevent moisture penetration into spot-welded seams, fairly soft butyl-based
materials may be used; these do not liberate corrosive hydrochloric acid as a decomposition product when welded through. 20 Explain the importance of tinning a panel before commencing body soldering. 16.10.12 Low-rigidity laminate The first identification is by touch; the laminate will feel spongy and more flexible than usual. 2 If either the
damaged area or the repair materials are at all damp, the strength and life of the repair will be seriously affected. Fire is a chemical reaction called combustion (usually oxidation procedure is that the vertical scale built into the sill
clamps and telescopic pointers set the vehicle at the correct height. There are three standard shapes of faces for the bottom wheel - flat, small radius and full radius - and the choice of wheel depends on the required shape of the finished panel. It is often necessary to repair panels where the metal has partially disintegrated through rust, or has been
torn or otherwise broken. The mainframe of the bench has two wheels which are centrally located. 11 Explain why bodyshop lighting plays a crucial role in the repair and final finish of a vehicle. The following are some of 438 Repair of Vehicle Bodies the important criteria to be considered in the selection of suitable equipment. Acrylics are best used
on repair work over an original highbake acrylic finish, but can also be used as a refinishing material on complete resprays. Under a microscope leather can be seen to consist of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium, or bulk of the hairy epidermis and under that the corium and the hairy epidermis and under that the corium and the hairy epidermis and under that the corium and the hairy epidermis and t
14.33 Checking the centre line of a vehicle (Dataliner, Geotronics Ltd ) Straightening equipment The straightening equipment is designed on the vector principle using hydraulic rams and chains. The broad blade spreads the blow evenly over a larger contact area, thereby reducing the possibility of sinking the metal. If the partial failure does not
exceed 20 per cent of the total nugget area, the strength of the weld should not be impaired (see Figure 10.17). Specialist equipment to the customer, certain equipment is required in the workshop. Parallel A parallel circuit is one where items are connected
electrically alongside each other. The arch consists of a number of heating Automotive finishing and refinishing and refinishi
The pigment for this type of paint is zinc chromate which makes it an ideal primer for aluminium, although it can be used also with good effect on most other metals. Much of the new technology caters for what is now regarded as four-wheel or total alignment. The latter type is intended for use in all normal blind riveting situations where the
materials to be fastened do not present structural problems. In this case the component involved will not operate. Whether it is the panel which is being repaired which is be
taken Gas cylinders involved in a fire may explode. 40 Explain the purpose of using coach screws in vehicle body assembly. Warning Warning signs have a yellow triangle with a black outline (Figure 2.15b). It is usually found that any break in a moulding is surrounded by an area of bruising where the resin is crushed, and this must be removed. Mini
bracket/support system. This system, although greatly reduced in size and weight, still retains the main features of the Car Bench System. The fine grades are used with fine compounds and creams for final burnishing to promote a deep gloss. Note: if stiffeners are added after cure, bonded surfaces should be sanded to assure good adhesion. 6 Do not
use cylinders as rollers or supports. It is fixed by clipping into predrilled holes, thus eliminating the need for screw fixings (Figure 7.58). Figure 7.58 The Avdelok fastener (Avdel Ltd.) 7.5.2 Hemlok system The Hemlok is a blind fastener which comprises a steel stem and shell. If the site is a long way from existing services, determine in advance
whether the cost of connection would be worthwhile. 3.15.3 Cold chisels Figure 3.29 Aviation snips (Frost Auto Restoration Techniques Ltd.) to 12 in (152–305 mm). In shearing the cutting action must be along a straight line. Another option is renting an existing bodyshop. Upon this information can be determined the number, types and mix of bays
required in the bodyshop. 39 Name the two main types of seatbelt arrangement which are fitted to a standard saloon vehicle. These depressions are minimized by the use of larger-sized electrode tips on the show side. 4 Advice on the maintenance of the system once it is installed. The speed of welding is then increased because the molten metal has
less tendency to run, better penetration can be secured, and the work is less fatiguing for the welder in this position. With the rear seats down there is no division between the passenger and luggage compartments and this increases the luggage carrying capacity of the vehicle (Figure 1.6b). Accelerator A constituent of synthetic resin mix which
hastens a reaction. Treat rubber seals with appropriate dressings. In some cases a combination of pulling and pushing is needed when correcting damage, and this requires a heavy-duty body jack to be used in conjunction with pulling equipment. 4 It must be capable of being reheated and reworked without forming hard spots. For example, if cooling
water can absorb heat to a point where more heat is being absorbed than generated, the fire will go out. These measurements are supplied by most manufacturers on data sheets or in body alignment manuals. When spots are not overlapped long enough to produce a continuous weld, the process is sometimes referred to as roller spot or stitch
welding (Figure 10.8). The screwdriver has a six-pronged star profile which provides greater turning power and less slipping out of the fastener's head. 6.2.18 Screw pitch gauge (Figure 6.13) consists of a metal case with two sets of flat pivoting blades, each
having teeth cut on its edge to correspond to a screw thread form. Wet flat these areas with 360 paper. Also the tools and equipment are dedicated for use only on aluminium bodied cars. It will give a semi-permanent release 542 Repair of Vehicle Bodies interface when correctly applied to moulds from ambient up to 135 °C. It should also be efficient,
with adequate facilities for detailed assessment of damage and an accurate method of estimating repair times needed and parts required. An ordinary garden spray, of the type which can be pressurized and adjusted to deliver water in the form of a very fine spray or a small powerful jet, has been found to be very effective in helping to locate most
leaks. It also hides the fibre pattern of the reinforcement. This may be done in a suitable oven or salt bath. 4.3.4 High-carbon steel This can be hardened to give a very fine cutting edge, but with some loss of its ductile and malleable properties. The eccentric action is suitable for feather edging, flatting surfaces prior to painting, and levelling surfacers
and fillers. The tool can be easily turned when cutting owing to the narrow width of the blades, and so can cut curved as well as straight shapes. Several of these may be needed at any one time, and it may not be possible to secure them to bonded frame areas if there is not a suitable smooth surface. The proper alignment of suspension and steering
systems centres around the accuracy of six control angles: camber, caster, steering angle inclination (SAI), scrub radius, toe (in and out), and turning radius (Figure 14.93). Applicable at temperature of 70 °C and less. 17.5.3 Sealers There are three types of sealers used by the refinisher: standard, isolators and bleed inhibitors. The alligator bonnets
have their catches at the front, and in most cases the catches are controlled from inside the car. 16.4.6 Staple fibres These are occasionally used to improve the finish of mouldings. If the panel has undergone a severe impact it may have some residual distortion. It may also be used for spray coating the wheel arches and underside of the vehicle.
Neither polycarbonate nor polyester could fulfil totally these requirements. Short, jabbing strokes should never be used, as these will only scratch the panel and will not indicate low spots. Annealing, or softening, of the metal is usually carried out before or during curvature work such as raising and hollowing, provided the metal is not coated with a
low-melting-point material. However, surfaces such as the roof, bonnet, boot lid and parts of the doors and wings of cars can be rubbed down or polished more economically and efficiently with power tools. After hardening, a strong moulding is produced with a smooth outer surface requiring little maintenance. Both are good for mechanical areas and
forecourts, but their colour rendering makes them totally unsuitable for bodyshops. Disc sanders are driven either electrically (Figure 3.55) or by compressed air (Figure 3.56). A wide range of special chisel bits is produced for the power tool. Needle felts are blends of natural and manmade fibres locked together by needle punching. One example of
this type of construction is the car body, which has certain panels which are made separately and later bolted in position so that they can be replaced as individual units if damaged. With a plumb bob and length of cord, plot on to the workshop floor a series of points common to both right- and left-hand underbody members. Also I would like to take
this opportunity to thank my son Andrew for the production of some of the photographs taken especially for this edition. Although general-purpose fluxes are available, it is always desirable to use the fluxes recommended by the manufacturer of the particular rod being employed. Metal that is returned to its original pressed shape during roughing out
will smooth out more quickly and evenly. Leftward and rightward welding are shown in Figure 9.17. The first step in making any hook-up is to anchor the pulling equipment into anchor pots, a rack-system, or an alignment and repair system. In those days the painter not only mixed his own colours but actually manufactured his own paints, using a
pestle and mortar to grind the pigment and oil together. Watch the course of the plate is the same, maintaining a molten puddle approximately 6-10 mm in width. 12 Describe, with the aid of sketches, three different methods of using a portable hydraulic body jack in the realigning and
straightening of vehicle body damage. 2 Take into account the workplace when selecting equipment. Planning officers are trained to help to implement the following of correct procedures in the planning, erection and completion of all buildings. Manual steering gear: check for excessive play and leaks, check U-
joint at steering shaft. 3 Select the necessary hand tools and, if using the hydraulic body jack, decide which basic set-ups and attachments are best suited to the job. As age hardening reduces ductility, any appreciable cold working must be done while the metal is still soft. An aerodynamic or streamlined body allows faster running for the same
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consumption of energy, or lower consumption for the same speed. The distance between the points is set by means of a fine adjustment screw mounted across the legs. Figure 9.18 gives details of edge preparation. This is then attached to a rubber rubbing block and the damaged area abraded using a liberal quantity of water to keep the work clean so
that continual inspection can take place. The unit is now ready for operating. 13.16.8 Minor repairs to sill panels on a car is attached to the door pillar and floor, and is of double-panel box-like construction having both inner and outer panels. The equipment requirements can be categorized as follows: Specialist equipment: essential and
desirable General workshop equipment: essential Hand tools and expendable items: essential Hand tools are expendable items.
strength PU two part Very low to medium modulus Very low to medium strength Very simple to use. Among the materials which are readily weldable by this process are most grades of carbon, alloy or stainless steels, aluminium and most of its alloys, magnesium and its alloys, copper, coppernickel, phosphor-bronze, tin bronzes of various types,
brasses, nickel, nickel-copper (Monel alloy), nickel-chromium-iron (Inconel alloy), hightemperature alloys of various types, virtually all of the hard surfacing alloys, titanium, gold, silver and many others. The growth for the future can be expected to come from the use of plastic for bodywork and some mechanical components. Primary damage is
identified by first determining the direction of the primary impact. It can be assembled to the panels by hand and no welding or riveting is required. 2 Before performing any work in the torch, always disconnect the main voltage. 5.1.7 Elasticity All metals possess some degree of elasticity; that is, a metal regains its original shape after a certain
amount of distortion by an external force. The drive screw is then withdrawn, leaving the Nutsert permanently and tightly placed in the hole and ready to receive either a screw or a bolt. These will be reluctant to leave the end of the wire and will often settle as spatter beside the weld (see Figure 12.22). A choke coil reduces the peaks in the welding
current and thus eliminates the cause of welding spatter. An unsaturated polyester resin is one which is capable of being cured from a liquid to a solid state when subjected to the right conditions. It appears as fine hair cracks in the surface of the resin. Wooden spokes and iron tyres were the first wheels to appear, and with both rear and front wheels
of the same dimensions. On mono constructed vehicles the correct positioning of new panels, which may incorporate reinforcing members, becomes increasingly important and calls for expension units. 21 With the aid of a
sketch, give a detailed explanation of the working and function of the hose check valve on oxy-acetylene welding hoses. Trim panel fasteners are used principally in the automotive industry to attach door and tailgate panels to inner door panels. 16.11.4 Spillage and disposal Most of the following products are covered by the terms of the Deposit of
Poisonous Wastes Act: Polyester resin Absorb spillages in dry sand and dispose by landfill or controlled incineration. Major accident damage can range from a single mobile pulling unit to multipulling units; these may be arranged around a bracket jig
system or a measuring bridge system; they may be set up on mobile benches, centre-post or four-post lifts; and they may incorporate brackets, or measuring systems or a combination of the two. The order of tenacity of various metals in tons per in (MN/m2) is: steel 32 (494); copper 18 (278); aluminium 8 (124); zinc 3 (46); lead 1.5 (23). Therefore it
is essential to follow the guidelines offered by the vehicle manufacturer on recommended repair methods. These products must be used in a well ventilated area. In the next stage of manufacture, the iron or through the liquid iron,
which causes oxidation of the molten metal. Body panels Pressed metal panels, or plastic moulded composite panels, which are fastened together to form the skin of a car body. A range of kits of various sizes is available to suit the needs and capital expenditure of various repair shops. Selection by computer One firm, Permabond, has a computer
program called the Permabond Adhesive Locator and Sealant Guide (PAL II). It has good adhesive qualities on bare metal and is a good rust inhibitor. Though developed primarily for the refinishing trade, they are in fact used by vehicle manufacturers in the rectification of damaged or faulty finished vehicles. MIG/MAG dip transfer welding is a low
heat input process owing to the relatively low amperages required, and it is ideal for welding fine sheet thicknesses because of the absence of distortion with minimal jigging. Paint solvents may cause dermatitis, particularly where skin has been in contact with peroxide hardeners or acid catalysts: these have Protective clothing is worn to protect the
worker and his clothes from coming into contact with dirt, extremes of temperature, falling objects and chemical substances. Handy 'limit gauges' are available for the routine testing of parts specified substances are in
use. Do not clean dusty overalls with an air line: it is more likely to blow the dust into the skin, with possible serious or even fatal results. In conventional cold spraying and hot spraying solvent, whereas in hot spraying the necessary reduction in
viscosity is achieved by heat. Move the torch along so that the metal is cut right through. With this system, calibration of laser measurements has been simplified considerably. 6 Check control pedals and foot wells, especially under front seats. The hand unit has a storage capacity for data and specifications for up to four different car models (Figure
14.38). If the workshop is equipped with hot air blowers, these should be directed away from the moulds (Figure 16.46). Nominal composition (wt%) Ag Cu Tensile strength (N/mm2) Notes Low melting point, very fluid, high strength (percentage).
The chisel is subdivided into cutting edge, shank and head. Landau A cabriolet limousine having only the roof behind the rear windows collapsible. In other words, crystals or grains within the metal which have been displaced and deformed during the process of
annealing. The crumple zones are designed to help decelerate the car by absorbing the force of collision at a controlled rate, thereby cushioning the possengers and reducing the puddle, combining with oxygen in the air as it falls so that part of
it burns up and will cause a weak, porous weld. Correct current control gives a pool that is sufficiently molten to ensure good penetration. Do disguard contaminated shoes. Good bead profile. Acetylene A combustible gas which is mixed with oxygen and used in oxy-acetylene welding. The pitch of a rivet is the spacing between the rivet centres.
Always wear goggles when using a bench grindstone or portable grinders, disc sanders, power saws and chisels. Figure 13.30 Swing of the planishing hammer wrist action is impossible. These instruments are used for marking-out objects
Max. 3 Apply degreaser to engine and compartment. Another factor against it was that it required four hours to cure. The feed mechanism and rollers require more frequent cleaning. You will need to disconnect the electric window power supply
leads and the central locking wires from inside the door, after removing the door trim, before attempting to remove the door skin panel. The plumb-bob line should be marked with a pencil cross. Then set back heat one step to stop
splashing. Polyester stopper is intended for use on bare metal or over high-baked primers. Figure 7.22 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.21 Hand operated riveting tool, plier type (Tucker Fasteners Ltd.) Figure 7.23 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.24 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.25 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.26 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.27 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.28 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tucker Fasteners Ltd.) Figure 7.29 Hand operated riveting tool, lever type (Tu
following factors must be considered when selecting the type of rivet to be used on a particular job: Rivet diameter In some cases this may be decided by the size of an existing hole. In the past each manufacturer employed different means of identifying the properties of his electrodes. Although every vehicle receiving major collision damage must be
individually treated, the following is a basic approach to repair procedure: 1 Inspect and check underframe or chassis for alignment using conventional equipment. The damaged area should be levelled up as previously described, and the whole of the surrounding panel wet flatted with P400 grade paper. The importance of this Act cannot be over-
emphasized; no working methods may be employee that can be seen to be a health or safety hazard to employees. The Mark 5 equipment consists of the following: alignment bench, Draw aligner, measuring system (Figure 14.41). 12.2.1 Argon Argon is one of the rare gases occurring in the atmosphere and is obtained from liquefied air in the course
of the manufacture of oxygen. Engineers 24 Repair of Vehicle Bodies express the aerodynamic drag using the drag coefficient Cd. The coefficient Cd. The coefficient can be appeared to the welding of brasses, bronzes, copper
silicon alloys and in the process of bronze welding, the degree of oxidation required being determined experimentally. Likelihood of occurrence Table 15.2 14 Evaluate the likely severity of the harm. Finish off with a double-header coat to obtain a smooth finish. An increasing number of companies in the body repair industry are now seeking
registration to BS EN ISO 9001-2000, the national standard for quality management systems. Damp cloth This is the result of having an over-thick gel coat, and occurs when the laminate has received a reverse impact. Some cylinders are
fitted with hand wheels, obviating the need to use a spindle key. You must not use an airline for dusting off components, especially brake and clutch parts as the very fine dust can cause damage to the throat and lungs. pillar front inner lower Pillar front inner lower Sidemember front fender Pan front floor Reinf. (b), (c) Set the spot
welding gun controls. Typically the procedure is to switch off the ignition and completely remove the key, then disconnect the battery - remember always to remove the earth lead first - and then wait about 10 minutes for the capacitors in the control unit to discharge themselves. 2 Use the warning triangle and hazard lights. These blocks are used in
the same manner as the sandbag for shaping metal, although the blocks are more solid and do not 'give' as much as the resilient sandbags. When glass breaks, an air gap opens up. The colour changes are caused by the formation at different temperatures of thin films of oxide, called tempering colours (Table 5.4). Figure 7.25 Types of structural
fastener used on a vehicle body (Avdel Ltd ) Methods of joining 209 7.5.1 Avdelok system This is not a blind fastener, but has a number of advantages over the conventional rivet or nut and bolt which it replaces. Deep cracks appear in the resin and the colour changes from a green to a mauve purple and hot to the touch. 4 Apply for assessment and
certification to the British Standards Institution. Craft techniques and minor accident damage 403 Do not • Drop any SRS components. 2.3 Safety signs in the workshop It is a legal requirement that all safety signs in the workshop It is a legal requirement that all safety signs used in a bodyshop comply with BS 5378: Part 1. Disconnect the 592 Repair of Vehicle Bodies fluid hose and blow it out with compressed
air. 3 Provide appropriate health surveillance for employees where the risk assessment shows it to be necessary. Steering component inspection is as follows: 1 2 3 4 Tie rod assemblies. A brake is fitted to work in conjunction with the clutch and is of the drum-brake shoe-operated type. 8 Coil springs, torsion bars and shock absorbers. Alternatively,
oxygen enters the torch at a very much higher pressure than the fuel gas and sucks the fuel gas in through an injector which also mixes the two gases. Disadvantages are that the labour context is high and the quality of the moulding depends on the skill of the operators. For road vehicles wings are used to hold a vehicle on to the road, this can be
called downthrust or negative lift. With the advent of mass production and the development of the motor car, speed of production became an essential factor. Some of the causes of blistering are: 1 Moisture on the surface prior to painting 2 Excessive heat on article during service 3 Salts on surface prior to painting. Frederick Lanchester produced his
first car, a 10 hp model. To distinguish the connections still further, the oxygen regulators are red. Blushing appears mainly with lacquers and can usually be cured by overspraying with a mist coat of antiblush solvent. The simplest spraying/stoving unit, i.e. the combined spray
booth and oven, is capable of handling six to seven vehicles per working day of eight hours, providing it is kept in use over the lunch hour. Positioned between the two hand grips is a turnscrew threaded left and right hand for adjusting the blade to concave or convex positions to suit the user's requirements. Whilst mobile forced heaters are relatively
expensive to run, they are cheap to buy and flexible in use. Thus asymmetric points can be checked and repaired simultaneously. Examples include: 1 Underbonnet components 2 Mechanical applications 3 Bumpers, using elastomeric PBT for paint on-line 4 Body embellishment (wheel trims, handles, mirrors) 5 Lighting, headlamp reflectors. Duramix
will start to set within 50 seconds after it has been dispensed, so the body repairer should work quickly to apply the contouring plastic. Craft techniques and minor accident damage 397 Cutting aluminium, though it is soft, requires special care when cutting. The most common precursor is polyacrylonitrile (PAN); pitch and cellulose are
also used (Table 16.6). If a cylinder is leaking and on fire, and you suspect the valve is damaged, do not attempt to extinguish the fire yourself. However, hammers are available with the square end domed and the round end flat, or alternatively with both faces flat or both faces crowned. Stitch The wire feed motor starts and stops at intervals which
are set on the welding timer and pause timer. The majority of body repair shops have alignment and repair equipment capable of handling this type of repair. It pivots at one end to permit easy removal of the finished work. Hold-out The degree of imperviousness of a dried paint film. There are two sizes of pins: small (2 mm) which are normally used
for skin panel damage, and larger (2.5 mm) which are used for chassis legs or thicker-gauge metals. 17.19.3 Blushing Figure 17.74 Smaller bogies can be used with three-track rails Blushing is similar in appearance to blooming but without loss of gloss. When the tool is operated, either manually or automatically, the mandrel head is drawn into the
hollow rivet, expanding the end of the rivet which is on the blind side of the structure and at the same time pulling the material together. Both heat and wire speed parameters can be affected by the welding positions. Measurements should be taken on the damaged door, working from points that can be easily established on an undamaged door, and
the readings compared to determine whether the damaged door requires further attention. The condition where the sighting pins are not in line, while the gauge bars are still parallel (Figure 14.60b) indicates that the underbody members have moved to one side only (sway). From 1.00 mm to 3.2 mm: square edge preparation. There are several
commercial spraying systems available, where the glass fibre and resin are deposited simultaneously on the mould face. Head shield or face screen fitted with special coloured lenses is an absolute necessity, because an electrode arc produces a brilliant light and gives off invisible ultraviolet and infrared rays which are very dangerous to the eyes and
skin. 18 Why must a welder take into account the expansion and contraction of metal? An oxidizing flame used for Table 8.2 Copper-phosphorus brazing alloys BS 1845 ref. Copes well with light contamination. The pole is relatively narrow, like a telegraph pole of lamp post, so there is major penetration into the side of the car. Gottlieb Daimler also
produced a car. 2.8.13 Professional emergency services are summoned immediately by authorized persons in the event of a fire/disaster An authorized person is somebody who has the task of carrying out a specific job. These slabs are reheated prior to rolling in a computer-controlled continuous hot strip mill to a strip around twice the thickness
required for body panels. With the aid of a number of high-precision jigs, which have to be made by specialist tool and jig makers, construction of this first stage of the car takes approximately three weeks. 4.14 Safety glass More and more glass is being used on modern cars. The grinder must never be tilted so that only the edge of the disc contacts
the 364 Repair of Vehicle Bodies surface. Always apply skin cream after using waterless hand cleaner. Indirect damage found in the area surrounding the damage found in the area surrounding the damage which caused it. It is a versatile one-handed machine, and will cut away damaged metal, remove rust, grind down spot, MIG and gas welds, smooth infills and generally
grind down prepared surfaces. A wrench is a tool for twisting or holding bolt heads and nuts. A drain cock is situated at the base of the chamber to drain off accumulated impurities periodically. Hot rolling is followed by cold rolling, which imparts finish and temper in bringing the metal to the gauge required. 17 Explain the importance of the adaptive
self-setting timing control unit when welding high-strength steels. The engineering structures are designed for production, at a given date, at the • Allgemeiner Deutscher Automobil-Club e V (ADAC), motoring organisation - Germany Figure 1.24 Road
testing a prototype (Ford Motor Company Ltd ) The final stages are now being reached; mechanical specifications, trim levels, engine options, body styles and the feature lists are confirmed. When heating the panel to carry out a repair the temperature should not exceed 200 °C. It is a specific requirement of the COSHH Regulations that equipment is
maintained in efficient working order. To comply with HASAWA, COSHH and EPA Regulations it is essential to incorporate such items as purpose-built mixing rooms, dust extraction, fume extraction, funded in the first of the f
not contain any ferrite or iron. The front integral beams run longitudinally, as do chassis legs, thus allowing first improved access to the engine compartment, and second the production of stronger, simpler brackets. Some of these are also designed with a pre-filter to remove solid particles from the air passes (a) Figure 2.6 63 (a) Dust
mask (b) Dust mask in use (Racal Safety Ltd.) (b) 64 Repair of Vehicle Bodies through the chemical cartridge. Never 440 Repair of Vehicle Bodies through the chemical moving parts, as false readings will be obtained. A small lightweight filter can be fitted to the handle of the
spray gun as an additional safeguard in conditions where exceptional humidity exists. The nut runs freely on the bolt threads until contact is made with the locking elements, each of which has a predetermined area of contact. This film is thin, tenacious and invisible and is essentially a layer of chromium oxide formed by the chromium in the steel
combining with the oxygen in the atmosphere. This tends to darken the final effect, as light does not reflect too well from the flakes in this position (Figure 17.51). The current modern shapes are to allow the usage of thinner sheet steel which is lighter and of course cheaper. When installing these heaters, the general principle is for the heater to be
angled down at about 45 degrees when wall mounted and up to 90 degrees when mounted overhead. All these activities should take place in a building. rev/min RH RHD radius reference revolutions per minute right-hand drive $\to$ SAE cm2 in 2 std second (angle) Society of Automobile Engineers square centimetres square inches standard
TIG tungsten inert gas (welding) VIN VOCs V vehicle identification number volatile organic compounds volt xxxi This Page is Intentionally Left Blank 1 The history, development and construction of the car body 1.1 Development of the motor car body 1.1.1 Brief history, development and construction of the car body 1.1.1 Brief history, development and construction of the car body 1.1.1 Brief history.
similar in design to horse-drawn carriages, were made almost entirely of wood. The speed of travel should be such that a continuous penetrating bead of electrode is deposited. 15.6.12 Further reading One thing that any person working in a bodyshop must always bear in mind is that ignorance is no excuse in the eyes of the
law. The following is an example of where a service manager colleague came to the rescue. The D-post and rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section is integral with the rear wheel arch and can include a rear quarter section in the rear wheel ar
and feeds it through a torch to the arc. 6 After extensive wheeling on an aluminium body panel, the metal becomes work hardened. Care should be taken not to allow the faces of the mallet to become damaged when in use. When cooled they again become hard and will assume any shape into which they were moulded when soft. Toughened glass is
produced by the process of heating a solid piece of glass and then rapidly cooling it so that its liability to fracture is greatly reduced and its strength increased to about six times that of untreated glass. Alternatively the top is joined to the rear quarter panel by another smaller panel which is part of the roof assembly. Spray up beside the window of the
tailgate; if unprotected this is particularly vulnerable to rust. This tool provides the user with clear visibility of the cutting line, allowing an accurate cut. In the single-sided spot welding process the operator manually forces the single electrode against the panel, with the electrical circuit being completed by an earth clamp and the cable back to the
transformer. On no account must wire or a nail be used, for this can distort the holes and permanently damage the air cap, resulting in a distorted spray pattern. The wheel arches must be done carefully (Figure 17.66). If in wood it is tooled and sanded to perfection, and if in metal it is panel beaten with the greatest possible skill, then ground and
polished if necessary. These two groups can each be subdivided in two further ways: Visible damage to the bumper, grille, bonnet and front wings. Often requires heating to achieve acceptable production times. The
metal may then be quenched in water or allowed to cool out slowly in air. Owing to the small size of the wire and Gas shielded arc welding comparatively high currents used for welding, the wire melts off very rapidly. Carbon Fibre is produced by the controlled oxidation, carbonization and graphitization of carbon-rich organic materials -
referred to as precursors - which are in fibre form. Gases, powders and chemical vapours are all types of hazardous elements to which fume extraction can be applied. The tungsten electrode is set inside the argon shield to ensure that fusion takes place in a completely shrouded atmosphere. The rubber weather seals used are either mastic sealed,
dry glazed, self-sealing or push fit (Figure 14.105). Figure 13.60 shows a twin-linked aperture restraint holding the door opening in shape while pulling or pushing takes place, so that the door aperture does not go out of alignment as the repairs are carried out. A specially designed tool is used to insert the filler strip into its channel. 39 How are
material costs established on an estimate? 3 What is the level of exposure? Comfort improved tremendously with the use of latex foam rubber together with coil springs in the seating, instead of the original plain springing. Avoid getting solvent on your overalls as this can lead to skin irritation, be especially careful not to put solvent soaked or oily rags
in your overall pockets. 1 Never approach or attempt to move cylinders. This would reduce absorption of the finishing coats by the surfacer and promote a high gloss. Honeycomb Honeycomb are made from a variety of materials, including extruded thermoplastic - ABS, polycarbonate, polypropylene and polyethylene - bonded paper, aluminium alloy
and for fire resistant parts, Nomex. The property of malleability is used to advantage in the manufacture of mild steel sheets, which are rolled to a given size and gauge for the motor industry. 3 Within the storage area oxygen should be stored at least 3 m from fuel gas supply. Blind rivets, as their name implies are rivets which can be set when access
is limited to only one side of a structure. Care should be taken not to overlap the colour on to unflatted enamel. 12.5.2 Welding torch Various types of torches are available to suit the different applications, a standard machine screw
can be substituted if necessary. Consequently planishing using hand dolly and hammer is accepted universally as the best technique in the repair of panel surfaces by planishing and smoothing any raw edges. When they are widely spaced it is open coated. Alternatively,
to recirculate the purified air, an electrostatic unit can be employed to eliminate harmful particles and utilize existing preheated air. Run engine to aid drying (Figure 14.131). Faster drying times are obtained at almost every stage of the job, with the result that vehicles are refinished much more quickly than when using air-drying materials. First
the same specified properties are achieved. 2 Interior trim which is difficult to clean and repair, especially tears and gashes. This allows for capillary attraction of the solder (Figure 8.4). The smaller pressure vessels can be carried in the operator's free hand (Figure 17.14), but ones from 10 litres capacity upward can be mounted on wheels for easy
cutting action of the blades. The nozzle is held at an angle of about 20 degrees and is run along the crack without applying any pressure. The readings take several seconds to change, as the material changes colour with the change in temperature to indicate the temperature. The symbol or text used must be white and placed centrally on the
background. It consists of a blade (Figure 6.6) which is usually marked in English This is a flat square made of hardened and tempered tool steel. When joining thin sheets, improved characteristics can be obtained if the hole is plunged or extruded (Figure 7.35). Figure 3.36 Straight and offset ring spanners (Facom Tools Ltd ) Combination spanner
Caution: do not slam the vehicle's doors with the windows fully closed until the screen is fully cured. Stopper Stopper is a putty-like substance certificate is provided by the insurance company for the vehicle owner to sign when he has
seen that all the agreed repairs have been completed satisfactorily, and the damaged parts reinstated to their original condition. 157 Plastic coated laminated glass which has soft elastic polyurethane films bonded on to the inner surface to provide improved passenger protection if fragmentation occurs. Supercut
blades are 8 tpi (teeth per inch) generalpurpose standard blades. Different types of wax coatings are available, some classed as penetrants and others as heavy-duty coatings. A reduced open-circuit voltage will produce a shorter arc length. There are many different types of stake available, and those most commonly used are as follows (Figure 3.28):
Pipe stake consists of one or two cylindrical arms having different diameters. Its function is to satisfy the needs of all the departments within the organization, and also both trade and retail customers when necessary. In the case of the older vehicle where new panels are not available or where the vehicle's age or condition make it uneconomical to fit
new panels, the method of fabricating or patching these areas, by cutting out and replacing the sections from flat sheets fabricated by hand, is adopted. Volumetric - A sensor inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure if something moves inside the car which senses movement or changes in pressure in the car which senses movement or changes in pressure in the car which senses movement or changes in pressure in the car which senses movement or changes in the car 
application for both ferrous and non-ferrous metals. Oddly however, the new vehicles are not lighter in weight; this is because of the addition of electrical body controls such as electric windows and seats. These modular blocks can be moved both vertically and horizontally to obtain unlimited positions. In some cases, instead of using a sandbag for the
shaping to be carried out on, a hollowed-out recess in a wood block can be used. Tilting will give an uneven spray pattern resulting in lines across the work (Figure 17.28). Fuse A fuse is a breakable link in a circuit. Most mechanics are only likely to encounter such problems every few years, but the professional is the person who can save the day. In
some cases the entire panels are inner construction on one make of car and a combination of inner and outer on another. The square head prevents rolling and provides a larger face for striking with the hammer, while the cupped and bevelled point limits skidding off the nail head. The Chobert rivet is made in a wide range of materials and sizes
3.23.8 Rotex sander This tool (Figure 3.61) can be used as a fine sanding random orbital machine or as a rough sanding machine; in the latter mode it can also be used as a polisher. 171 The following safety precautions should be observed when working with guillotines: 1 Keep the blades of the machines sharp. In repairing the high crowned radius of
a wing you will have to use a dolly block with a high-crowned radius (Figure 13.34). Strength is built into the floor by the transmission tunnel acting like an inverted channel section. An important feature of this equipment is the incorporation of a sensitivity control which enables the operator to check a wide range of fitments. If the file digs in, too
much pressure is being applied and hence a need for reduction is essential. 4 Raise the lower bending blade to a position that will produce the desired angle of bend. It's a little more challenging, especially if it's powered or heated. Resin and curing agents should be stored away from the working area in a cool place, observing the necessary
precautions for flammable liquids and keeping in mind the special hazards associated with organic peroxides. This not only speeds up the wheeling but prevents to a large extent marking the surface of the panel with wheel tracks, which are really the evidence of an overstretched panel (Figure 13.11). High-carbon steels possess a high degree of
tenacity, evidence of which can be seen in the steel cables used to lift heavy loads. Before deciding whether it is possible to repair a particular panel or not (this fact is influenced by the equipment which is available), and also whether it will be cheaper to
repair or replace any one section. The layers of atoms slide like playing cards in a pack, and in doing so are changing shape in a ductile way. Where two different materials are used they are referred to as composites. 9.11 Gas cutting The oxy-acetylene process is widely used to cut metal, especially in the body building industry where heavy sections.
have to be cut to special shapes for construction, and also in the repair side of the industry where special nozzles have been developed for cutting away damaged parts of sheet metal body sections. 50 Explain the importance of the use of scale models in vehicle design. This contact should be heard as a ringing noise if successful planishing is to be
achieved. 8 Explain the use of a blind rivet nut. The normal method of joining HSS and AHSS panels is by spot welding. 6 Collect information. The warm air will allow the panel to return to its original shape. The washer allows the stud to be positively and securely located prior to and away from the final assembly point. Why are they necessary for
inclusion in colour mixing schemes? No spraying to be done outside spray booth Air-fed respirators must be worn (i) when ever isocyanates are present or (ii) when zinc or strontium chromate containing primers are used and the ventilation in the spray enclosure is inadequate for the particular job Gloves Goggles or visor Conclusions: Cartridge mask
used but in poor condition Conclusions: Spraying in open workshop Poor extraction As above 520 Repair of Vehicle Bodies 15.1 Bodyshop planning Figure 15.13 COSHH assessment record (Akzo coatings PLC) 521 522 Repair of Vehicle Bodies 15.6 Environment Protection Act 1990, like the Health and
Safety at Work Act, allows the Secretary of State to introduce Regulations to control, amongst other things, the release of harmful substances to air, water and land. Craft techniques and minor accident damage 399 Diode This is a one-way valve for the flow of electrical current; zener diodes only allow electricity to flow when the voltage exceeds a set
figure. It is your duty in the eyes of the law to know about the regulations which affect you; in practice you will learn them as you learn your trade. The mechanical parts of a motor vehicle are also subject to some form of heat treatment, and in the constructional field heat-treatable aluminium alloys are being used extensively in commercial body
work. Research for the ideal shape is done on reduced-scale models from the same manufacturer may differ in how they mount. Slots in the extension arms permit the movement of the front gauge away from the bed to accommodate the larger sheets. Curing The change of a binder from soluble fusible state to
insoluble infusible state by chemical action. At this point, even though the heating is continued, the temperature of the steel will first remain constant for a short period and then continue to rise at a slower rate until it reaches 775 °C. Reception staff play a very important part by instilling confidence into customers through their courteous approach
and knowledge of vehicle repair. 4 Dangerous occurrence - if an explosion or other dangerous occurrence happens, this must be reported to the HSE, it does not need to involve a personal injury. They are aimed mainly at improving health and safety management, and can be seen as a way of making more explicit what is required of employers under
the HSW Act. The latter is made in strips which are rolled and pinned in position. 26 Define what is meant by the term 'non-ferrous metal'. Metal dip transfer is the most suitable mode of metal transfer for welding on car repairs, as it offers good bead control and low heat input, thus cutting down distortion when welding in panel sections. The paint is
heated to a temperature of 70-80 °C, and one coat will be sufficient to give the required film thickness. Welding operation. Before commencing work make sure that the appropriate tools and other materials are close to the job and
within easy reach, thus avoiding a delay during working operations. The fluid in the system is under pressure and should be removed before disconnecting any parts. A basic socket ratchet set consists of a ratchet, bar extensions, a universal joint and a set of sockets (Figure 3.39). Should this come about, damaged areas could be removed and
replaced with a new section which is already coloured to match the rest of the car. As an example, vehicle body engineers used to use a wooden buck of an engine to help them to design the body work, and see if it could be fitted to and removed from the initial body design. A combination of all these distortions contributes to the general spot-weld
appearance, which is virtually unacceptable on a consumer product. Second, this coating of silica combines with the flux used in bronze welding process. 37 Explain how the airbag system works in a vehicle. 11 Pressure
wash and rinse bodywork, grilles, tyres, mudflaps. The need to apply excessive pressure to the pump handle indicates that the ram has reached the limit of its movement. 11 Describe how a patch mould can be used during the repair to damage of a GRP laminate. To compensate, the welder must either select an electrode made from materials that will
alter the thermal resistance factor, or vary the geometry of the electrode tip, or use pulse equipment. Layers of resin and glass fibres are added until the required thickness is achieved. 8 What are the purposes of forming angles and flanges along the edges of sheet metal panels? Molybdenum Increased hardness and strength at high temperatures.
Take strips of masking tape and attach them across the join between the body and the screen. Ideal for pulling out large dints by using a slide hammer with a special hook attachment which fits through the rings, which are later broken off by twisting. The floor pan is manufactured from isophthalic polyester 16.8 Body production in reinforced
composite plastic (Lotus) At present composite reinforced plastic finds its use in road transport applications, where in some cases complete cabs and bodies are manufactured using the material. This ensures that the strongest part of the vehicle is securely anchored to the jig bed and that it remains so throughout realignment and repair. A range of
highstrength formable steels with good welding and Summary of material grades, chemical compositions and types of steel available: BS 1449: Part 1: 1983 Chemical composition Material grade Rolled condition (see Table 4.1) C min. Even though most car refinishing paints are nowadays formulated to provide a good gloss from the gun, the final
appearance of the vehicle can be further enhanced by careful burnishing and polishing. This method is generally called puckering, and after being made each pucker must be eliminated by careful blows to drive the metal into itself, so thickening the work at the edges. Impact test, the Charpy V notch and there are two main types of impact test, the Charpy V notch and there are two main types of impact test.
Izod test. 6 Should stopping up be necessary, this should be done after the first ground coat which should, of course, be allowed to through-dry completely. The first is the method of combustion testing, where a small strip of material is held in a butane flame and the flame colour is noted. 4.13.3 Identification markings Many manufacturers now mark
their products with a code which will enable the identification of the type of plastics used. Punched holes also have ragged edges which must be smoothed, otherwise they will decrease the shearing resistance of the rivets. In collision repair, the welding position is usually dictated by the location of the weld in the structure or panel assembly of the
vehicle. Figure 13.56 Stretching with body jack (Blackhawk Automotive Ltd.) Another combination, which is less popular in use, is clamping (Figure 13.57). The thinner the metal can be rolled or hammered into sheet without fracture, the more malleable
is the metal. Among the methods of production, the most used method is that of contact moulding, or the wet laying-up technique as it is sometimes called. A good plan gives a flow of work (flowline system) and eliminates any possibility of bottleneck problems. Much greater advantage may be taken of puckering in aluminium alloy sheet than in most
metals because of its malleability and ductility. The problem is usually avoided by careful selection of the weld metal composition. The AC transformer, as its name implies, is an instrument which transformer or steps down the voltage of the normal mains electrical supply to a voltage suitable for welding between 60 and 100 volts (Figure 11.3). Wet flat
stopper with 320 wet-or-dry paper. However, if the damaged area is not extensive and the paintwork on the rest of the wing is in sound condition, the work can be carried out, without the use of paint remover, by rubbing down the area. Tensile test This test can be used to assess the yield point, ultimate tensile strength and elongation percentage of
the weld specimen. \ge \diamondsuit (\ge) Nm dB(A) Lep,d Lep,w no. data sheet for the particular vehicle (Figure 14.43). It is better to achieve load transfer by adhesion rather than by mechanical interlocking; mechanical methods are satisfactory, however, if only small loads are involved. Normally used for dip transfer only Low heat input, stable arc. With its own
integral keyhole slot feature, it can be attached to the trim panel either with a suitable adhesive or by heat staking. Welding under these conditions will normally produce adhesion defects owing to the lack of fusion. Vehicle body panels consist of flat or slightly curved areas, sometimes quite Figure 13.28 Change in grain structure during pressing
(Sykes-Pickavant Ltd) Figure 13.29 Prepressed wing panel large and elastic in nature (low crowns), such as door panels; these are held in position by stiffened, rigid sharp bends and swages which are non-elastic in nature (low crowns), such as the cant of roof panels (see Figure 13.29). 3 Non-synthetic overalls with buttons at neck and wrist, or
similar clothing, should be worn. 10 Identify the harm that could arise from hazards. For manual metal arc welding, mixtures 307 generally similar to those used for gas welding are supplied as the coating from chipping and also help to stabilize the arc. By careful study of the
damage sustained it should be possible to ascertain the direction and strength of the impact force, and this is always the preliminary stage of a detailed assessment. The backbone chassis extends rearwards from the front bulk- doors and B-posts. The face screen provides adequate protection but needs holding by hand. If the flame is moved forwards from the front bulk- doors and B-posts. The face screen provides adequate protection but needs holding by hand. If the flame is moved forwards from the front bulk- doors and B-posts.
too rapidly, the heat fails to penetrate far enough and the metal does not melt properly, but if the torch is kept in one position too long the flame will burn a hole through the metal. Allow the air to flow for a few seconds. Sanding machines available include types which are dual acting: that is, they can be set to either rotary or orbital (eccentric)
actions (see Figures 17.46 and 17.47). This bar is used to cut a number of pieces of the same length by the adjustment that is allowed on the rods. When hot shrinking, the mallet is the tool to achieve a most successful shrink because a normal planishing hammer would tend to stretch the metal rather than shrink it. This can be a problem to the
painter, as work can be subject to uneven build and runs and sags can occur in spite of gun adjustments. The shielding gas used is normally pure argon. Round-bottom stake consists of a single vertical piece with a flat round head on top. Most fire extinguishers tend to both starve the fire of oxygen and lower the temperature of the fire so that it goes
out. As there is no dependency upon platen size and press tonnage - an obvious limitation of other processes - there are no panel size Reinforced composite materials 547 limitations. By reactuating the switch, welding stops when the switch is released. 25 Name three types of spanner that could be used by a body repair worker. Some incorporate
pantograph or electronic devices, enabling profiles to be accurately copied from templates or direct from drawings. 330 Repair of Vehicle Bodies line and gas shielding effect. Such joins are termed open butt joint. Antifreeze spilled on paintwork will soften the paint surface and cause discoloration, so it too must be wiped off immediately with
absorbent paper roll or towel and washed down if needed. Carbon fibre can be recognized by its graphite grey colour. First start by obtaining as much information as possible from the customer as to when, where and how the leak occurs, and also whether the water appears to be clean or dirty. Repairs can be carried out on flexible plastic bumper
bars, semi-rigid plastic panels, ABS plastic grilles, polycarbonate bumper bars, and thermoplastic bumper bars alloys, copper, nickel, stainless steel and also for MIG
brazing. 7 Draw a sketch of a vehicle body shell and name all the major body panels. The main point to consider when deciding which process to use is the condition of the existing finish allied to the
extent of damage in the case of a local repair. Cobalt Increased hardness, especially at high temperatures. Machines are made in all sizes: bench rollers for light tin plate work, hand powered rollers for general sheet metal, and motor driven rollers for light tin plate work, hand powered rollers for light tin plate work, hand powered rollers for general sheet metal, and motor driven rollers for light tin plate work, hand powered rollers for light tin plate work, hand powered rollers for light tin plate work, hand powered rollers for general sheet metal, and motor driven rollers for light tin plate work, hand powered rollers for light tin plate work, hand powered rollers for light tin plate work and in all sizes: bench rollers for light tin plate work and in all sizes in a size of a local repair.
and its thickness. Free flight transfer In this metal transfer a continuous arc is maintained between the electrode and the workpiece and 
the joint. MIG: aluminium and copper TIG: austenitic stainless steel, some copper nickel alloys MAG: plain carbon and low-alloy steels Stable arc performance. Even 6.8 mm thick glasses will have slight variations of curvature. 6.2.21 Imperial standard wire gauges A wire gauge (Figure 6.16) can either be oblong or circular in shape. The actual
bending of the metal is done by swinging up the front part of the bed which carries the bottom blade on a hinged centre with the top blade. Wing punch (Figure 3.18b) is a hole punch with a specially designed head which allows it to be used on wing panels and channel sections and also fit over roof gutters and wheel arches. Portable heaters come in
a variety of sizes and types, from electric fan heaters and propane gas to forced air space heaters using gas, oil or paraffin, and even mobile IR quartz heaters. The rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) provides the shut face for the rear standing pillar or D-post (18) pillar or D-po
quarters. Body damage and alignment should, wherever possible, be corrected at the same time as any underbody damage. 2 Dust or fumes are generated during use. 9 State two advantages of Dozer equipment when used in repair. The alignment methods are based on comparative measurements in which one distance is compared, by means of a
trammel, tram-track gauge or measuring equipment incorporated in an alignment measuring system (such as in Figure 16.39 Applying chopped strand mat 9 Impregnate each layer with resin, and roll with a split washer roller to pack down the fibre glass and resin (Figure
16.40). The length of each horizontal stroke is 450-900 mm approximately, or whatever the sprayer can manage comfortably. The legislation is wide in scope, with the long-term aim of minimizing environment pollution. High-alloy steel may be defined as a steel having enhanced properties owing to the presence of one or more special elements or a
larger proportion of element than is normally present in carbon steel. 5 Give adequate information, instruction and training. The panel steel is then at its best condition to be hammered down, thus reducing the surface area and so making shrinking possible (Figure 13.41). This brought about the development of the closed cars or saloons as we know
them today. Celette jig lifts The jig lifts The jig lifts (Figure 14.16) are of wheel-free design which enables rapid loading and anchoring of damaged vehicles. This stricter standard requires that a new vehicle must pass a full-scale crash test designed to simulate a collision at an intersection in which a car travelling at 15 mile/h is hit in the side by another car
travelling at 30 mile/h. Increasingly aggressive environmental influences tend to shorten the life of the car, whereas ever more specialized steel sheets are being incorporated into vehicle construction in the battle against corrosion. A converter liquid is available from most manufacturers of low-bake paints which can be added to the enamel for
showing side loading doors and track, and housing IRT arch (Spraybake Ltd ) Figure 17.58 Corner installation showing two low-bake units, height 2.5 m (Spraybake Ltd ) sprayed if the viscosity is reduced to 22 seconds with the appropriate thinner. 2
Windows and skylights (safe opening, closing and cleaning). These gauges are made in either fractional or decimal sizes, number sizes, or lettered sizes, or lettered sizes, or lettered sizes, number sizes, or lettered sizes. This conforms to the British Standard specification. Welding earth A length of cable which is flexible and connects the work to the plant. 540 Repair of Vehicle Bodies Figure 16.12 Production of
unsaturated polyester resin (Scott Bader Co. Ltd.) Polyester resins are formulated by the reaction of organic acids and alcohols which produces a class of material called esters. 45/52.5/2.5 solder, known as tinman's soft, is cheaper because of the higher lead content, but has poorer wetting and mechanical properties. 21 Explain the form in which theaper because of the higher lead content, but has poorer wetting and mechanical properties.
electrode is manufactured for MIG/MAG welding. 2 Paint preparation bays should be 6 metres. Various types of foam rubber have been evolved to suit the different parts of the car seating, and the designer's choice of material is governed by cost, comfort, durability, the type of base, the type of car, and whether it is a cushion or a squab, a
rear or front seat. Apply cellulose stopper where necessary. Transistor This term covers a number of different solid state devices, including diodes. Pinch rolls are used for rolling all types of thin gauge sheet metal up to 2.00 mm. The harmful effect of liquids, chemicals and materials on the hands can be prevented, in many cases, by wearing the
correct type of gloves. The advantage of quenching is that the surface of the metal is cleaned of dirt and scale. They are supplied as surface finishing pastes, liquid wax or wax polishes. The main idea of straightening underbody damage is to exert force in the reverse direction from that of the collision impact. As soon as tension is applied to the chain
safety wires must be fitted in case the clamp or chain tears away from the main structure of the spanner, so that it fits around a nut and a bolt head of equal size. The entire system stays in place while repairs are being made. Material is supplied in the annealed (soft condition) and in at least
three degrees of hardness, H1, H2 and H3 (in ascending order of hardness). This offers quick and easy mounting on to cross-beams and allows the possibility of checking and anchoring up to 22 points on the underbody of a vehicle (4 anchorage and 18 mini brackets). Chemical etching Some materials require chemical treatment to ensure optimum
performance. Polyurethane and silicone materials are usually supplied as a pumpable tape. In the first type, the two gases enter the torch or in the nozzle. When the wire speed is reduced, the current intensity is diminished, at the same
time increasing the length of the arc. Chassis The base frame of a motor vehicle of composite construction to which the body is attached. 15.6.7 Provision and use of Work Equipment Regulations 1992 These regulations whatever
the industry. Toxic gases may be given off when cutting, especially if zinc or cadmium coated steels are involved. 34 Which material should not be used for axle stand pins? This is the threshold temperature for the aluminium. Ignoring this precaution could lead to contact with high DC voltage. In addition to this the lifting unit assists the mounting
the vehicle. Figure 16.29 Front nose attached to main tub of Mercedes Mchaven SLR with aluminium frame Curing The resin, whether it is by wet lay-up or pre-preg needs time and heat to dry it out and make it hard. Closed saloon-type body. The specific strength weight ratio) of glass-polyester laminates is high, but rigidity tends to
be on the low side. The frame can be bolted down after calibration. This reduces the risk of accidental damage on site and ensures a more efficient workflow since the bodyshop personnel know exactly where to collect the next vehicle requiring attention or repair. A clean, dry lambswool mop is recommended for best results. Not all metals can be
projection welded. During this operation, interchangeable tough nylon pads prevent damage to the screwdriver is determined by the width or diameter of the blade and the length of the shank. This ensures that the steering wheel spokes
are horizontal when the car is travelling straight ahead (Figure 14.94). Thus the cutting of iron and steel merely involves the direction of a closely regulated jet or stream of pure oxygen on to an area that has been previously heated to ignition temperature (1600 °C, or when the metal has reached a bright cherry-red colour). The wire from the feed
rolls is fed along a carefully designed conduit system which also carries the welding current and shielding gas. Hence special care must be taken in preparing the metal surfaces to be joined with silver solder. 12 Final bodyshop check for quality control of completed work, prior to returning vehicle to customer. Safety committee's main objectives 1 To
ensure that the company's premises outside and inside are safe and healthy. However, the quality of the modern sheet metal is such that many forming operations, such as deep drawing and pressing, may be carried out without the need for an application of heat. Direct side damage is caused when the vehicle is struck at an angle to its side, causing
substantial damage at the point of contact. A good assessment will not only show whether there is a problem but will also point to where the problem lies. Check that the gas nozzle and electrode of the torch are not damaged, and set the electrode distance as required for the selected electrode type using the nozzle tool. 9 What is the most common
form of vehicle body construction? When considering the foams available, it is apparent that the number of permutations is large. The resultant weave is symmetrical with good stability and reasonable porosity. Modern equipment has been made necessary by the chassisless construction of modern mass produced cars and vans, which require careful
alignment of the complete structure following any serious impact in addition to panel damage rectification. Spray foam extinguishers expel an AFFF solution in an atomized form which is suitable for use on class A and class B fires. First rough out the damage but do not remove any panels unless it is necessary. Remember that blunt blades drag the
metal and can cause the loss of a finger. With the fuse removed the machine cannot be restarted if the isolator is accidentally turned on by a colleague who confuses the isolator for the one on an adjacent machine. Unscrew the pressure regulating screws on the oxygen and acetylene regulators. Brazing method When the cleaned parts have been
assembled, brazing flux is applied evenly over the joint surface of both parts to be brazed and the filler rod (brazing alloy). 17 State the procedure to be followed in order to mount a vehicle on a bracket-type jig system. Before glazing can be Major accident damage 469 Figure 14.109 Electric windscreen cutter (Fein/George Marshall (Power Tools) Ltd
) Figure 14.108 Removing direct glazing using a piano wire replaced, the bonding surfaces must be prepared correctly. It was Lionel Martin, with Robert Bamford, who began the Aston Martin story in 1913, and he achieved a great reputation for the standard of finish of his cars and for his infinite attention to detail. Since the development of the
carbon dioxide process it has become widely used for the welding of plain carbon steels. It would be necessary to reinforce the undamaged pillar with suitable packing material. Most vehicle batteries are 12 volts. 1.5.5 A-post assembly This is an integral part of
the body side frame. 80 Repair of Vehicle Bodies 7 If a wound is bleeding heavily, apply pressure to the wound with a clean bandage to reduce the loss of blood. High-tensile steels are used for bolts and nuts which will be subjected to a heavy load. The windscreen can then be removed from the body opening. 7.2.4 Riveting procedure Plates to be
riveted should be clamped together with their rivet holes in alignment. The most common form of protective clothing for the body repairer is the overall a one-piece boiler suit made from good quality cotton, preferably flame-proof. The gun is two stage: the first pressure delivers just air, and the second delivers both air and material. When using
epoxy-based systems, abrade lightly with abrasive discs, belts or cloths, or use mediumgrit emery paper. The front of the glasses or eyepieces can become obscured by welding spatter adhering to them. The support cross tube with reinforcing pipe is slid through the bosses in the body anchor clamps, thus providing a rigid thrust point for the rear
anchor post (Figure 14.5). When the ratio between the voltage and the wire speed is correct, a highly characteristic hiss or hum will be heard from the arc. For thicknesses between 3.2 mm and 4.8 mm an 80° bevel is used, leaving a small gap at the bottom edges. Striking the arc may be accomplished in one of the following ways: 1 Using an
apparatus which will cause a spark to jump from the electrode to the work (arc stabilizer AC equipment); or 2 By means of an apparatus that starts and maintains a small pilot arc which provides a path for the main arc. Newsletters supplement published data, providing information for immediate action within the vehicle repair industry. It is excellent
for absorbing energy during impact. The heat and pressure involved in the welding process changes the microstructure of the metal, so great care is needed in this process. In the correct circumstances, satisfactory bonds can be made on many metallic and non-metallic materials. Standard pattern curved or bent snips are designed for cutting circular
outlines and inside circles or curved shapes, as the actual cutting blades themselves are curved. During the 1930s most of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the complete construction of the large companies who manufactured motor vehicles adopted the use of metal for the large companies who manufactured motor vehicles adopted the use of metal for t
allowance for any particular sheet, and this depends mainly upon the thickness of the metal being cut and its physical properties. The KPI will reduce the need for large camber angles, and therefore reduce the tyre wear by allowing the wheel to be near vertical. 3.17.1 Spanners or wrenches A complete collection of spanners or wrenches is
indispensable for the body repair worker. The bond between the panels becomes stronger as the pitch is shortened, but if the pitch becomes too small and the spot weld (Figure 10.15). Changing the flat blank to the cup
is called the drawing operation. See Figure 14.142. These dollies, together with the planishing finish down to the metal tools for the painting are open to the painter: (a) completely strip the existing finish down to the metal
substrate, or (b) prepare the surface by rubbing down with abra- sives. Light pressure is kept on the pivot leg with one hand while the other hand describes the arc with the other leg. The subdividing of risks can starve a fire, prevent large losses and enable portable extinguishers to retain control; for example, part of a building may be demolished to
provide a fire stop. Keep the white cone just clear of the work surface, and ensure that the cut is penetrating the surface. Dashboards and some flexible bumper assemblies which are made from thermoplastics can be welded. The best procedure is a corner integral with the structure, with no joints. The non-rusting qualities of the aluminium group are
well known and are another reason for their use in bodywork. However, care should be taken to ensure that welding conditions are comparable with the material used: for example, higher weld current ratings may be necessary on the heavier coatings. First, the height of the critical points on the vehicle's underside were controlled relative to an
imaginary datum line, and so height became of vital importance. When the joint has been heated just above the temperature at which the silver solder flows, the flame should be moved away and the solder applied to the joint, usually in rod form. This type of transfer will also permit the welding of thinner gauges of sheet steel, and is practical for
welding in all positions. 12.3 TIG welding 12.3.1 Principles of operation The necessary heat for this process (Figures 12.3 and 12.4) is produced by an electric arc maintained between a non-consumable electrode and the surface of the metal to be welded. First check with the local authority, who will require information about your operation such as: 1
Who and where you are 2 What you do it 3 What is released to air, how much, and wherefrom 4 What you do to prevent, control and monitor such releases 5 Evidence or proposals that the objectives of BATNEEC will be met. These pimples represent stretched metal, but in being formed also raise the surrounding metal. Many other
organizations give preferential treatment to suppliers who show a visible commitment to quality by pursuing this British Standard, BS EN ISO 9001-2000. They were attempting to improve body weight by the introduction of high-strength steels and vehicle safety by incorporating strong passenger compartments with front and back and crumple zones
to absorb impact on collision. Characteristics: no smell. The quartz-halogen lamp is able to produce a more powerful beam because the filament can be made hotter without shortening its lifespan. Always wipe away any surplus anti-corrosion fluid as you go. 13 Craft techniques and minor accident damage 13.1 Panel beating: forming panels by hand
Essentially, panel beating is a hand method of producing hollow or double-curvature shapes by means of hammering. The torch head should be held at right angles to the work (Figure 9.32). CODE PLATE DESCRIPTION The plate shown model code, engine model, transmission model and colour code. The strength is triggered by work hardening by
the stress induced during the stamping or forming process. This provides uniformity of impact, irrespective of the model, and provides data based on constant factors, thus making model damage comparison more meaningful. The size of Figure 5.16 Wheeling machine (Frost Auto Restoration Techniques Ltd.) 176 Repair of Vehicle Bodies Figure 5.17
Range of wheeling machines (Frost Auto Restoration Techniques Ltd.) the gap in this frame usually determines the machine's specifications, which are from 0.75 m to 1 m in width and about 0.6 m in depth; the wheel diameters are approximately 90 mm. 1.3.3 Semi-integral methods of construction In some forms of integral or mono assemblies, the
entire front end or subframe forward of the bulkhead is joined to the cowl assembly with bolts. Frequently, a combination of reinforcement materials is used. Aluminium panel repair is not difficult; it is just different to repairing steel ones. However, there will still be a place for the refinisher, as car owners will, in all probability, desire the occasional
colour change on their car. The Nutsert is placed on the threaded drive screw of the placing tool and inserted into a prepared hole in units to form a complete body, which has been preassembled in units to form a complete body, which has been preassembled in units to form a complete body shell (Figure 1.33). Hinges used on the modern vehicle can take a good deal of force without
altering their settings. This makes a secure metalto-wood joint which is ideal for panelling in the Methods of joining 215 Figure 7.43 Screw nail (European Industrial Services Ltd ) friction between the head of the bolt and the parent metal. Over the years, the value of Cd has been reduced roughly as follows: body shape, underbody contours and
projecting parts. Styrene, catalyst and acetone are particularly dangerous. In addition to marks to identify the manufacturer, the head is also marked with symbols to indicate the strength grade, e.g. 8.8; 10.9; 12.9; 14.9. As an alternative, some bolts and screws have the M and strength grade symbol on the flats of the hexagon (Rover Group Ltd ) The
following types of head are available onbolts: Hexagon head This is the most frequently used shaped, and it is suitable for all spanners. 28 What is the difference between baking and force-drying a paint film? As the glass flows out of the bushings under gravity it is attenuated at high speed. The estimates are produced using a system of bar coding
information from a collision repair estimating guide (CREG). First select a length of contouring plastic which will cover the entire repair area. J. The dust given off from the sander when using body solder is also injurious. However, if this sheet is bent to a short arc or radius it exceeds the limits of elasticity or flexibility; the metal in the bend becomes
stiff and will take on a permanent set and retain the curvature. It has many advantages, however, if carried out correctly: it will reduce water leaks, it suits modern car construction, it results in a load bearing glazing member, and it lends itself to robotic assembly in mass production. When the acids are polybasic and the alcohols are polyhydric they
can react to form a very complex ester which is generally known as polyester. 10 What are the alternatives to integral construction? If the limit values are exceeded a satisfactory weld cannot be obtained. The motoring press were impressed with its reliability. Even if welding can be made without removing such gaps, the welded area would become
smaller, resulting in insufficient strength. No special tools are required, as they assemble on the principle of a push-in rivet. 7 Should sanding down of the ground coats be necessary, allow to dry for at least 6 hours, and dry-sand using P400 lubricoat paper. The angle at which the electrode meets the plate being welded should be about 70°. These
sealers are recommended when carrying out a colour change over a colour which is suspected of being a bleeder, i.e. some of the pigment or dyestuff will float into the new coating and discolour it. Manufacturers of welding torches provide information regarding the size and rated gas consumption of tips for different thicknesses of metals and alloys.
The tool is capable of producing bends of up to 100° and will produce both channel and box sections. The edges of the skin are now hammered over the door frame using a hammer and dolly until the flange is folded over completely. In particular, rust attacks wings, sill panels, wheel arches, floors of luggage compartments and bottoms of doors, the
worst being the sills because of their close proximity to the road. Drinking water. The properties of sealers will obviously vary according to their type and to their application. There are three distinct phases in the curing reactions of the
proportions of oxygen and acetylene can be made at the welding torch, and three distinct types of flame are obtained (Figure 9.16) as follows. Hand apply with a pad of damp, good quality mutton cloth or equivalent, in straight even strokes. The edges are left square and separated by a distance equal to one-half the thickness of the sheet used.
Contamination of the hot tungsten by particles of molten metal causes immediate spattering of the electrode and particles of tungsten may, according to the degree of contamination, become embedded in the weld pool. Commence with one cord from the bottom righthand side of the windscreen, leaving about one foot-spare for pulling. Periodically,
the filler rod is lifted and the flame is used to sweep the liquid metal along the joint; but if the metal is run too quickly in this way it may begin to solidify before it properly diffuses into the mating surfaces. Welding characteristics are excellent. This can be done by attaching a base plate to the bottom Figure 13.52 Body jack combinations (Blackhawk
Automotive Ltd ) 376 Repair of Vehicle Bodies Figure 13.53 Pushing with body jack (Blackhawk Automotive Ltd ) end of the ram to spread or distribute the load, which can be spread over an even larger area by putting a piece of solid hardwood timber between the base plate and the pushing point. 13.6 Hammering techniques 13.6.1 Roughing out
damage Unlike most other trades, where the hammer is used with a follow-through action from a combination of wrist, elbow and shoulder, in the skilled hands of a body repair worker the planishing hammer swing is a rhythmic action involving finger and wrist movement, producing a ringing blow (Figure 13.30). 14.2.2 Korek body/frame
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straightening system Figure 14.4 Right-angled body anchor clamps (Blackhawk Automotive Ltd.) The system commences from a flat base area which is actually a high-tensile steel, box-section modular Major accident damage 409 Figure 14.5 Anchor clamps in position on body sills Figure 14.6 Self-tightening clamp attachments Figure 14.7 Dozer in
position frame with a slotted upper face. 24 Name a pneumatic tool which can be used for the removal of a damaged panel section. The windows may be operated by switches on either the centre consul or the inside door trim. This could result in a shakier movement of the gun and a loss of precision in following the joint. Products with a flashpoint
greater than 32 °C do not fall within the Regulations, but other Regulations require that products with a flashpoint up to 55 °C have a 'Flammable' warning. Alternatively, converting a purpose-built building might be considered, although it is
probably the most popular option. A PDI checklist for the particular vehicle is useful to do this job. Deep drawn panels are used for automobile front wings, rear quarter panels and instrument panels are used for automobile front wings, rear quarter panels and instrument panels. 13.11.2 Process of body soldering During the repairs of Body soldering During During the Repairs of Body soldering During During the Repai
is necessary when it cannot be restored by normal panel beating methods. This has led to the introduction of single-sided and double-sided coated galvanized steel, high-strength steel and aluminium. 3.15 Cutting tools 3.15.1 Hand snips These are used to a great extent in the fabrication or repair side of the panel beating trade, for cutting thin-gauge
mild steels and aluminium alloys. Relative density (RD) Relative density is the relationship which other materials have with this. 11.1 Principles of manual metal arc welding Manual metal arc welding with an oxy-acetylene
torch, you will have to practise a series of operations in a definite order. 15 Describe the purpose of a contact tip in a MIG/MAG welding torch. The main object of reading a drawing is to obtain a clear mental picture of what another person has represented on paper by means of a conventional arrangement of lines and symbols. Conversely, if you put
the same carrier bag in a freezer it would go stiff and make a crackling noise when you handle it. This is done by using the laser guide to deflect the light on scales on two undamaged measuring points under the vehicle, vertically adjusting the laser guide to deflect the light on scales on two undamaged measuring points under the vehicle, vertically adjusting the measuring rail and angling the laser guide (see Figure 14.32).
This process makes steels containing 0.3 per cent or more carbon extremely hard, but steels having a carbon content of less than 0.3 per cent cannot be hardening effect. III Super The III Super features five pushing-pulling towers and
multifunction robot arm, all operated by remote control electrohydraulics. The milling on the file blade tends to shrink the panel as well as leaving a regular rough patterned surface ideal for locating low spots on the panel under repair and for finishing with a body file. Neutral flame A balanced flame, indicating perfect combustion of both oxygen and
acetylene gases. That is a letter 'e' or 'CE' followed by a number which indicates the country of approval. The outer panel is either provided with an opening through which the outside door handle protrudes, or is recessed to give a more streamlined effect and so to create better aerodynamics. The shear is used extensively in the cutting of light
materials for the construction of new vehicles, but also plays an important role in the removal of damaged sections in crash repairs, as it leaves a nice neat cut and there is no risk of flame damage as with the more traditional methods of oxy-acetylene cutting. 31 Describe two ways of attaching a windscreen to a vehicle body. With brushes and hand
roller, the resin is drawn through the mat (Figure 16.17). On many vehicles the front door hinge pillar is also an integral part of the cowl. These may be useful in the event of legal proceedings. If a surface has oil or grease on it, remove these substances by heating the area to a bright red colour and thus burning them off. 4 A good quality tin-lead
solder. (a) (b) Figure 2.1 (a) Disposable protective coverall (b) protective coverall and face mask in use (Gramos Chemicals International Ltd ) Head protection is very important to the body worker while it is being repaired. Apart from providing a rest
for the front passengers' feet, it seals off the engine and gearbox from the body Figure 1.38 Espace high-rise car with galvanized skeletal steel body shell (Renault UK Ltd ) and connects the scuttle to the main floor. Each test has a 50-page operating manual. The scrap is in the form of a ribbon commonly called the 'skeleton'. The dolly should be
allowed to lie naturally in the hand with the face to be used uppermost and, as with the hammer, should be held firmly but not tightly. Can be speeded by warming/heating. It is advisable to work the lance into the desired position and to fog on the outward stroke. In some cases these high spots can be reduced by careful, controlled hammering which
spreads the force of the blow over the area of the metal, thus reducing the high spot. The first is a tungsten electrode intended for cutting with nitrogen or an argon/hydrogen mix. They are ground at one or both ends to a fine point which should be kept sharp and protected when not in use (see Figure 6.2). Plasma arc cutting will prove of benefit in a
modern body repair shop as an alternative cutting technique to speed up damaged panel removal and to complement traditional methods. The chosen electrode must be of a diameter which suits the current. The aluminium content makes them particularly easy to mix and apply. The recessing tool can be used on the edges of panels to
form a lip or joggled section so that one panel passes over the face of the other, forming a flush finish which is ideal for spot-weld connections and joints in panels. The temperature of the building should be controlled between 15 °C and 25 °C. It is used in conjunction with an air supply, which constantly blows on to the cutting area of the blade. Metal
forming processes and machines 4 Explain the following treatments that are associated with aluminium alloys: (a) solution treatment (b) age hardening (c) precipitation. The joint preparation may be significantly affected by the welding process, consumables and equipment which are available. When dried off, it is sprayed over with a heavy epoxy-type
primer surfacer and hand rubbed before a second similar coat is applied (Figure 13.20). However, it has the disadvantage that it fits the nut or bolt on two sides only; consequently there is a greater tendency for the open-ended spanner to slip off the bolt or nut, resulting in rounded nuts and injured hands. Backhand welding Sometimes classified as
'rightward welding'. The fluid cup is usually limited to 0.5 litre capacity, Automotive finishing and refinishing Figure 17.11 Typical suction-feed spray gun 1 2 3 4 5 6 Air cap Fluid inlet Fluid inlet Figure 17.12 Gravity-feed spray gun
(DeVilbiss Automotive Refinishing Products) which makes the gravity-feed gun unsuitable for the spraying of large areas. This will give you a matrix from 1 to 25 (Table 15.2). The rate at which cooling takes place depends on various factors such as the size of the work; the amount of weld metal and the speed at which it is deposited; the thermal
conductivity of the parent metal; and the melting point and specific heat of the weld metal. When a condition of misalignment exists that affects the bonnet opening, it will be necessary to X check the opening before deciding whether to move either the wings or the grille panel. Figure 10.2 Robot spot welder on an assembly line (Vauxhall Motors Ltd
Figure 10.4 Portable spot welding machine in use (SIP (Industrial Products) Ltd.) Electric resistance spot welding (Figure 10.5) is basically confined to making welds approximately 6 mm diameter between two or more overlapping sheet metal panels. Best results can be obtained by moving the flame in
a circular motion until the entire area is heated, insufficient time had been allowed for the mat to absorb the resin before rolling. The bare electrodes have The correct current setting in accordance with the size of electrode used is most important (Table 11.6). Readings are taken from the dummies inside the vehicles as well as the photographs of the
vehicle as it deforms under impact. Touch in stone chips. Tunnel A raised floor panel section for drivershaft clearance. Spray sufficient coats of primer surfacer or filler to bring the repaired area up to the level of the surrounding surface; use air pressure of 3 bars (45 psi). 17.7.1 Paint supply methods Suction-feed gun With this type, a stream of
compressed air creates a vacuum at the fluid tip which allows atmospheric pressure within the fluid cup to force the paint up the fluid tube to the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the glass of the alarm by the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the glass of the alarm by the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the alarm by breaking the fluid tip and air cap. In the event of discovering a fire raise the fluid tip and air cap. In the event of discovering the fluid tip and air cap. In the event of discovering the fluid tip air cap. In the event of discovering the fluid tip air cap. In the event of discovering the fluid tip air cap. In the event of discovering the fluid tip air cap. In the event of discovering the fluid tip air cap. In the event of discovering the fluid tip air cap. In the event of discovering the fluid tip air cap. In the event of discovering the fluid tip air cap. In the event of discovering the fluid tip air cap. In the event of discovering the fluid tip air cap. In the event of discovering the event of discovering the event of discovering the event of discovering the eve
weave is a form of satin weave with a different stagger in the repeat pattern. This in turn has demanded an increasing amount of repair equipment to augment the traditional hand tools and equipment of the body builder, panel beater and sheet metal worker. There are a wide range of sizes available in steel, aluminium or brass with thread sizes from
M4 to M10. 16 When referring to sheet metal snips, what do the terms 'right hand' and 'left hand' mean? It serves as a general purpose anvil for riveting and shaping round and flat surfaces, straight bending and corner seams. Any voltage over 50 V is potentially lethal. The transmitter is placed in a base plate which automatically switches it on via a
reed switch in the base of the transmitting body. Acetylene cylinders in a fire: key actions Refer to Figure 9.26. In addition there are 'fire buckets' full of sand, and 'fire blankets'. In major accident damage, removal and replacement of the windscreen is an essential feature of the repair. Its application to the design of a car body constitutes one of the
chief lines of the search for energy economy in motor vehicles. All have a bottom cutting blade which is flat and is fixed to a moving beam. 4 It can be used to repair parts that have to be rechromed. The most useful set of Phillips screwdrivers ranges from number
0 to number 4. 15 Bodyshop planning 15.1 Initial planning 15.1.1 Preplanning Setting up a bodyshop capable of carrying out repairs that will meet customers', insurance companies' and motor manufacturers' quality standards requires significant investment in time and money. Polyester primer/filler possesses exceptionally good build qualities, and
when dry can be very easily smoothed down with abrasive paper used either wet or dry. The snap or round head rivet is used where high strength is required. The system is widely accepted, and repair to Glas-Weld standard would 472 Repair of Vehicle Bodies not cause the vehicle to fail the statutory Department of Transport test for windscreens: 80
per cent of stone damaged windscreens can be repaired by this method (Figure 14.111). Figure 17.10 Single-braid air hose is smooth, it will still create a certain amount of resistance to the flow of air, particularly when long lengths are used. Generally the blades have a very steep rake or angle to permit
piercing of the sheet for internal cutting. Some alloys, chiefly the wrought materials, harden more rapidly and to a greater extent than others. 19 Why is it important to disconnect a battery on a vehicle before commencing any MIG/MAG welding operation? In general the floor unit is made up from a series of panels with suitable cross members or
reinforcements. Generally they can be defined as follows. This cap is removed by rotating the hexagon nut in either direction using a regulator spanner: this will cause the cap to split for easy removal. Plastic parts are made from a composite material based on polyester resin: pre-impregnated type (SMC) for parts 1, 4, 5, 6, 7, 8, 9, 10; injected resin
type for parts 2, 3. Hardening time This is the time from the setting of the resin to the point when the moulding or laminate to be withdrawn from the moulding 
14.37 Dataliner drive-on rack system (Dataliner, Geotronics Ltd.) checking of measurements. The second pair is kept clear to allow movement of selected bodies to the spraying and/or stoving position (Figure 17.72). The system has other features which make it attractive to body shop operators because they greatly facilitate the work on crash repairs.
Double phaeton A phaeton which had two double seats including the driver's seat. By their slagging properties they dissolve and segregate oxides and other impurities whose presence might otherwise adversely affect the quality of the welded joint. The following points should be observed: • • Always ensure that the panel is fully supported on both
sides. A canister mask of the CC type can be used as an alternative, but these can prove to be expensive as the canister is only useful for 15 minutes continuous use and should then be discarded. During welding, metal or paint preparation, or spraying, some form of protection is necessary. If you have comments on this book, mail me at Andrew
Livesey [email protected] xvi Preface Table P1 Automotive skills S/NVQ qualification framework: Vehicle body and paint operations BP17 BP18 MR06 MR09 Note: 6 mandatory units to be completed for each route within each level. The line of cutting may be straight, angular, curved or of a broken design. Too fast a thinner and too heavy a coating will
produce this defect. A further 10 per cent is composed of other resistance welding processes: seam, projection, flash and butt welding. The regulations will also: 1 Place duties on the employees to follow health and safety instructions and report danger. The weight of the planishing hammer for general and new work ranges from 12 oz (340 g) to 16 oz
(450 g), and the handles, which are usually very thin at the neck of the shaft for balance purposes, are made of hickory or ash to give the hammer a good rebound action when used with a dolly block. In practice many vehicle manufacturers now collect used oil and brake fluid for recycling or safe disposal. Figure 14.133 Brushing and vacuuming
(Autoglym) Figure 14.134 Cleaning carpets (Autoglym) 12 Plastic coated fibreboard may be painted or stained to cover damage or scrape marks. The suspension system used the loads must be transmitted to the wing valances and on to the body panels. There are also flat surfaces
possibility of spoilt paintwork. Care should be taken here to avoid overheating the repaired area. The identification of bolts is outlined in Figure 7.46. This allows quick and accurate reading of longitudinal, transverse and vertical measurements. Nomex is a paper-like material based on Kevlar fibres. The capacitor in a distributor absorbs the flow of
electricity in the LT circuit when the CB points open. Therefore it is recommended that consultant specialist bodyshop or re-equipping an existing workshop with new lights. Using the appropriate Lotus panel tool, separate the lower quarter panel from the B-post cover and
discard. Therefore the key actions to be taken are as follows: 1 Evacuate the surrounding area to a minimum distance of 100 metres. The onward march of technical progress increases each year with vehicles becoming more complex and where the ancillary equipment, especially the electrics, require delicate handling and treatment as part of the
repair process. Most heads have a single slot for insertion of a screwdriver; some, known as Supadriv heads, have a star-type slot and must be placed with a special type of screwdriver (Figure 7.36). Following careful inspection of the vehicle, it can be brought up to the painting stage by using the method described in Section 17.13.2. A process
summary would be: 1 2 3 4 5 6 7 8 9 10 11 12 17.14.4 Cellulose synthetic (half-hour enamel): refinished today are first patch repaired, followed by refinish. Apply etch primer to bare metal parts only. However, they are
generally classified as plain, single-V, double-V, single-U Figure 11.14 Types of arc welded joint and double-U. BS refers to British Standards Institute, other countries may just use the term ISO 9001. Carriage steps retained on earlier models gave place to running boards which in their turn disappeared altogether. 6 Describe four types of blind rivets
and their placing procedure. The length of joint that can be soldered before the bit, its temperatures; improved tensile
strength and resistance to wear. In small or confined areas, fume extractors must be used. The other type, made from cast iron, is ribbed along its length, and has a flat face. Subsequently, repair methods are established before publication. 17.5.4 Finish Finish is the term used to describe the finishing colour coats. The pull is made by a chain taken
round the pivot post, located by means of the sliding chain quide, and passed through the selected clamp or attachment. Half-moon stake consists of a single vertical shank with a half-rounded head on top. 8.3 Soft soldering The mechanical strength of soft soldered sheet metal joints is usually in the order of 15-30 MN/m2, and depends largely upon
the nature of the solder used; the temperature at which the soldering is done; the depth of penetration of the solder, which in turn depends on capillary attraction, i.e. on the power of the heated surface to draw liquid metal through itself (Figure 8.1); the proper use of correctly designed soldering tools; the use of suitable fluxes; the speed of
soldering; and, especially, workmanship. The pressure exerted on the metal by the press also changes the grain structure to work harden the surface layers. The paint should be cleaned off about 20 mm (3/4 in) on both sides of the joints. All calibrated scales are easy to read, and are attained by sliding the beams and base blocks to their specific
location. Before fitting the regulators, blow out the cylinder valves to remove any dirt or obstruction. Thus for bodywork the successful application of their properties. 11 12 13 14 603 Spray finishing material thinned 1:1 to a viscosity of 21-23 seconds. The performance
of body panels can be changed whilst retaining the panel thickness, simply by altering the type of reinforcement used within any given panel thickness. For example, if a tip diameter of 5 mm is allowed through wear to increase to 8 mm, the contact area is virtually doubled; this will result in low current density and weak welds. After a little
experience you will be able to work out how components are best manufactured, this is usually a good guide as to the type of material used. Hemlok provides strength and good clamp-up, and the well formed fastener tail achieves this without deforming thin sheet material. A compound of this type has good capillary attraction and can filtrate into
joints, seams and otherwise inaccessible areas. The usual practice is to beat the metal in a suitable recess in a wood block or upon a sandbag in what is known as the hollowing or blocking process. 1.5.14 Doors Several types of door are used on each vehicle built, although the construction of the various doors is similar regardless of the location of the
door on the vehicle, as indicated on Figure 1.47. Unprotected cavities are prone to rust. Welding wires are available for joining most ferrous and non-ferrous metals: Solid wire The composition of solid filler wire is usually chosen to match the parent metal being welded. Second is the universal bevel, which has offset blades and can be set at any angle
Before commencing to weld it is essential to clean the surfaces that are to be welded. The type of gas used determines the heat input, arc stability and mode of transfer, as well as providing protection for the solidifying weld metal. The floating blow is given to the metal when it is held over a suitable head and hit 'off the solidifying weld metal. The floating blow is given to the metal when it is held over a suitable head and hit 'off the solidifying weld metal. The floating blow is given to the metal when it is held over a suitable head and hit 'off the solidifying weld metal.
points of impact. The windscreen aperture is moulded as a part of the inner body, and incorporates steel reinforcing hoops which are braced directly to the chassis. In case of doubt, perform a trial weld on a section similar to the dented one to help you select the best setting. In response stylists are endeavouring to upgrade and soften the interior,
using fabrics with the appearance and feel of textiles to appeal visually and functionally. Standard bumping hammer This hammer (Figure 3.1a, b) is used for initial roughing out of work on damaged panels. Abbreviations for automotive plastics repair A new car is made up, by weight, of about 65 per cent steel, 5 per cent non-ferrous
metal, 15 per cent plastics material and 15 per cent other non-metallic materials. Veteran cars are cars up to and including this year. The holes left by these tacks can be later filled in by welding. Brazing is carried out at a much higher temperature than that required for the soft soldering process. When this is done, a higher volume of paint will be
applied, increasing the risk of runs, and so the fluid needle adjusting screw should be turned to the right until a satisfactory volume of paint issues from the fluidnozzle. 9.6.2 Power of flame The power or heat value of the right until a satisfactory volume of paint issues from the fluidnozzle. 9.6.2 Power of flame The power or heat value of the right until a satisfactory volume of paint issues from the fluidnozzle. 9.6.2 Power of flame The power or heat value of the right until a satisfactory volume of paint issues from the fluidnozzle. 9.6.2 Power of flame The power or heat value of the right until a satisfactory volume of paint issues from the fluidnozzle.
follows: flat, horizontal, vertical, overhead and, owing to the complexities of panel shapes, a combination of these (Figure 12.24). The most widely used is unsaturated polyester resin, which can be cured to a solid state either by catalyst and heat or by catalyst and accelerators at room temperature. However, if you use large quantities of detergents
wash bays which are fitted with the correct type of drainage system should be used. Care must be taken when laying up several layers, to ensure the pattern is set to minimize stress levels. The shafts are mounted one above the other, one of them in a fixed housing, and the other in a housing which has some vertical adjustment with reference to the
fixed shaft. Very good application characteristics. 333 must be used for the protection of the welder. If the soilants are or become flammable from the effect of body temperature, a spark from welding or grinding could envelop the wearer in flames with disastrous consequences. Use the hook spray, since it is directional. Therefore the skill of wheeling
lies in the use of correct wheel pressures and careful manipulation of the panel through the wheels; this can only be learnt by experience. Employers with five or more employees will have to record the significant findings of the assessment. When this is known, the first pulling must always start as near to the major impact as practicable. Remove such
foreign matter from the surface before commencing welding. These beams absorb the kinetic energy produced when the vehicle is struck from the side. The obvious limitation of a combined spray booth and low-bake oven is that no further paint spraying can be done during the stoving schedule, in addition to which valuable working time can be lost
whilst waiting for the booth to return to a comfortable working temperature. Electrolyte A substance which dissolves in water to give a solution capable of conducting an electric current. Finally, with a solvent-soaked rag wipe the outside of the paint container clean. 16 What happens when the welding arc is too long? The bruising will then show up
as a dark or light patch depending on the colour and content of the laminate, and can be marked out for removal. The hole diameter can vary from 6 to 40 mm depending on the filler rod 10-20° from the surface of the horizontal plate respectively
(Figure 12.11). Although it is stable under low pressures, it becomes very unstable and dangerous if compressed to any great pressure. The equipment is described in the following sections. 15.3.1 Radiant heating is the transfer of energy by IR electromagnetic radiation; this is the portion of the electromagnetic spectrum between
visible light and the top section of the radio-radar wavebands. The brackets also act as a solid welding fixture, clamping new parts in their correct position at the critical points during welding up (see Figure 14.15). The welding rods come in various profiles, and there is a speedweld nozzle available to suit each rod. The flange can be strengthened by
adding layers. Therefore the fillers obtainable are of a duo-pack type containing paste and hardener. 12.15.1 Visible examination This is normally carried out during and after welding and prior to any other non-destructive or destructive test being used. Consequently the correct sequence should be first to remove the last ridge which was formed, and
then to work towards the first point of impact of the damaged area. The spray painter should attempt to keep these areas ahead of the gun, so that with subsequent passes of the gun he can coat over the dry spray and dissolve it into the wet paint film. If a vehicle is coloured towards the red end of the spectrum, it can be less obvious to other road
users than a yellow one, especially in sodium vapour street lights: a red car absorbs yellow light from the street light and The history, development and construction of the car body 19 Figure 1.10 Safety cage (Volvo Concessionaires Ltd.) reflects little, and so appears to be dark in colour, whereas a yellow car reflects the yellow light and appears more
obvious. The outer end of this conduit system is connected directly to the welding torch (Figure 12.20). If 240 volts is used for power tools, then a safety circuit breaker should be used. His theory not only explained the nature of plastics, but also indicated the ways in which they could be made. The body spoon really does the same job as a dolly block
but is designed for use in confined spaces where a normal dolly block cannot be held in the hand, e.g. between door frames and outer door panels. All personnel should use a suitable barrier cream before starting work and again when recommencing work after a break. The accurate life-size model is used for further wind tunnel testing and also to
rutile E — — — RR rutile, heavy coated E————S other types. Figure 6.17 Universal surface gauges (Neill Tools Ltd (Eclipse)) 194 Repair of Vehicle Bodies fastened to the base, and an adjustable clamp attached to the pillar for holding the scriber. This is done by the simple means of riveting them together, taking care to place a layer of insulation
material between the two to prevent the electrolytic reaction that will occur between these dissimilar metals. Its rollers produce a smooth, uniform stepped panel edge to create a flush-fitting lap joint, allowing a panel replacement to be inserted. To use a square to scribe a line at right angles to the face side, the blade of the square is laid flat on the
workpiece with the inside of the stock pressed firmly against this face side; the line can then be scribed along the outer edge of the blade at the position required. Tyre inspection, front and rear, is as follows: 1 Check for any unusual wear patterns: camber, toe wear, inflation wear, cupping. Carr (NCTEC Final, CGLI Final Motor Vehicle Painting and
Industrial Finishing), who is a lecturer in motor vehicle spray painting and industrial finishing and last compiled the information and illustrations in Chapter 17. From time to time, research into specific aspects of vehicle engineering is undertaken for manufacturers. The bonnets and boot lids will need to be removed for the later assembly work, so
care (personal hygiene) systems 2.1.3 Protective clothing All employees should be aware of the importance of personal hygiene and should follow correct procedures to clean and protect the skin in order to avoid irritants causing skin infections and dermatitis. Initially the file was used for smoothing off panels prior to sanding and locating high and
low spots. 17.20.2 Procedure for identifying a particular colour 1 Note the make and year of manufacture of the vehicle. If it is required to exhaust the products of combustion to the atmosphere, the individual heaters can be linked into a manifold system with one exhaust fan. When open the bonnet is virtually unsupported as it is only held in place by
situations. It allows the repair of collision damage without the extensive dismantling and reassembling of components. Figure 17.2 Composition of paint 577 17.4 Types of paint Cellulose synthetic This dries by the evaporation of the solvent. Correct heat treatment is essential to develop the properties provided by alloying elements. 2 The pressure
exerted by the bottom wheel must be correct for both the thickness and type of metal being wheeled. 3 If so, where to? Paint removers were formerly of a highly flammable nature and constituted a fire risk, but nowadays non-flammable types are available and are widely used. 17.14.9 Metallic finishes Practically without exception, metallic colours
being applied by car manufacturers in Britain are based on acrylic resins. There is a choice of impact grades for the lenses (Figure 2.2). Careful consideration of bodyshop more comfortable. Regular maintenance to the following parts is important:
gas nozzle, gas distributor, contact nozzle and wire guide rollers. This was the acrylic resin stoving finish which was produced with the cooperation of the plastics industry (being of the thermoplastic type). 3 What are the main functions of a flux in soft soldering? The type of binder or adhesive will produce differing moulding characteristics and will
tend to make one mat more suitable than another for specific applications. Spray one coat and allow to flash off for 10 minutes, then apply a double-header coating. Loads are usually light, particularly for those used inside vehicles are a special case,
because of their importance to and impact upon society, and have been subject to specific technical standards almost from their first invention. The car body is then dried off and baked. When alignment is correct, further tack welds may be placed between the first set. There were often two supplementary seats. This four-post lift allows work at any
comfortable height giving complete freedom and access around and under the bench. 11 With the aid of a sketch, describe pressure areas and tension areas on a damaged panel section. It is ideal for roof gutters and for welding patches to vehicle has a
crash sensor which signals the airbags to deploy on impact (Figure 1.13). The ideal is to ensure that every vehicle is placed so that it can be removed from its location, without obstructing or interfering with its neighbour, to any other bay or booth. 13.9 Hot shrinking One of the most important skills in the repair of damaged panels is that of hot
shrinking. However, its efficiency relies on the car having two parallel axles, and front and rear wheels perfectly in line with each other. mm (in) 25 26 27 28 29 30 31 32 33 Front pillar positioning notch (Upper section) Front pillar positioning notch (Upper section) Notch of roof side rail Notch of front pillar outer and side sill outer Centre pillar
measuring system (Kroll (UK) Ltd ) Figure 14.75 MacPherson strut measuring (Kroll (UK) Ltd ) a large gap will exist between the rear of the bonnet is too far back this gap will be too small and there is a possibility that when the bonnet is opened it will catch the scuttle panel and chip
the paint on either or both of these panels. 529 15.7.3 The bodyshop's action plan 1 Accept the opportunity to move towards BSI approval. You will soon become aware of which parts on which vehicles can be repaired. Punches (Figure 3.18a) have interchangeable heads to punch holes of either 163 in (5 mm) or 14 in (6 mm) diameter,
and enable joining panels to be accurately aligned for welding. These include primary design elements such as dual-circuit braking systems, anti-lock braking systems, in the deriver's environment safer, such as efficient through ventilation, orthopaedic
seating, improved all-round vision, easy to read instruments and ergonomic controls. 5 Suggest an appropriate repair situation which would require the use of a long straight edge. 538 Repair of Vehicle Bodies Figure 16.10 Chopped strands (Owens-Corning Fiberglas) 16.4.7
Application of these materials Probably chopped strand mat is most commonly used for the average moulding. A deep hole in the bottom of the set is used to draw the rivet through the metal sheet before riveting, and a cup-shaped hole in the bottom of the set is used to draw the rivet. It is made from two base metals, tin and lead. In this instance the
molten metal falls from the electrode without actually fusing with the base metal, resulting in a defective weld (Figure 11.13). 5 Metal forming processes and machines 5.1 Properties of metals Metals and alloys possess certain properties which make them especially suitable for the processes involved in vehicle body work, particularly the forming and
shaping of vehicle body parts either by press or by hand, and some of the jointing processes. Risk grid Hazard security index Very likely Likely Quite possible Possi
• Biological hazards • • 527 Boredom Bullying Isolation Lack of control Lack of support Long hours Monotonous work Shift work Stress Violence Work overload Using this information the Risk Assessment Form (Figure 15.14) can be completed. Ferritic Usually containing 12-18 per cent chromium. 13.16.4 Minor repairs to door panels When repairing the support Long hours Monotonous work Shift work Stress Violence Work overload Using this information the Risk Assessment Form (Figure 15.14) can be completed.
door panels the main difficulties arise through the fact that most door panels are nearly flat sheets of metal, which means that even the slightest stretching due to over-hammering will produce a fullness which will stand out after the repair has been painted. 3 Use the flashing lamp on your recovery vehicle. 19 How are welding electrodes identified?
24 What is meant by the upper critical point of steel? 2 Two digits indicate the strength (tensile, yield and elongation properties) of the weld metal (see Table 11.1). Pillars Whenever possible remove the courtesy input switch for access, otherwise extra holes may have to be made. He called it Celluloid to indicate its raw material, cellulose. The grade
of wet-ordry paper chosen to rub down the damaged area depends very greatly on the degree of damage, but normally 180 grade is suitable. 20 Replace all carpets, mats, spare wheel, ashtrays, tools, wheel trims. Steep and clean the air cap and finally dry out the tank with a piece of cloth. Rinse, dry and tack off. 7 Explain the uses of a set of
trammels. Use shampoo vacuum if necessary. Welding in the new skin panel The spot welds should now be replaced to fix the new skin panel to the frame, taking care to use the correct electrodes, especially on the face side of the panel. Figure 14.39 Blackhawk PB 31/8 mobile straightening and measuring system (Blackhawk Automotive Ltd.) The
measuring system works on the principle that a measuring scale can locate vital alignment points in the length, width and height on every vehicle model. 3.2 Hammers Planishing or panel hammer available should be obtained. 10
After overnight hardening, transfers, lining and lettering may be applied. (a) Clean the damaged area with an abrasive disc. Authority to repair from the insurance company involved before any work is started on the damaged vehicle. The lowpressure system is no longer widely used, and not at all in body
repair work. 4.4.2 Boron steel A particular type of HSS is referred to as Boron steel, containing a very small amount of boron, typically 0.001–0.004 percent. If the defect has not changed its position, the obstruction is on the fluid tip. Alterations to this standard method can be made where necessary. 626 Repair of Vehicle Bodies 14 Reduced tinters
have one-tenth of the tinting strength of a full-strength tinter. The toughened acrylic adhesives are even more hardy, and some will actually bond through a film of oil (so too will the heat cured epoxies). Maintain the temperature typically at 150 °C for about 5 hours, then gradually lower the temperature, again over about a 30-minute period. When
the bolt is passed Methods of joining 217 Figure 7.49 Nut identification. The material used to treat these cavity areas is based on wax dissolved in a solvent with rust inhibitors added. Sealing Having located the point of entry of the water, it is then necessary to carry out satisfactory rectification. The welding operation, which takes a little time to
practise, consists of striking the arc and passing the electrode tip with the shortest possible arc rapidly along the seam to be welded at a uniform rate, without any sideways movement. Usually the backfire is arrested at the mixer or injector of the welding torch. 17 List, and describe, four types of self-locking nut. Repeat this operation taking the next
highest spot in the stretched section of the panel, until the bulge or fullness is finally shrunk down below the level of the surrounding surface. Then check at hourly intervals until it is seen that steaming has ceased. 12.2.6 Choice of shielding gases Shielding gases must be carefully chosen to suit their application (Table 12.3). Lap joint A form of joint
obtained by overlapping the edges of two pieces of metal. 12 Do not weld near inflammable materials. 3 Provide storage for PPE when it is not being used. However, MIG spots can be made from a specially treated spring steel which retains its original
spring locking power so that the clips are reusable, and hence economical. The size of the nozzle is governed by the diameter of the opening at the welding end. 27 Explain the difference in properties between lowcarbon steel and alloy steel. This lead to American car makers forming the Ultra Light Steel Auto Body (ULSB) group and
Steel Body - Advanced Vehicle Concepts (ULSB - ACV) group. Malcolm Tagg Director General Vehicle Builders and Repairers Association Limited This Page is Intentionally Left Blank Preface This book is written for a wide range of students and professional practitioners in the field of vehicle body repair and re-finishing. They are convenient for
assembling small, lightly loaded items for use in less severe environments. There is also available a hot melt adhesive in the form of a strip about 0.5 mm thick, impregnated in a synthetic fabric scrim made up into a composite tape backed with aluminium foil. 9 Which important points should be considered when reshaping a resistance welding
electrode? This is the most common of all spray painting defects. Major accident damage 443 Figure 14.65 Manufacturer's alignment points No. Standard measurement point Hole-Size shape. There is still an unfortunate tendency on the part of designers to use a traditional design, known to be satisfactory for wood or metal, for reinforced plastics
which have, of course, completely different properties and processing characteristics (Tables 16.3 and 16.4). When placed at the from tor the rear of the jig, the puller will pivot through 220 degrees, allowing pulls to be obtained from both sides of the vehicle without removing the unit from the jig bed. UB Electronics is a measuring system with digital
readout. Bodyshop personnel should be aware of the various classes of fire and how they relate to common workshop practice. In all, this was a paint ideally suited to the expanding motor vehicle industry, and by the early 1950s all new motor cars were being finished in these stoving synthetics. at 70-95 °C melt adhesive, on the other hand, relies on
mechanical keying to the surface roughness of the substrate surfaces, and the adhesive's chemical affinity with the substrate. Its properties in terms of low melting range and quick setting are still adequate, and hence it is used for general applications. It can also be used to give rigidity to large flat panels to prevent 'drumming'. It can then be
brought up to its correct level by planishing with a hammer and dolly and then finishing with a panel file. Where the standard rubber flex head does not suit the shape of the body, the wide-angled wedge head must be used, as it will automatically adjust to fit the corner. Spatter usually results from either excessive voltage or insufficient induction in
dip transfer or argon enriched gas mixtures. Adhesive is used on certain doors to fix the skin panel to the door frame. These strips afford a guide when finally fitting the screen after sealant has been applied. 2.8.4 Dangerous situations are reported immediately and accurately to authorized persons As a trainee in the motor industry your company will
require you to report any dangerous situations to your supervisor; this will be a person that you know as the chargehand, foreperson or service manager. Use paint renovator with polisher, or appropriate cleaner/polish. Poor gel coat adhesion can be caused by inadequate consolidation of the laminate; by contamination of the gel coat before the glass
fibre is laid up; or, more generally, by the gel coat being left to cure for too long (Figure 16.48). That means you must work in a safe and sensible manner. Inclusions tend to be more angular than gas pores and can result in higher stress levels as well as forming a plane of weakness in the weld. Titanium Strong carbide forming element. 10 Describe
the advantages of the Monobolt system of structural fasteners. Very stretched sections can be shrunk by the use of heat spots during the roughing out. Glazing sealers must be capable of maintaining a leak
tight joint whatever deflection the body undergoes. Setting up the equipment, hanging the targets in position, entering the vehicle's information, and positioning the body scanner, take a qualified bodyshop technician approximately ten minutes. The rivet has an aluminium alloy body and a Figure 7.11 POP blind rivet, grooved type: setting sequence
(Tucker Fasteners Ltd.) Figure 7.12 POP blind rivet, peel type: after setting (Tucker Fasteners Ltd.) earth connection to pre-painted sheets without damaging the finish. Not greatly different, just that you should follow a set of procedures and
remember the characteristics of aluminium. The ultimate tensile strength of a single glass filament (diameter 9-15 micrometres) is about 3447000 kN/m2. 524 Repair of Vehicle Bodies 5 Set up emergency procedures. Polluted air is often invisible to the naked eye. Machines can be used for burnishing large areas of panel using liquid burnishing
materials. 13.16.6 Pulling out double-skin panel damage When inaccessible body panels are damaged, a method of repair for the removal of the removal of the damage, without leaving holes or having to remove interior trim, is to use a special pin welding gun. The duty of the repairer is to see that the damaged car is reinstated to its original condition. Blistering can
occur on old paint films where the metal substrate has corroded from the reverse side, e.g. car wings, sills and lower door edges. This accident led to the invention of laminated safety glass, made from two pieces of glass with a celluloid interlayer. Residual adhesive can be removed with adhesive remover. The remaining 65 per cent is either extracted
to the atmosphere or collects on the workshop floor and walls. These are garnet, flint, emery, aluminium oxide and silicon carbide. The steel parts are then allowed to cool slowly in the box. Plain woven roving gives optimum mechanical properties at right angles, while unidirectional roving mat shows highest strength along the roving; as the roving is
continuous and uncrimped, this last type will be stronger than other types of reinforcement. Ideally the refinishing area should form a selfcontained area separate from the workshop and the preparation area. This is achieved by using the correct angle of the workshop and the preparation area should form a selfcontained area separate from the mechanical and repair side of the workshop and the preparation area.
the lowest point and work upwards. The contact moulding process is carried out in the following manner. Tool reloads automatically Methods of joining 207 The range of tools has been designed to cater for all riveting conditions, whether they are used on high-speed assembly production lines or for occasional use. Figure 14.129 Pressure washing
engine compartment (Autoglym) 8 Apply traffic film remover to engine compartment. Figure 3.21 Inter-grip welding clamps (Frost Auto Restoration Techniques Ltd ) Hand and power tools job, prior to final welding. Metal is transferred by a rapidly repeated series of short circuits when the electrode is fed forward into the weld pool. This clearance
allowance is usually 5-10 per cent of the metal thickness. In some cases where the door panel is badly creased and is inaccessible for the use of hand tools, it would be better to rough out the damage with the aid of the body jack or spoon acting as a lever, smooth it over with hammer and dolly, then fill it with body solder and file the area to obtain the aid of the body jack or spoon acting as a lever, smooth it over with hammer and dolly, then fill it with body solder and file the area to obtain the aid of the body jack or spoon acting as a lever, smooth it over with hammer and dolly, then fill it with body solder and file the area to obtain the aid of the body jack or spoon acting as a lever, smooth it over with hammer and dolly, then fill it with body solder and file the area to obtain the aid of the body jack or spoon acting as a lever, smooth it over with hammer and dolly, then fill it with body solder and file the area to obtain the aid of the body jack or spoon acting as a lever, smooth it over with hammer and dolly, then fill it with body solder and file the area to obtain the aid of the body jack or spoon acting as a lever, smooth it over with hammer and dolly, then fill it with body solder and file the area to obtain the aid of the body jack or spoon acting as a lever, smooth it over with hammer and dolly, then fill it with body solder and file the area to obtain the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with the aid of the body jack or spoon acting a lever with 
final finish. If a piece of laminated glass is broken, the interlayer will hold the splinters of glass fibre composite skin panels This method of producing complex shapes involves applying layers of glass fibre and resin in a prepared mould.
The upper wheel is carried on a horizontal shaft which is allowed to rotate freely in bearings. 12 Identify how they may be harmed. Temperature The measurement, in degrees, of the intensity of heat. Although metal arc welding is only used a small amount in private car construction for heavy-gauge assemblies in cars which have chassis, it is still
used in the commercial vehicle body building industry for the assembly of the fully welded, trailer-type bodies in mild steel, stainless steel and aluminium. Phosphoric acid types of flux. 5.9 Rolling machines 5.9.1 Bending rolls 5.8.4 Box
and pan bending machine (universal bending machine (universal bending machine) It is possible to form boxes with more than one bend using the clamp folder if there is sufficient clearance between the clamping beam and the top blade to allow the workpiece to be removed. 14.4.9 Motor vehicle glazing systems Since the introduction of legislation on the compulsory wearing or
seatbelts for front seat passengers in the early 1980s, both the type and style of glass fitted into windscreens have changed. The skill is in the selection of the appropriate temperature. The term 'toe-in' is used when the wheels are closer at the rear. (d) Compression moulding is a high-
volume, high-pressure process suitable for moulding compound or preforms. The whole assembly is now tried back on the jig and any small rectification Craft techniques and minor accident damage 351 required is carried out by further
planishing methods (Figure 13.16). When leaks occur between a screen glass and the weather strip, or in the case of direct glass and the body, avoid removing the glass and the body, avoid removing the glass and the weather strip, or in the case of direct glass and the weather strip, or in the case of direct glass and the body, avoid removing the glass and the body, avoid removing the glass and the weather strip, or in the case of direct glass and the weather strip, or in the case of direct glass and the weather strip, or in the glass and the weather strip, or in the case of direct glass and the weather strip, or in the case of direct glass and the weather strip, or in the glass and the weather strip.
part of the damage and working outwards. Aluminium castings Use cast aluminium alloy rods with silicon and flux. The wire is fed at a rate which is just greater than the burn-off rate for the particular arc voltage being used; as a result 323 the wire touches the weld pool and short-circuits the power supply. In so doing the area within the 100 mm
modular grid spacing can be covered; any further variations are covered by additional offset on the model-specific top unit. These two papers are most effective when used with specially formulated disc adhesives. Then heat the surfaces of the weld area. A casual inspection of a
same time, design engineering personnel construct models of alternative interiors so that locations of instruments can be determined. It is of the greatest importance that separation of the moulding from the mo
case it is a layer of a penetrant or a sealant. The inert properties of synthetic materials also contribute greatly; properties like corrosion resistance, low friction coefficients and light weight are of prime importance. Note that the applicable EEC Directive (see later) has effectively banned the fitment of toughened windscreens from the end of 1992.
This is due to the internal strain imparted to the metal by the forming dies in manufacture. The screws are inserted in predetermined holes of the correct size and hammered so that the spiral thread is forced to cut into the material. Each dummy costs the same amount of money as a super car such as a Ferrari. It is a liquid which solidifies in contact
with air. The range of self-supporting arms, combined with the versatility to mount the system on ceilings, floors, benches and walls, make the access to applications unlimited. 36 Describe, with the aid of sketches, how the hydraulic system of a body jack works. Describe a method used to anneal the panel, and 404 Repair of Vehicle Bodies a
workshop test which will indicate when the correct temperature is reached. For full coverage, the heaters should be positioned around the perimeter of the building at spaces of about 4-6 metres, using load densities of 100-200 W/m2 based upon heat loss calculations. The countersunk head rivet is used when the surface of the component must
remain smooth. Given the correct environment it does not corrode. Applying these materials is straightforward enough, but it does need care and attention. Improved performance can be obtained by alloying these materials is straightforward enough, but it does need care and attention. Improved performance can be obtained by alloying these materials is straightforward enough, but it does need care and attention.
Correction is carried out by using alignment and repair equipment in conjunction with hydraulic pulling and pushing equipment to realign any underframe members which do not align with the specified locating points (see Figure 14.78). As far as is known the only real source of physical harm is the dust produced in grinding, but all the materials and
byproducts contribute to discomfort, and sensible evasive action is essential. When welding a horizontal joint, angle the welding torch upwards to hold the welding torch upwards to hold the welding a horizontal joint, angle the welding torch upwards to hold the welding a horizontal joint, angle the welding torch upwards to hold the welding a horizontal joint, angle the welding a horizontal joint, and sensible evasive action is essential. When welding a horizontal joint, and sensible evasive action is essential.
If the drawing does not reduce the potential of the original ideas, he then produces more comprehensive sketches of this design, using colours to indicate more clearly to the senior executives the initial thinking of the design (Figure 1.7). Now the thermoplastic types can be welded by using various forms of equipment, in particular by hot gas welding,
hot plate machines which include pipe welding plant, ultrasonic and vibration methods, spin or friction welding machines, and induction, resistance and microwave processes. Hood American term for bonnet. To the motorist this means that leather does not get hot and uncomfortable in warm weather or cold and inflexible in winter, and although
 permeable to water vapour it offers sufficient resistance if it is exposed to normal liquids. It is inflated by gas generated by the application of heat. 3 Steam cleaning plant - the hazard here is that as well as being wet the water is scolding the protection of heat.
vehicle must still be considered as a unit and the pulling force applied must act on the whole of the body and not just on the damaged parts. Of this waste material, 30 per cent is classified as volatile organic compounds (VOCs). To measure current flow the ammeter must be connected in series with the circuit, the ammeter
must be able to handle the expected current or it will be burnt out. In body shops wood screws are applied by hand or 7.6.2 Metal screws (self-tapping screws) Often there is a need for a fastening which will fix two or more parts together securely for indefinite periods, yet can be dismantled if necessary. Approved parts carry the E-mark. Electrode tip
dressing is best carried out with a fine-grade emery cloth. The flexible areas are large areas of mainly flat or slightly curved sections such as bonnet tops, outer door panels, sections of wings and centres of roof panels. 14.2.8 Globaljig universal bracket system The Globaljig universal bracket system is manufactured in Italy and is available as a mobile
(Figure 14.25), four-post lift or centre-post lift or centre-post lift unit (Figure 14.26). It fits the nut all round by means of teeth cut in the inner surface of the ring. At the front of the unit are three independent pivoting towers. In 1963 Vauxhall introduced a finish on their new Viva model which the paint manufacturers claimed had better colour stability. A deep freeze
cabinet is therefore needed for storage. Tack off before spraying the enamel. In the case where the edge is formed outside, a plastic moulding is clipped over the protruding edge. The sander should never be used for dressing down the solder except as a last resort, because it is too severe and tends to cut deeply and unevenly into the solder. During
the forming process the head of the rivet is subject to severe impact, and when in service rivets are frequently required to resist shear, twist and shock loads. The gradual development of the shape of the motor car body can be clearly seen in Figure 1.2, which shows a 2 Repair of Vehicle Bodies Figure 1.1 Timber constructed bodies: (a) De Dion
Works body shop, Finchley, c. Two types are normally available, a compact form for contact moulding and a soft bulky form for press moulding. The pressure will force the solvent to the gun. The cause of this fault can be large build-up of resin due to drainage or to excess application; both lead to extreme exotherm. In all four areas of fabric use in car
interiors (seating, door and side panels, bolsters and headliners) fabrics are gaining ground against exposed plastics. Dissimilar thicknesses may be joined using lap and fillet configurations, but it may be necessary to equalize the cross-section at the joint to perform satisfactory edge or butt welds. An added bonus with the remote machines is that
they can also be used as a vacuum cleaner for the workshop. These tools are made of high-carbon tool steel, which is forged and then heat treated to give long service in the hands of a skilled body repair worker. Figure 3.31 Drill cutting attachment (Frost Auto Restoration Techniques Ltd ) 3.16 Bending and swaging tools 3.16.1 Sheet metal folder
Figure 3.30 Mini sheet metal cutter (Sykes-Pickavant Ltd ) This is a small, compact folder constructed and designed for mounting in a vice (Figure 3.32). Fully cured and needled products can be given various surface treatments including abrasion-resistant and waterproof coatings such as latex, PVC or rubber, or they can be combined with bitumen
to improve the sound insulation properties. It is important to differentiate, as a matter terminology, between 'mouldi and 'moulding', one being the product itself. The edge grips have 12 mm deep jaws to clamp flanges and other edge work. Figure 10.15 Current shunting in resistance welds positioned in close
proximity Inspection of spot welds Spot welds Spot welds are inspected either by outward appearance (visual inspection) or by destructive testing. In fact, this is the title for a wide range of alloys. They must be given appropriate instruction and training. (For the Grovit, annual convolutions are forced into materials.) Continue to pull the mandrel through rivet
which symmetrically expands shank to fill hole The rivet has good bearing in hole and a parallel bore is left in the rivet at 4 1 2 3 Figure 7.20 Briv placing sequence (Avdel Ltd ) 4 1 Magazine loaded rivet to fill hole and clamp materials 4
Completed rivet. Coated abrasives fall into two additional classifications based on how widely the minerals are spaced. Copper should be heated to a temperature of about 550 °C or dull red, and either quenched in water or allowed to cool out slowly. Direct and alternating current There are two kinds of current used in arc welding: DC and AC. As a
direct result of this, most accident damage is covered by insurance and is therefore repaired in body work establishments. 8 Observe what happens in practice. Wet flat with 280 grade paper and rubbingdown block. Marking-off tables must be used for no other purpose except marking out and measuring. 16.7 Designing reinforced composite
materials for strength The ability to design and fabricate large structures as a whole, rather than as an assembly of components, is one of the chief advantages that glass resin laminates bring to the designer. Table P2 links the qualification framework with the contents of the book, showing which sections in the book relate to specific units. The
heating flame is made to serve the dual purpose of melting off the bronze rod and simultaneously heating the surface to be joined. A major repair will be obtained if the material is applied in thin layers with a suitable drying period between applications. It
occurs when the resin is too viscous, or has a high filler content, or when the gel coat resin wets the release agent imperfectly (Figure 16.47). 6 Cylinders which are not directly involved in the fire and which have not become heated should be moved as quickly as possible to a safe place, provided this can be done without undue risk to 269 personnel.
20 State two reasons why door handles should not be 'bandaged' when masking up. If an acetylene valve or tightening the gland nut, eliminate all sources of ignition, move the cylinder outside to a safe area and contact your supplier. Both the side frames and valance assemblies are
connected to the cowl or dash panel, The front-end assembly is attached to the main floor at the toe panel. The method of spraying a panel is shown in Figure 17.29. 29 What is the importance of care of customer's vehicles when received for repair in the workshop? When repairing collision work, the normal method of correction is to reverse the
process which caused the original damage. 17.15.3 Final detail work Attention to detail when completing a respray can make the difference between a professionally done job and the amateur one. They range from mixtures of inert fillers and semidrying oils to heat curing plastisols which may be applied in a thin paste form as an interweld sealer or
as extruded beads. Therefore their siting, together with an appreciation of their individual characteristics, is fundamental to their success in fighting fire (Figure 2.13). A complete set of colour formulae is provided by the paint supplier and is updated at regular intervals, 2 With the aid of sketches, describe how a lowcarbon steel can be shaped into
four different forms to provide strength in body construction. Generally the majority of metals are capable of withstanding greater loads in tension than any other type of stress. Most bodyshops are now fitting combi-booths. Isolating this way is fine while cleaning the machine, but for carrying out maintenance or repair work it is advisable to remove
the supply fuse from the isolator box. Following rinsing and drying off, tack off and apply the sealer and lacquer coats as described. Numerous companies in the United Kingdom have already adopted MIG/MAG welding to their own particular requirements. Can be drawn and formed Exhaust systems and catalytic converter components and freight
container cladding Tanker jackets, interior trim, body mouldings, windshield wiper arms Martensitic 410 S21 13Cr 0.12C Corrosion resistant. (b) (d) Figure 3.15 Impact driver (Sykes-Pickavant Ltd.) (e) Body trim tool This is a universal spring steel tool for removing body trims and clips, and also weather strips, door trims, headlamp fittings,
windscreen clips, plastic mouldings, motifs and badges (Figure 3.16a). This thinner evaporates very quickly but tends to produce a low gloss which will require burnishing and polishing. Nitrocellulose a thorough cleaning of the
chassis frame with a solvent, followed by hand spraying a heavy coat of zinc-phosphate paint. Position the torch on the workpiece, ensuring that the tip has a good contact. If the panel height is great the operation is called deep drawing; low panel heights indicate shallow drawing (Figure 5.25). This section aims to look at the basics of body electrics
as may be tackled by the personnel in a body repair shop. Argon Cylinder colour: blue. Finally the parts are guenched and ready for use, red cream green blue black water foam vaporizing liquid dry chemical powder carbon dioxide Fires need fuel, oxygen from the air and heat. Power for the pulling equipment is supplied by a heavy-duty hydraulic
pump operated from a remote control handset. The following function controls are the most widely used: seam for continuous welding; spot, which makes use of a time setting to ensure uniform spot welds; and stitch, which is used through the weld timer and pause timer and provides intermittent welding so that the welding is interspersed with
pauses, therefore reducing heat input and preventing melt-through on thin materials and gapped joints. Side impact test This is similar to accidents where the car is hit by another on the stoving room, the usual spray painting equipment used in refinishing shops is required. 15 Compare the advantages of a beating file with those
of a planishing hammer. The cowl or dash panel forms the front bulkhead of the body (Figure 1.45) and is usually formed by joining smaller panels (the cowl upper panel and the cowl side panel) by welds to form an integral unit. The design and planning services provide everything for the re-equipping of new bodyshops in existing premises,
extensions to original bodyshops, or the total development of greenfield sites. Downward welding can also be performed more rapidly, which is important in production work. 15 How is the weld affected when the arc is too short? Work the damage out of the metal with a hammer and dolly while the metal is under tension from the pulling equipment
To prevent laminate crushing it is a good plan to use spacers for bolted connections. As a general guide, look out for parts such as 'A', 'B' 132 Repair of Vehicle Bodies and 'C' posts, screen pillars, cant rails and strengthening cross members on cars made after about 1990. Most acetylene cylinders supplied by the manufacturers are protected by at
least one safety device. The products now available to the body repairer include the following: 1 Alignment systems that incorporate either a mechanical (see Figure 14.69) 3 Dual equipment, which incorporate both
measurement and bracket systems 4 Cassette-type multifunctional alignment and repair systems (see Figure 14.71). 8.2 Soft and hard solders In spite of the growing use of welding, the techniques of soldering remain one of the most familiar in
the fabrication of sheet metal articles, and the art of soldering still continues to occupy an important place in the workshop. Two methods of repair can be used for doublepanel assemblies. The three techniques used in the manufacture of the
boot lid. After alignment checks have been made, hydraulic equipment is used to push and pull the body shell back to its correct shape (Figure 14.79). Also select the torch nozzle for seam or spot welding application. For striking a DC arc an open circuit of 55-60 volts is required, whilst an AC set requires 80-100 volts. At the middle of the gauge is a
sighting pin which always remains central irrespective of the distance to which the gauge is extended, and which is used to establish the datum line (the vehicle's centre line). A better method is to apply the colour forther still, using a fade-out technique. The surface
gauge is used in conjunction with a marking-off table or surface plate to mark out very accurate, parallel lines to a true surface. The size of an object is measured by the contact principle, which requires it to be positioned between the anvil and the spindle head of the micrometer. Light the torch and heat the spot to approximately 10 mm diameter in
the centre of the high spot or stretched area to a cherry red, using a circular motion when heating the spot. The filler should not be applied in any great thickness, especially where excessive vibration occurs, or the surface will crack and fall out. The type of bonnet catch mechanism depends on the type of bonnet used. Lighting should be efficient, and
floor covering attractive but practical and easy to clean. The actual cylinder valves are all opened anti-clockwise in the usual way. Cyanates, BMI and polyamides cost about 10 times the price of the others. The components are submerged in the solvent and dirt is loosened with a stiff-bristled brush. Direction of welding Flame
points towards finished weld. Wet flat damage area with 180 grade paper and feather edge. If a cylinder is involved in an accident, withdraw it from service and set it aside clearly marked; contact the supplier. Low boilers, on the other hand, evaporate and dry quickly. All of these items become secondary heat sources, transmitting energy into the
surroundings of 509 the workshop. 579 Primer surfaces A primer surfacer does the work of both a primer and a surfacer. Although this might appear insignificant at first, the smallest pin prick of corrosion can lead to a large rust patch. 10.9 ARO Spotrite Pulsa resistance welding system For resistance spot welding in vehicle body repair there is now
a British invention called the Spotrite (made by ARO Machinery Co. Ltd). Figure 13.17 Random chassis checking on surface table (Aston Martin Lagonda Ltd.) Figure 13.16 Planishing a hand-made panel (Autokraft Ltd.) Aston Martin Lagonda Ltd.) Figure 13.17 Random chassis checking on surface table (Aston Martin Lagonda Ltd.)
fabrication methods together with press work. Original research into systems and concepts is then balanced against careful analysis of operating characteristics, features performance and economy targets, the projected 15 cost of ownership and essential dimensional requirements. The ultimate tensile strength (UTS) of a material is normally
expressed in tons per in 2 or MN/m2, and may be calculated as follows: When referring to hardness, it should be carefully stated which kind of hardness is meant. Doors must provide a good seal against dust, water and air, and in order to do this they must match the contour of the body at all points. The high pressure of the air can quickly turn a small
leak in an airline into a large gash which in turn may make the airline wip around and cause damage to colleagues or customers' vehicles. The car body number is provided separately in the engine or boot compartments. Dynamic pressure, which is also a kinetic energy of unit volume in terms of cubic metres, comes from the Bernoulli equations.
Following rubbing down and cleaning off, the surface can be sprayed with synthetic resin primer surfacer if it is of a rough nature. This can be of great benefit for insurance companies for quick approval of additional repairs, and also for customers requiring verification of repairs. It provides substantial labour saving in avoiding the necessity to
remove fuel tanks and soft trim as required before any welding repair. The depth of penetration through the component part is controlled by the current and time cycle. When the weld is finished, the gun is pulled away leaving the welding rod attached. It can be a partially or fully insulated type, the latter being by far the safer. The boot compartment
is also a separate hand-laid GRP moulding, as are the doors and some of the other panels. (h) RRIM is emerging as a leading process. Weld the pins at the selected positions on the damaged section. These parts have a good tolerance of poor-quality hole conditions. Figure 6.6 Combination square (Neill Tools Ltd (Moore and Wright)) and/or metric
scales, and which may be used in conjunction with any one of three heads. Although at present the majority of British manufacturers are producing motor vehicle bodies designed and built on mono or unitary construction, in addition to the available
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European and American vehicles which are based on composite construction. A carbon fibre panel which is painted black will absorb a lot of heat if left in the sun for a long period. Fluid nozzle The orifice in the fluid tip. An important point at this stage is not to overheat the tinning paste when tinning or the surface will turn discoloured, usually blue,
and the tinning will be burnt; solder will not then adhere to this surface unless it is recleaned and tinned again. As with the repair shop and paint shop, the parts department must be efficient and well organized. These models are usually constructed of wood and clay to allow for modifications to be made easily. It is also a common practice to increase models are usually constructed of wood and clay to allow for modifications to be made easily. It is also a common practice to increase models are usually constructed of wood and clay to allow for modifications to be made easily. It is also a common practice to increase models are usually constructed of wood and clay to allow for modifications to be made easily. It is also a common practice to increase models are usually constructed of wood and clay to allow for modifications to be made easily. It is also a common practice to increase models are usually constructed of wood and clay to allow for modifications to be made easily. It is also a common practice to increase models are usually constructed of wood and clay to allow for modifications to be made easily. It is also a common practice to increase models are usually constructed of wood and clay to allow for modifications to be made easily. It is also a common practice to increase models are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modifications are usually constructed of wood and clay to allow for modi
the wire diameter from 0.6 mm to 0.8 mm when welding these thicker panel assemblies. The green lamp should be illuminated, as it indicates that the more control you will have over staff movement and job completion. Various methods have been devised for testing the capacity of
metals to 5.1.9 Weldability This property is a measure of the ease with which a metal can be welded using one of the orthodox systems of welding. To join boron steel panels the method used is often MIG brazing. The plate material 5083 is a medium-strength non-heat-treatable alloy particularly suitable for welding. 17.18 Movement of vehicle in the
paint shop In any refinishing shop, the movement of vehicles is of primary importance. When repairing mono constructed bodies, basic body repair methods and a knowledge of panel beating is absolutely essential. 43 With the aid of a sketch, show the position of a pull-dozer to realign a centre pillar after side impact. In this country it was 1927 before
one of the first truly effective sealers was introduced. They are transmitted as pulses by a probe connected to an ultrasonic test set. 4 Welding timer switch this switch the welding time is chosen, when the selection switch is in the stitch or spot position. 5 Paint tyres with tyre black. The nut allows a certain degree of float, which facilitates
speedy assembly. Inert. The exact degree of shaping of the metal which is permissible depends upon the particular alloy being worked, its malleability and the ability of the craftsman. Has good flowing properties Brushable coating, suitable for underbody and wheel arches. The suction-feed spray gun is easily identified, as the fluid tip protrudes
slightly beyond the air cap (Figure 17.11). These multifunction devices afford an additional safeguard, particularly in locations where a fire following flashback could not be tolerated, such as garages, body shops and other workplaces with flammable or hazardous materials. Sometimes a piece of soap is used instead of the wood; when the soap leaves afford an additional safeguard, particularly in locations where a fire following flashback could not be tolerated, such as garages, body shops and other workplaces with flammable or hazardous materials.
a brown mark the heating should be stopped. Then following thorough drying off and masking up, three coats of half-hour enamel will produce guite a good finish which can be further improved by flatting, burnishing and polishing. Where seam penetration is required, the nozzle should be specifically directed toward the seam. It is essential to
maintain both the distance between the tip base and the metal surface, and the correct torch angle, otherwise a problem can arise owing to the wire length being too long. By way of a further safeguard against overloading, there is a built-in thermal fuse which cuts out the machine at 120 °C. Spatter is minimal and weld bead appearances enhanced
owing to the improved wetting of the parent material by the 332 Repair of Vehicle Bodies molten metal on account of the various additives present in the wire composition. The advantage of this type of machine is that any number of finger blades can be removed, permitting a great variety of bends to be made. These gauges are hung underneath the
car from specific data reference points, giving an instant alignment check according to the siting on the pins (see Figure 14.61 and Section 14.2.13). 16 Describe the basic properties required of a body joint sealing compound. This research should include asking bodyshop staff what improvements they would like to see in the new bodyshop, visiting
other bodyshops, and talking to other managers to collect advice and recommendations about good practice and possible problems to be avoided. An ISO metric bolt or screw made of steel and larger than 6 mm in diameter can be identified by either of the symbols ISO M or M embossed or indented on top of the head. After the occurrence of this
short-circuit, the arc re-ignites. All structural seams sprayed by the manufacturer can be re-created with this sealant, so that the original finish can be restored after repair. Switch on the power source, which in some cases has a built-in timer and then apply the tip of the electrode to the highest point on the surface of the stretched panel to be shrunk
The main difficulty experienced in this type of repair is the welding of the new metal on to the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on to the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on to the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on to the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on to the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on to the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on to the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on to the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on the old; this is one of the reasons why it is important to cut away all the rusted section so that the new metal on the old; this is one of the reasons which is not all the rusted section so that the new metal on the rust of the
discarded. It is to the repairer's advantage for him to ascertain that the clearance certificate has been duly signed before the vehicle is returned to its owner. Lift dynamic pressure wing area figure. Following the finishing coats, the vehicle may, if
required, be burnished and polished; the method for this is described in Section 17.15. A coarse-grained sanding disc should be used for this operation as this will provide better adhesion for the plastic filler. It is the only production method which takes full advantage of the two Reinforced composite materials 543 Figure 16.14 Typical formers: (a)
metal tube (b) paper rope (c) cardboard (Scott Bader Co. Ltd ) most important characteristics of polyester resin, namely that it can be set without pressure. The word 'universal' means that this single pair of snips can be used for cutting straight lines and both external and internal
curved edges. PAL links the common engineering materials, generic adhesive types and Permabond's own products to assess the relationship between materials, design, production and use. When metal structures in service are subjected to vibration over long periods, the rapid alterations of push and pull, i.e. compressive and tensile stresses,
ultimately cause hardening of the metal with increased liability to fracture. Once spraying is completed, the combi-booth can be put into the bake cycle in which the internal booth temperature is raised to promote rapid curing of the paint. 16.5 Resins used in reinforced composite materials The first man-made plastics were produced in this country in
1862 by Alexander Parkes and were the forerunner of celluloid. These gases can be used to weld low-carbon mild steel, high-strength steel (HSS) and very low-carbon rephosphorized steels. 446 Repair of Vehicle Bodies Figure 14.72 Front diagonal alignment check No. Standard measurement point Hole-Size shape. Almost all the offence comes from
the styrene vapour and glass filaments, both of which advertise their presence before the concentration reaches a danger level. An estimate has to be a clear, concise statement of what you consider to be a fair return for the care and work you carry out on a crash damaged vehicle. The first step is to strip the door of interior trim and window. 17.10.2
Spraying curved surfaces As previously stated, the gun should be kept at right angles to the surface and as near a constant distance from it as possible (Figure 17.32). The motor drives the compressing pistons, which are situated within two cylinders set above the storage tank. The rear bulkhead, mainly in the form of a rear squab panel, is again a
very stable structure. Once measurements are satisfactorily achieved, the accurate positioning of new panels can be made prior to welding. It is designed with a chamfer at both ends of the stem; this facilitates easy insertion into the placing tip of the installation equipment, and into the hole in the workpiece. The coils are stacked on a furnace base,
covered by an inner hood and sealed. 28 Explain the basic principle of plasma arc cutting. Figure 12.40 Lack of fusion between the weld bead and the parent metal can produce serious crack-like defects. Disc pad adhesive Bonding paper discs to backup pads. It can also be used
for setting out lines at right angles to an edge or surface. Anti-submarining ramps built into the front seats further aid safety by reducing the possibility of occupants sliding under the belt (Figure 1.8). Off side The right-hand side of a vehicle as viewed from the driver's seat. The tools are manufactured in various sizes from 18 in to 34 in (3-19 mm). 9
When the cylinder content are unknown, treat as acetylene cylinders. You are not expected to be a first aid expert, nor are you advised to attempt to give first aid unless you are properly qualified. Automotive finishing and refinishing 587 Non-bleeder gun These are equipped with an air valve. 308 Repair of Vehicle Bodies 8 When welding outside a
permanent welding booth, be sure to have screens around so the arc will not harm persons nearby. The base frame is manufactured from polarized steel. Tensile strength and ductility, which are good in mild steel, are vital to 'crumplability' (the ability to absorb the impact energy), and this is why resistance spot welds are used. 7.7.1 Spire speed nut
This nut has a double-locking action which operates by means of an arched base and arched prongs. This depends on the thickness and the thermal conductivity of the metals. 13.2.3 Wheeling The craft of wheeling has been used for many years in the production of curved panel assemblies that are used to make up the modern vehicle body. This
system reduces VOCs by 70% and CO2 by 15% compared to conventional techniques. Cures by means of air moisture Particularly suitable for all automotive problem areas where cleaning is difficult. Metal halide (MBIF) These lamps are now both long life and suitable for colour matching. Putting your thumb on the flat section at the base of the hook
will help to direct the spray. Safety in the bodyshop has become a priority, with an ever increasing need to ensure a safe and healthy working environment. Clearance between the surfaces Any clearance between the surfaces to be welding surfaces and healthy working environment.
Originally the process was evolved in America in 1940 for welding in the aircraft industry. The wheels are completely detachable, allowing the bench to be lowered directly to floor level. 2.1.2 Hand protection Body technicians and painters are constantly handling substances would a grid dolly beautiful to health. 14 In what circumstances would a grid dolly beautiful to health.
used? Requirements of the Petroleum (Consolidation) Act 1928 Paints, thinners, and other products governed by this Act will either be labelled 'Petroleum mixture giving off an inflammable heavy vapour' or have a flame symbol and the words 'Highly flammable', indicating a flashpoint below 22 °C. 508 Repair of Vehicle Bodies 15.2.6 Preparation and
refinishing area When planning your bodyshop, productivity, health, safety, and environment regulations must all be taken into consideration. 13 Name the types of materials that could be used to reinforce polyester resin. This type of bloom cannot normally be cured, except by flatting and recoating. A quick test for identifying to which group a plastic
belongs can be made by cutting a very thin sliver off the component. 17.14.1 Coach finish This is the traditional materials mainly because of its lengthy drying time. Lift 1/2V2ACL 32 Repair of Vehicle Bodies Grid system The vehicle body shape is broken
into grid squares, or cells, see Figure 1.29. The landmarks in more modern motor vehicle history are as follows: 1688 Ferdinand Verbiest, missionary in China, made a model steam carriage using the steam turbine principle. Metals having a refractor surface oxide film, like magnesium, aluminium and its alloys, are normally welded with AC, while DC
is used for carbon steels, stainless steels, copper and titanium. The results of the elasticity of the air bellows, and any pressure changes on the measuring unit are controlled by internal
regulators. This allows the frame to be pushed under the vehicle. Soft and hard soldering methods 247 7 If the pieces to be welded are grooved, use several passes to fill the V. Be careful when Craft techniques and minor accident damage 401 Figure 13.76 Mercedes McLaren SLR door
disconnecting and re-connecting the seat wiring because seats also may incorporate an electrical earth cable to reduce the risk of travel sickness and connections for the pyrotechnic anti-submarine seatbelt pre-tensioner. Unless the surfaces are tinned properly the bronzing procedure to follow cannot be carried out successfully. In an effort to
conform to the EPA, spray gun manufacturers have developed spray guns which atomize the paint at low air pressure, that is 0.6 bar (10 psi) as opposed to the usual 4-5 bar (60-75 psi). Compared to that at TDC. Figure 1.18 illustrates the
improvements in aerodynamic drag coefficient achieved by alterations to the shape of vehicles. Alternatively a hook is inserted into the slide hammer to pull out each washer individually (Figures 13.65 and 13.66). The hatchback and estate car have a rear window built into the boot lid, which is then known as a tailgate. A small brush is used to apply a
solution of soap and water to the filler channel. (m) Lapped sections are held in place mechanically with adhesive or wet resin between sections as seal. In some cases a fine-toothed hacksaw blade, fitted in a padsaw handle, and a pair of snips or shears can be used to remove damaged sections of panels. The vernier scale is based on the difference
between measurement made on two scales which normally have one division difference. The 600 g/m2 density is rather too bulky for many purposes, and may not drape as easily, although all forms become very pliable when wetted with the resin. Resin can be removed from the hands with proprietary resin removing creams, or with acetone followed
immediately by a wash in warm soapy water. They are supplied ready for use and are applied over the final coat of surfacer or spray filler to provide hold-out of the finishing material and promote higher gloss. Christmas-tree buttons are a variation of push-in fasteners, and when they are pushed into the hole they take up great variations in panel
thickness. Spraying pressures should be in the order of 3-4 bars (45-60 psi). This should be bolted to the floor at least 300 mm from any wall, and sited where it can receive an ample supply of clean dry air. These can be either electric or driven by compressed air. 7.5.3 Threaded inserts (such as Nutsert) of high strength (Figure
7.30) can be placed by any of three specially designed tools. In the other type, the catalyst injector system, accelerated resin is sprayed from a (b) Figure 16.20 The spray-up technique (BP Chemicals (UK) Ltd ) single-nozzle gun, but liquid catalyst is metered into the resin in the gun itself. Shallow drawn panels are used for automobile roofs, doors,
bonnets and boot lids. Normally after 12 hours immersion the cylinder will be safe to be disposed of by the gas supplier. A positive camber is when the top of the wheel tilts away from the vehicle. 1831 Sir Charles Dance ran a steam coach (built by Sir Goldsworthy Gurney) on a regular The history, development and construction of the car body 9
Figure 1.4 1905 and 1909 Vauxhalls with wooden spoked artillery wheels with pneumatic tyres (Vauxhall Motors Ltd ) Figure 1.5 Twin concept car with interchangeable engines (petrol/electric motor drive module) (Vauxhall Motors Ltd ) service from Gloucester to Cheltenham. All rolling machines comprise two front rollers which lightly grip and draw
steels Argon \equiv 30 to 40% He \equiv up to 1% O2 MIG: dip, spray and pulse welding of stainless steels groove, V groove, as well as T and lap joints (Figure 12.5). It also caters for the various types of paint and colours. The first step therefore is to visit the local council office and arrange an appointment with the planning officer who will want details of
dimensions of proposed buildings and construction materials. The doors are left suspended on their hinges to act as templates during the operation. As a result of ECE Regulation 43 this type of windscreen has been superseded by the fully zebrazoned windscreen. If this metal is bent to a small radius it exceeds the limits of its flexibility, and the metal
in the bend becomes stiff and retains its curved shape. They are available in a variety of weights and sizes but are usually round or square in shape (Figure 3.27). The joggled panel edge provides a stiff joint and helps prevent distortion when welding. Unlike some plasticized materials, leather does not appear to attract dirt and dust as a result of static
electricity. Remember that polishing is the final process; should grit be picked up on the disc, scratches will result which can ruin the finish on a vehicle. At this stage their cores will have a coarse grain structure due to prolonged heating, and the grain is refined by heating the steel parts to 900 °C and quenching them in oil. 2 On thick sections,
especially in repairing castings, bevel the edges to form a 90° V-groove. The final finish can be achieved by using different grades of emery paper or a sanding machine with a very fine grit sanding disc. The basic types of tools consist of: 1 2 3 4 5 Manually operated plier types Manually operated lazy tongs Portable pneumatically operated guns
Portable pneumatic hydraulic guns Pneumatically operated stand tools. The hydraulic repair system includes a multidirectional push-pull facility together with accessories. Apply three full coats, allowing 10-15 minutes between coats. The side valance assemblies form a housing for the wheels, a mating edge for the bonnet and a strong box section for
attachment of front wings. All the brake shoes on the car are bonded together. Most reinforcement materials are manufactured from continuous filaments ranging in fibre diameter from 5 to 13 micrometres. Special grades of roving are available for each of these different chopping applications. This can be done with infrared lamps or in a heated
booth (though not in excess of 50 °C). 8 In some panels it is possible to use a spoon for the backing tool for the hammering operation, especially on door panels or over inner constructions. Otherwise, gas holes will form in the bead, resulting in porosity which weakens the weld. The two streams of resin spray converge near the surface of the mould
simultaneously with a stream of glass fibre ejected by a glass rovings chopper. 14.4.2 Repairs to underbody is the foundation on which the vehicle is built. However, before any plans are prepared for building works, advice should be taken on bodyshop planning. The Car-O-Tronic can also be linked into
the Auto-quote management control computer package. This has the effect of drawing the assembly together and put it on charge to ensure that it will re-start the vehicle when the repair is completed. Epoxies Based on an epoxy resin, which is
mixed with a hardener. Thorough rinsing with water and drying should follow. Wind is very rarely a straight-on head wind, so calculations can be done for any of the 360 degree possible wind directions 31 for each of the ten million grid squares. 1 12 3 13 2 14 5 6 11 4 7 6 10 9 8 Figure 1.43 Major body panels 1 2 3 4 5 6 7 Roof panel Bonnet panel
Boot lid Front wing Radiator grille Front bumper bar 44 Repair of Vehicle Bodies The history, development and construction of the car body (Facing page) Figure 1.44 Body shell assembly (Austin Rover Group Ltd.) 1 2 3 4 5 6 7
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 Underbody assembly Body side frame assembly Windscreen upper rail assembly Cowl and dash panel assembly Front wheel house complete panel Instrument panel assembly Bulkhead brace assembly Rear
quarter centre panel assembly (back window) Back window upper rail panel assembly Rear end upper panel assembly Front side member assembly Front side member assembly Front side member assembly Front side member assembly Rear end upper panel assembly Front side member assembly Front side mem
front-end assemblies (Rover Group Ltd ) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Headlamp panel Front cross member closing panel Front cross member Bonnet frame extension Bonnet skin Bonnet frame Dash panel
Scuttle panel Front bulkhead Chassis leg reinforcement RH and LH Front inner wing RH and LH Front chassis leg gusset RH and LH Front wheel arch RH and LH Front wing RH and LH Front wing RH and LH Front wing RH and LH Subframe mounting RH and LH Front wing RH an
reinforcement RH and LH A-post front reinforcement RH and LH 45 46 Repair of Vehicle Bodies around the entire windscreen opening so that the upper edge of the cowl panel forms the front edge of the roof panel. The fastener is supplied in 6.4 mm diameter in various lengths. 2.8.8 Injuries involving individuals are reported immediately to
competent first aiders and/or appropriate authorized persons and appropriate interim support is organized to minimize further injury Should there be an accident the first thing to do is call for help. (c) Only take from the stores sufficient flammable material for the job in hand. In the workshop aluminium is annealed by the use of a blowpipe, and a
stick or splinter of dry wood is rubbed on the heated metal; when the wood leaves a charred black mark the metal is annealed. That is, if the vehicle hits a wall, then the occupants will decelerate at a gentle rate as possible in the time available. 4 Using a special ultraviolet lamp, the resin is cured. The introduction of systems of body jigs was a major
0.20 - 0.40 - 0.10 0.05 0.15 Rem. The joining of metals to both thermoplastic and thermosetting materials is possible by some welding operations and by using adhesives. Table 9.2 gives material thickness, nozzle size and pressures for use with Saffire equipment. Figure 5.9 Bending allowance 5.8 Bending machines 5.8.1 Angle bender (clamp folder)
The essential factors in producing a clean bend on sheet metal are that the edge or blade over which the metal is bent should be straight, smooth and fairly sharp and that the pressure applied to bend the metal over this edge should be equal throughout the length of the divider must be kept finely ground and without making
one leg shorter than the other, and the points must be protected against damage when not in use. Moreover, whenever the underbody has been damaged by collision there is a possibility of a broken hydraulic brake line which could lead to complete brake failure. Damaged AHSS and HSS panels are not readily repairable as the impact changes the
microstructure, making the metal harder. Unlike resistance spot welding, no pressure is Gas shielded arc welding required on the workpiece with MIG/MAG spot welding, and neither is a backing block. Spraying reduces labour costs, especially when the volume of production is large enough to keep the equipment in constant use. The construction of
today's mass-produced motor car has 1.3.1 Composite construction (conventional separate chassis) The chassis and body are built as two separate units (Figure 1.32). 12.5.5 TIG electrodes Figure 1.32).
hard-to-remove dirt detergent can be added to the pressure washer. Thickness of spray-up over the form should be limited to an area of approximately 1 square metre. Alternatively a body shop may require different types of filler such as a general-purpose filler, a glass fibre reinforced
filler (with added fibreglass strands, which provide great strength for bridging holes and strengthening weakened areas in metal and GRP), a fine surfaces, file marks or sanding marks) and, where repairs are being made to galvanized panel surfaces, a filler suitable for
zinc (a filler possessing high adhesion to coated steel surfaces). Thatcham suggest a set sequence of paint refinishing operations, these are shown in Figure 14.143. Except on very thin material, extra metal in order to strengthen the seam slightly. In the machine the top blade is fixed to the
moving member or ram and the bottom blade is fitted on an extension which is shaped like a spiral so as to part the material after cutting. The average body shell is joined together by approximately 4500-6000 such spot welds. BC-post Central pillar acting as a central roof and side support between the rear and the front of the car. Any material that it
may be necessary to add to complete the weld is known as filler metal which, if in rod or wire form, is obtained from a welding rod. This method has been continued, and today solder filling plays a major part in the finish and repair of the modern car body. 15.7.1 Requirements of BS EN 9001-2000 BS EN 9001-2000 identifies basic disciplines,
procedures and criteria to ensure that products and services meet the customer's requirements. Often double-curvature panels such as wheel arch fabrications must be made up in three or four parts for ease of patching on to the coating, which is
shop floor. The electric supply for this type of welding may be Manual metal arc welding Figure 11.1 (a) Principles of metallic arc welding (b) cross-section of a coated electrode in the process of welding may be Manual metal arc welding 795 voltage. There are two types of straight edge. Systems therefore have been specifically designed to overcome problems of dust, noise and oil
pollution. Ideally, one drop is transferred with each pulse and is fired across the arc by the pulse. Screws are available in steel, brass and bronze, without sufficient experience there is a danger of over-stretching the metal owing to the inability to direct the blow accurately on to the low area under repair
Apply sealer all round the metal lip on the body aperture. Those with a flash point of 22-32 °C are governed by the Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972. Using a mirror and torch will help to see into any dark corners. The bulk of the machines for bending thin gauge metal are of 3 m or less, with capacities
starting at 20 tonnes and going up to about 200 tonnes. Disengageable frames allow other frames to be used with the material being welded 2 Physical properties of the material 3 The welding process and mode of operation 4 Joint type and thickness. The prominent
position of the bonnet requires its finish to be perfect because ripples and low spots can be easily seen when painted. The electrode used for carrying the current is usually a tungsten or tungsten alloy rod. The equipment uses multiple anchorage and hook-up points which provide tremendous versatility in the direction of pull available (Figure 14.8)
Thin spoon (Figure 3.9e) is a very special thinbladed spoon, the blade having a very slow taper which permits entry into restricted spaces between double-skinned panels which would not be possible by using a normal spoon. The ends of the cross tube provide a lifting point for the adjustable safety stands, enabling the car to be raised to give access
under-neath. When they are mixed together a catalytic action takes place, resulting in the filler hardening very quickly. This type of abrasive paper is normally used in conjunction with water to avoid a build-up of paint particles which would affect the abrading effectiveness of the paper. To provide additional safety a beehive or volute spring is fitted.
over the end of the barrel to prevent the chisel leaving the tool accidentally. 7 Pressure wash door apertures and edges to remove degreaser. The amount of sinkage after drying is virtually nil. The centre of the damaged area will slowly rise until the original contour is restored. Best below 1 mm Acrylic two part (VOX) Medium modulus Medium
strength Epoxy one part High modulus Very high strength Epoxy two part Medium to high modulus Wery fast. Mobile bench The mobile bench (Figure 14.22) is the simplest of all the Car Bench models. If for example testing was to commence around the windscreen, water cascading down could leak into the car via the heate
plenum or a bulkhead grommet. 5 Health and safety regulations demand protection for the operator in the form of a selfcontained air-fed mask. The same technique may be applied to boot lids, front wings, bonnets and rear quarter panels, and can be the means of repairing a panel in a position where direct pressure from inside would not have
achieved a satisfactory result. Melt the rod well into the weld, using the se problems, the paint manufacturers produce samples of these colour variants and literature with hints on how to match them. When you try repairing a few
items you will get a feel for the job, just like tightening nuts and bolts. Even vehicles outwardly similar to European-specification models, but intended for other markets, can often be unsuitable for use in Britain without, at least some, modification. The rear bulkhead also acts as a partition between the luggage and passenger compartments (Figure
1.47). 14 and lengths from 6.35 mm, 41 in, to 63.5 mm, 221 in. In addition it will include: the rectification of any misalignment of the underbody and body shell using conventional hydraulic pulling equipment, together with either a fixed bracket jig or a universal jig with measuring system; the realignment of the body shell, correcting damage with a
combination of pulling and pushing equipment; and the cutting out of panels and reinforcing members which are damaged beyond repair, and the welding in of replacements. This distortion results from the shrinkage which occurs when molten iron passes from the liquid to the solid state. If moisture is deposited on to a tacky paint film it can be
absorbed by the binder or medium, which will swell and give a cloudy, milky appearance with loss of gloss. Since free zinc is towards the inside of the car, it protects against perforation corrosion. On some cars the roof ends above the rear window, while on others it extends downwards so that the rear window opening is in the lower rear roof. A 70
per cent argon and 30 per cent helium mix is generally preferred for thinner cosmetic panels, since the richer 80 per cent helium mix can produce excessive penetration with an increased risk of distortion, although this can be used to advantage on thicker panel structures. The Motor Car Act resulted in considerable persecution
of the motorist for speeding, number plates and lights, so much so that the motoring organizations paid cyclists to find police speed traps. There is a pullout slide on each side of these which is provided with three mounting holes for height tubes. The portable dispenser is operated by pushing the handle down; the filler is then extruded together with
the correct amount of hardener for that quantity of filler (Figure 13.45). In some cases you will be able to correct the panel damage with a single blow which will spring the panel back to its original shape. These are: Moulded latex foam Low-grade fabricated polyether Fabricated p
foam Reconstituted polyether. Vehicle Body repair is both art and science. Push out the damage using the spread ram which acts as a wedge, or force it out using body spoons as levers, then planish and file. Then, using the felt swab, apply the primer evenly along the screen perimeter. This area forms the rear bulkhead between the two rear wheel
arches, forming the rear seat panel or heelboard, and in a saloon body shell can incorporate back seat supports and parcel shelf. 7 The colour of cylinders, valve threads, or markings must not be altered or tampered with in any way. • The geometry and orientation of the fibres in the composite. (b) If hot sprayed, heat to 60 °C and allow 1 hour
between coats. Rovings are also used for weaving, for filament winding and for pultrusion processes. They do not replace recently introduced law dealing with hoods and side screens. They must be cheap and capable of being formed into highly individual and complex
shapes. Phenolics One of the earliest types of structural adhesive. Carbon steel A flux must be used, and the length of time liquids or substances stay on the skin. It can also be connected to a centralized or free-standing dust collection
system. Will cause asphyxiation. Remove loose sealer. Protect tyres with dressing or mask. 12 Name one non-fusion welding process, and give a detailed description of the process. At the same time press firmly against the glass with your hand; this
should force the entire assembly over the body flange. The increase in safety which this piece of equipment affords makes it an essential part of the high-pressure system of welding. Kevlar aramid materials are also included where particularly high strengths are needed. 9.13.5 General equipment safety All equipment should be subjected to regular
periodic examination and overhaul. The allowance for riveting is the allowance for riveting is the allowance for riveting is the allowance for riveting above the plate before riveting is the allowance for riveting is
gauge These calipers are made in a variety of types, some being used for external measurements only and others for both external measurements are made in a variety of types, some being used for external measurements only and others for both external measurements. 13 What is meant by an oxidizing flame? The frames were generally made from heavy ash, and the joints were reinforced by wrought iron brackets which were individually fitted. When a crown
or curved surface is formed in a metal panel, it becomes strong in that it resists any change to its shape. 2 The welding heat must not in any way alter the inherent qualities of the parent metal. (l) Integral stiffeners are most easily incorporated as flanges at a joint to provide dual function. The advantage of this tool is that it can cut sheet metal
internally, and work along either a straight or curved line by drilling a small access hole in the metal to commence cutting. Panel beating is essentially a hammering process, involving different kinds of blows that can be struck on sheet metal. In hand machines the shafts are turned by a handle which
is fixed to the end of one shaft; in power driven machines they are turned by an electric motor which is connected through gearing to the shafts. The main provisions are designed to encourage a more systematic and better organized approach to deal with health and safety. Heel dolly has a low flat face with radiused corners. However, gases that are
a mixture of helium and argon produce a more fluid weld pool, which again leads to a flatter bead than with argon. It can also be used to great advantage in repairing by sectioning or patching, as two panels can be butt welded and then the weld completely dressed off on one side with a sanding machine and finished off, using normal panel beating
hand tools, to a perfect finish. 17 Which Act applies to waste management? The heated gas cannot expand owing to the constriction of the nozzle, and it is forced out to form a supersonic jet hotter than any known flame or a conventional electric arc. 7.2.1 Rivet holes Rivet holes can be punched or drilled. 4.4 Alloy steel is a general name
for steels that owe their distinctive properties to elements other than carbon. These textile sizes are generally removed by heat or solvents and replaced by a chemical finish before being used with polyester resins. 14.2.4 Celette UK 5000 pulling system This is powerful pulling system which is equally suitable for cars or light commercial vehicles. The
cause of the defect is usually incorrect operating parameters, high deposition rate, or low heat input (Figure 12.41). The limitation of spot welding is that the electrode assemblies have to withstand applied forces ranging from 2200 N to 4450 N for the range of sheet steel thicknesses used in vehicle construction and repair. In some cases where it is
difficult to weld a patch, the perforated section can be reinforced by using glass-fibre matting impregnated with resin and bonded to the underside of the repair. Welding torch When lighting up and extinguishing the welding torch, the manufacturer's instructions should always be followed. Combustion becomes impossible even though a considerable
proportion of oxygen remains in the atmosphere. For less important work an AC supply can be used with an open-circuit voltage of 100 volts. 17.14.14 Water-based paints use, as their name suggests, water instead of solvent. Bevel angle The angle of a prepared edge creating a bevel prior to welding. 6 The correct type of joint must be
used. 2 The patent Pro-Vac injector is filled with the appropriate resin, depending on local temperature and humidity, before being mounted on the screen. This will avoid marking the metal on the appropriate resin, depending on local temperature and humidity, before being mounted or oily clothing before wearing it again. The basic Dataliner kit includes two complete 10
tonne pulling units. The strength of laminates made from chopped strand mat is less than that with woven fabrics, since the Reinforced composite materials 537 Figure 16.8 Woven fabric (Scott Bader Co. Ltd.) glass content which can be achieved is considerably lower. The pull continues until the nose of the tool is drawn over the collar, compressing
the collar until it is swaged into the grooves of the pin. Solidification cracks (hot cracking) Solidification cracks (hot
by further planishing with hammer and dolly or using a pick hammer. 79 PPE Usage cotton overalls (boiler suit) safety footwear disposable gloves 'rubber gloves' all the time dealing with dirty or oily items operating the parts cleaning bath lifting heavy/sharp edged items rubbing down body filler or dusty items certain types of spray
painting reinforced safety gloves dust mask breathing apparatus and paper coveralls goggles waterproof overalls and boots using a grinder or drill steam or pressure cleaning You will often see safety notices requiring you to wear certain PPE in some areas at all times, this is because other people are working in the area and you may be at risk
Polished aluminium flakes, because of their silvery metal appearance, are the pigments most widely used. The latter types are generally favoured for lighter work where damage to the paintwork is not extensive, but the electric tools are most suitable where severe rusting of the metal has occurred. Automotive finishing and refinishing 4 Split sprayance.
pattern (Figure 17.41e) caused by the atomizing air and fluid flow not being properly balanced. To give the best possible abrasion resistance, pay particular attention to all joints and recesses. Curing takes place at room temperature but heat can be applied to speed up the curing time. There are, however, several other significant advantages in these
solvent-free substances. In the case of the spot-welding process the gun must have a pressure to the electrodes, and a transformer to enable current at high intensity to be fed to the electrodes. The spraying viscosities vary according to the type of material being used but a rough
guide is as follows: acrylic 16-19 seconds, cellulose synthetic 19-23 seconds, synthetic 23-28 s
impact. To ensure a perfect fit it is often necessary to trim the adjoining panels of ragged edges, and to straighten out the locating flanges using hand tools (Figure 14.99). If prompt action is taken, turning off first the oxygen then the acetylene valve, no damage occurs and the welding torch may be relit provided that the cause of the trouble has been
eliminated. Extremely durable. With type (a) bogies long enough to accommodate vehicles of differing wheel bases must be used (Figure 17.73). With portable extinguishers, a limited quantity of water can be expelled under pressure and its direction controlled by a nozzle. The resin and hardener are coloured light grey and black respectively to
provide a visual check that thorough mixing is achieved. Often edge treatment is used for more than one reason; an example of this may be found on the modern motor vehicle wing, where the edge treatment provides a stiffening effect, gives a safe edge, and also has the effect of being pleasing to the eye. Vehicle body repair work can be divided
basically into two groups: minor accident repair work and major accident repair work. The socket size is 108 Repair of Vehicle Bodies long for reaching nuts or bolts in limited access areas (Figure 3.40c). In other words, the thicker the gel coat the more resilient the resin needs to be. It takes only a few minutes to mount a vehicle on to the Autorobot
XLS II. Many of the components for these vehicles are still made using the traditional hand shaping methods. The outer surface stretches or lengthens while the inner surface stretches are st
vehicles are a good selling point, as customers are always interested in seeing work being carried out. Flat A panel is said to be flat when insufficient shaping has caused uneven contours and so flat areas are obvious. The powder is contained in the metal body of the extinguisher from which it is supplied either by a sealed gas cartridge, or by dry air
or nitrogen stored under pressure in the body of the extinguisher in contact with the powder. 3.15.5 Mini sheet metal cutter This is a lightweight metal shear (Figure 3.30) which will produce curved and straight cuts in mild steel up to 1.6 mm (16 gauge). There are over 25 standard grades of stainless steel specified by BS 1449: Part 2. 9 When
performing a shrinking operation, take care to avoid overshrinking the panel. Vernier calipers consist of a fixed jaw attached to a main beam which slides along the main Figure 6.18 Vee blocks (Neill Tools Ltd (Eclipse)) beam. Minor accident repair work To be able to carry out minor repairs, a good level of ability
with hand tools and all types of power tools, both electrical and air operated, is essential to the Craft techniques and minor accident damage 381 body repair worker. Two types of beating files are available; one is flat for use on low- and high-crowned surfaces, while the other is half-round in shape and is used on convex or reverse-curved panel
sections. 7 What determines the size of the ceramic nozzle to be used for TIG welding? To effect a good bond with a carbon fibre material an autoclave is needed to control the finishing process. 14.4.3 Wheel alignment, and particularly four-
wheel alignment, as an integral part of the major crash repair procedure. Foam can be made from a variety of synthetic polymers (Table 16.7) Densities of foam can vary between 30 and 300 kg/m3 and thicknesses available are from 5 to 50 mm. Parts bonded to chassis: Detachable parts: 1 2 5 9 7 Body top Roof Rear wing Front wing Sill 3 4 6 8 10
Tailgate lining Tailgate outer panel Rear door panel Front door panel Bonnet the transmission system from the engine to the rear axle, and holes may have to be cut into the floor to allow access to the gearbox, oil filler, and dipstick, in which case removable panels or large grommets would be fitted in these access holes (3). 4 Explain the type of steel
that would be suitable to manufacture a scriber. 11 Describe the differences between a bending machine and a rolling machine. It is also a matter of style, for the coachwork must be attractive to the public. When a flat sheet of metal is bent to a wide arc or radius it will regain its former shape when released; that is, it is elastic or possesses elasticity
A variety of thinners are available for use at various workshop temperatures. HSE staff have a statutory right to see a completed accident book or Form 2508, and they may also ask for further information. 17 What determines the number of runs that should be made on a weld? If the damage is very deep it will need pulling out, and this can best be
done using a panel puller on the outer panel surface. Basically the more stars the safer the vehicle (Figure 1.28). The boot framing is joined at the back to the rear end of the 41 boot floor, at the sides to the boot side
panels and at the top to the shelf panel behind the rear squab (10). Waste management: EPA Part 11 Section 34 of the EPA makes it a criminal offence to 'treat, keep or dispose of controlled waste in a manner likely to cause pollution of the environment or to harm human health'. The best possible results are obtained by cutting away the corroded
panel or section and replacing it with a hand-formed section or a factory-pressed panel. You should be kept away from your mouth and eyes, and contact with your skin may cause irritation or a more serious skin disease. Figure 14.58 Drop-line check on front and replacing it with a hand-formed section or a factory-pressed panel. You should be kept away from your mouth and eyes, and contact with your skin may cause irritation or a more serious skin disease.
may also be sprayed hot when thinned 6:1 with white spirit. Stress analysis is usually based upon the tensile strength at which crazing of the resin matrix occurs. In such cases, if the fire service is called out and there is not a fire, they may charge the company a large fee. 6 Set spot size to zero. Fusion welding A process in which metals are welded
together by bringing them to the molten state at the surface to be joined, with or without the addition of filler metal, and without the application of mechanical pressure or blows. Must be mixed Need good fit and narrow gaps to function effectively. Typical examples are as follows: Copper to steel Brass to steel Brass to steel Cast iron to mild steel brass to ste
Stainless steel to mild steel. 2 The use of the BSI logo on publicity material. Bend the top section or back panel back into position and weld. The tube will go slack just before the tip emerges from the opening. Commence with lower areas. In general, the diameter of the filler rod should be about the same as the thickness of the metal to be welded
Individual chemical products carry their own instructions, and health and safety procedures must be adhered to at all times. The vehicle now moves forward to the area where the suspension is fitted, for which purpose the subframes will now have to be removed. Figure 5.12 Bending rolls (Selson Machine Tool Co. Ltd.) 5.9.2 Pinch rolls Figure 5.11
Box and pan bending machine (Selson Machine Tool Co. Ltd ) 5.8.5 Safety measures for working bending machine that the throat of the normal swaging machine will not accept curved panels or wings, the rollers may be fitted on
to a wheeling machine which is virtually throatless. Before you use any fire extinguisher you must ask yourself three questions: 1 Can the fire be put out easily? If, however, the presence of other elements is suspected to be, or in the case of routine analysis is indicated to be, in excess of the specified limits, further analysis should be made to
determine that these other elements are not in excess of the amount specified. The operating voltage is about 25 volts, depending upon arc length and type of electrode, and over a current range of 40-450 amperes. Figure 3.27 Round-faced mallet, pear-shaped mallet and sandbags (F. Sensors When carrying out body repair look out for sensors
Owing to this construction, collision damage usually is confined to the area of impact; the box sections tend to crumple or concertina, thus absorbing much of the natural ageing aluminium alloys must be completed within two hours of quenching, or for
changing into a solid solution with the iron and forming what is known as austenite. 6.2.12 Trammels (beam compasses) Trammels (Figure 6.8) are used to describe arcs and circles of large radii and mark off lengths which are beyond the range of dividers. A central groove along the length of the blade enables each of the heads to slide along this
blade and to be locked in any position on the blade. Leaks through body seams should be sealed from the outside wherever possible to ensure water is excluded from the seam. Halon 1211 (bromochlorodifluoromethane, BCF) has a low toxicity level, is considered to be noncorrosive and has a long storage life. The floor is a complete panel from front to
rear when assembled, and is usually fitted with integral straightening ribs to prevent lozenging. When the repair has cooled, remove any excess or unevenness with the P60 and then finish to feather into the existing paint using P600. This elimination of blind spots is now being achieved by using bigger windscreens which wrap round the front A-post,
and rear windows which wrap round the rear quarter section, giving a wider field of vision. 30 State why water-cooled electrode tips are used in the manufacture of vehicle body shells. Fitted without the use of special tools, they are pushed or tapped on to a convenient panel edge, using a light hammer. Various bodyshop plans are shown in Figures
15.1a-d and 15.2a-c. 18 Explain the principle of the Spire speed nut and state where you would expect to find them on a vehicle body. Figure 16.3 Derivation of glass fibre reinforcement Figure 16.4 Manufacture of rovings. 23 Describe the major features of a TIG welding torch. For most grinding operations, finish grind in the longest direction
possible on the repaired surface. 13 Evaluate the likelihood of harm occurring. When windscreen were first introduced such accessories as windscreen wipers and washers were unknown. Should it prove to be too difficult or impractical to remove any parts, these should be masked completely. The technique is similar to that of using a dolly, as the
mallet is used on the inside of the panel to hammer and dolly. 17.14.8 Acrylic lacquer: local repair Acrylic lacquer can be used to repair high- and low-bake enamels, but is not recommended for repairs to half-hour enamels or
nitrocellulosebased air drying finishes. 7 Methods of joining 7.1 Development of joining methods In the manufacture of motor vehicles, the development of new and more effective fastenings is almost a branch of engineering in itself. A warranty is provided to the customer, but usually on condition that he or she has the vehicle checked for signs of
corrosion at regular intervals and is prepared to pay for any rectification work that may be required. These compounds are waxes and inhibitors dissolved in a solvent. Each part of the front and rear wing will be laid on its respective hammer former. arc voltage, though the current intensity remains almost constant. Therefore it is important to clean
off the oxide prior to welding, to be able to keep the aluminium fluid during the welding process at 650 °C. Combination spanner sets are available in AF 41 in to 114 in and metric 3.2 mm (Figure 3.37). 12.14.1 Residual stress and distortion The solidification and contraction of the weld bead will induce strain and consequently stresses in
       bint. It consists of a chisel bit which is retained by a spring through one end of a barrel, and a piston which moves to and fro within the barrel, on to a sandbag, and to give it a series 344 Repair of Vehicle Bodies Figure 13.2 The
technique of hollowing of blows around its outside edge, working towards the centre by means of a pear-shaped mallet. All types are readily paintable and weldable. The volume of paint passing through the fluid tip and implement
a formal quality system in the company, a controlled, logical action plan should be followed. A straight edge should never be used for any purpose other than that for which it is intended. oxygen cutting supply, and move the cutter steadily and at a speed which produces a smooth cut. 1.5.8 Complete underbody assembly This is commonly called the
floor pan assembly, and is usually composed of several smaller panels welded together to form a single floor unit. In addition, the following are used for non-body purposes: polyester, polyethylene, quartz, boron, ceramic and natural fibres such as jute and sisal. Will ignite and burn instantly from a spark or piece of hot metal. Preplanning is essential,
whether for the building of a new bodyshop or the remodelling of existing premises, because it is necessary to be certain that the finished bodyshop will meet all the operational requirements before construction is started. 37 State the welding process that is not recommended when welding HSLA steels. (d) Bolting flange. * These units are available
for accreditation in addition to those necessary for the full NVQ/SVQ, if required. 14.4.1 Repairs to monocogue bodies by pulling from the outside is not new, but the application of this principle has developed into two main methods. In the main after a collision if the stresses are removed from the rigid
areas first, then the flexible areas (except where badly creased in the impact) will regain their former shape. Briefly, cold working causes deformation by crushing or distorting the tops of rechargeable batteries and at the same time
providing a tab to serve as a connector. 1.6.1 Single vehicle approval scheme 1.5.20 Vehicle identification numbers The vehicle identification number (VIN) is stamped on a plate located typically inside the engine compartment or on a door pillar. These things will occur normally only if you hold both hammer and dolly loosely. Spatter may be
unacceptable for purely cosmetic reasons: it may also inhibit the application of surface coatings (as in vehicle painting) and may initiate corrosion. It is seldom that a pushing application can be achieved using the ram only, because of its limited travel; therefore there are available various combinations of extension tubes, couplings and pusher heads
to cater for any repair requiring straightforward push. It is essential to cool the metal slowly after welding. 9.3.7 Hose check valve Goggles fitted with tinted glass of an approved type complying with the requirements set out in British Standard specification 679 should be worn to protect the eyes from the intense light of the flame as well as from
sparks and small metal particles thrown up from the weld. For very accurate testing a vernier bevelled protractor must be used. A negative camber is when the top of the wheel tilts towards and forwards in a progressive forward motion melts
down filler rod and plate without the filler rod entering the core of the arc, and is recommended when welding plate in excess of 6 mm thick. The greater the crown or curve of the panel, the greater its strength and rigidity to resist change in its shape. The pointer carries slides on transverse rules with their own scales to allow width positions to be
set. Precautions should also be taken to prevent the mixed material or spray vapours making contact with the skin, as this can cause dermatitis. The hacksaw blades are classified by length and the number of teeth to the inch. This will have an oxide scale coating, unless an alternative finish is specified (see Table 4.2) Material produced by cold rolling
to the final thickness Skin passed Temper rolled SP Hardened and tempered H1 H2 H3 H4 H5 H6 HT Material that has been subjected to a final light cold rolling Material in the annealed last condition (i.e. which has not been subjected to final light cold rolling).
temper and gualified as follows: Eighth hard Ouarter hard Half hard Three-guarters hard Hard Extra hard Material that has been continuously hardened and tempered in order to give the specified mechanical properties 4.3 Carbon steel Carbon 
steel Medium-carbon steel High-carbon steel. Some of the factors which is too slow, retarding drying 3 Spray room temperature too low, also retarding drying 4 Spray gun held too close to the surface, or spray gun movement too slow, retarding drying 3 Spray room temperature too low, also retarding drying 4 Spray gun held too close to the surface, or spray gun movement too slow, retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding drying 3 Spray room temperature too low, also retarding a Spray room temperature too low, also retarding a Spray room temperature too low, also room temperature too low, also room temperature too low,
being sprayed. A so-called two-seat nozzle fits this design (Figure 9.23a). Therefore the final decision depends on what is economical to repair and what is economic
leverage that the ratchet handle provides is often all it takes to move a stubborn screw. Allowances must be made for the width of the cut and, when accurate positioning of the cut is essential, templates can be used as a guide. Therefore the better the metal is as a conductor, the more heat barrier should be applied when working with that metal. A
screw can be driven directly into thermoplastics, making it a very cost effective way of making positive joints. Cutting torches in which oxygen and the fuel gas are mixed in the body of the torch (injector cutting torch and two-seat
nozzle (b) three-seat nozzle (BOC Ltd ) 266 Repair of Vehicle Bodies and fuel gas. The Mark 5 is capable of lifting a car to a height of 1.4 metres using the scissor lift, thus allowing the bodyshop staff to work standing up, and therefore reducing stress and increasing speed and productivity. Skin panels are formed in reinforced polyester sheet, made of
equal parts of resin, fibreglass and mineral filler. Gravity types are also available (see Figure 17.22). 22 Use low-voltage equipment wherever possible (110 volts). Figure 11.13 Overlapping 11.6.9 Types of joint used in manual metal arc welding The selection of the type of joint to be used for a particular application is governed by the following factors
(Figure 11.14): 1 The load and its characteristics 2 The manner in which the load is applied 3 The cost of joint preparation and welding. 4 Doors, gates, escalators (safety devices). The shorter arc will minimize the tendency of the molten pool to sag or run down and cause overlap. When direct current is used the electrode may be connected either to
the positive or to the negative side of the power source, depending on the material to be welded. In the lowpressure system the acetylene gas is produced at a Figure 9.1 Low-pressure welding equipment 249 very low pressure. This stretches the
area being wheeled and so tightens up the loose edge. The corrective force should be applied as near as possible in the direction opposite to the force which caused the damage. Steel, on the other hand, may reveal a considerable degree of elasticity as, for example, in metal springs. The weight is 1 lb 10 oz (736 g). 3 Do not inhale fumes from
heat/flux application. It uses a variable question-and-answer sequence to determine the exact nature of the bond required and the conditions under which it must operate. Water penetration behind windscreen rubbers, door checks, etc. When the nut is tightened it is locked both by the self-energizing spring lock of the base and by the
compensating thread lock as the arched prongs engage the thread. Check that the tip force is enough without bending the electrode arms or sliding the tip one upon another. 13 Draw a sketch to show how a Dozer can be used to repair a front end damaged by collision. Rub down stopper with P400 grade paper, and spray locally with cellulose
surfacer. Rolls-Royce exhibited their first car in Paris, A smoother surface will be obtained if this is backed by a solid flexible former. On the rear end of the torch there are two female unions for connecting the relevant hoses; to Figure 9.7 Welding and cutting blowpipe, high pressure (Murex Welding Products Limited) eliminate any danger of
interchanging the hoses, the oxygen union has a right-hand thread and the acetylene union a left-hand thread and the acetylene union has a right-hand thread. This build-up of stresses in the bend or curve is an essential factor in the design of vehicle body panels which together form the body shell. This is a graduated disc with a fixed adjustable blade and a stock with a straight-edge extension.
Having accomplished its primary duty of removing the oxide film, the cleansing action of the flux restores the free affinities at the surface of the joint faces, promoting wetting by reducing the contact angle developed between the molten brazing alloy and parent metal. Zinc coated sheet materials require the use of heavier welding equipment capable
of producing a higher current to penetrate the zinc coating, and the electrodes must be constantly maintained by cleaning to avoid zinc pick-up when welding. As with the other tests, these are based on EEVC guidelines. The material to be joined is placed between two electrodes, pressure is applied, and the electric current passes from one electrode
through the material to the other electrode. Nitrocellulose materials are particularly prone to this phenomenon, which can affect the adhesion to the substrate. Jig brackets were introduced to serve as simple go/no-go gauges, providing a continuous visual indication of the extent of damage. Sizes range from no. The inner construction of the head roof
of these saloons was concealed by a headlining. The material thickness and joint design will determine whether or not filler metal in the form of welding rod needs to be added to the joint. The most obvious means of spreading is provided by the wedgies and spread rams. After fiberizing the filaments are coated with a chemical treatment usually
referred to as a forming size. Expansion The increase in the dimensions of metals due to heat. This is useful when carrying babies or small children in seats which are protected by airbags, or the seatbelts are used as part of a child restraint system. The disc or blank is rotated after each blow as in hollowing, but working from the centre in courses
outwards towards the edges of the blank. Wash down remaining traces with copious water. Of the above groups, the austenitic steels are by far the most widely used because of the excellent combination of forming, welding and corrosionresisting properties that they offer. 5 Allow the heat from the soldering iron to penetrate into the metal before
moving the iron along the joint; this will give the solder a chance to flow into the joint. If the surface requires filling and stopping up, it should be wet flatted with 280 grade paper using a water miscible solution or liquid detergent. The more solder, the weaker the joint; therefore a good joint has only a very thin film of solder between the metal plates,
which forms a surface alloy by using the tin in the solder. 7.8 Adhesives Adhesives Adhesives are to be found almost everywhere in the modern world. No further measuring of any kind is required. Questions 1 Describe the general precautions which should be taken in the storage and handling of oxygen and acetylene cylinders. Again this may be reduced by
rocking the plate between the rollers, but it may be necessary to preform the edges of the metal by hand before rolling. Process: soft soldering. Find used parts on auction or local sites. Pneumatic or electric cutter (oscillating) This is an air or electric powered tool to which special shaped blades to suit specific vehicle models are fitted. The bar code
contains information on the labour time, the cost of replacement parts and the part number for identification. 20 Describe the safety measures which would be necessary when using hand and small power tools in a workshop. Sometimes they did four round trips a day, doing 9 miles in 45 minutes. The rectifier emits a DC voltage, which is determined
by the remote control in the welding trigger and the gas/wire matching switch on the box. Tables 4.1, 4.2 and 4.3 are the specifications for steel sheet strip and coil for the manufacture of motor body shells in the automobile industry. Coming outside to find a damaged or dangling side mirror on your car is never fun. If the component, say a bumper,
has been holed, it is possible to weld in a piece from a scrap bumper of the same shape. Use a slightly circular torch motion and run the beads as in regular fusion welding with a filler rod. Usually rawhide is used on aluminium and the lighter metals as it gives a softer blow than boxwood and is less liable to mark the metal. On aircraft, the wing plan
area is more appropriate. The quarters (19) are the areas of the body sides between the rear standing pillars and the back light and boot. 4 An alternative method of production, designated H2, may be used instead of the H1 routes, subject to agreement between supplier and purchaser and providing that the same specified properties are achieved. It
is used to fabricate and repair panels where curves are needed in angle sections, especially around headlights, edges of window frames, door edges and wheel arches. Again working from the inside and starting from one of the top corners, pry the rubber weatherstrip off the body flange with a screwdriver. The blows should be heavy with a follow-
through action which will speed up the roughing-out operation. 4 Ensure the equipment is maintained in an efficient state, in efficient working order and in good repair. The floor pan is bolted at 16 points to the box section steel back-bone chassis, with further rigidity and occupational protection provided by a high-strength aluminium alloy
windscreen frame, a tubular steel scuttle beam, and steel beams in the Figure 16.33 Vehicle undergoing interior trim (Lotus Engineering) All Elans have RRIM bumpers front and rear to comply with US federal regulations, and energy absorbing front bumper construction is used. Respirators are usually needed in body repair shops even though
adequate ventilation is provided for the working areas. The power of a welding torch is measured by the number of litres or cubic feet of acetylene which is consumed in an hour with the flame perfectly regulated, and this figure is sometimes marked on the welding torch itself. Figure 13.73 'MIRACLE' pulling tool (Courtesy of POWER-TEC ®) •
WWW.forrestblades.com Use the correct cutting speed, up to 5.5 m/s (1000 feet per minute) - much faster than for steel. Checklist After components. Jenatzy set world speed record of 66 mile/h. They also cool in seconds, which means the vehicle can be moved out of the
booth almost immediately. The very act of compressing air will generate heat, and so the cooling period is essential. Three or four datum points are selected on any undamaged area, and the system is calibrated to the height, width and length position of these points. and, if they do strike parts of the inside of the vehicle, making sure that there is
sufficient padding to prevent serious injury 4 Designing the outside of the vehicle so that the least possible injury is caused to pedestrians and others who may come into contact with the outside of the vehicle. Where an insurance company pays for repairs to the damage of a new or nearly new car, the quality of the work must be such that when the
repair is finished there is no indication of the damage having occurred. 1.5.10 Roof panel The roof panel is one of the largest of all major body panels, and it is also one of the simplest in construction. By far the most important of all accelerators are those based on a cobalt soap or those based on a tertiary amine. Figure 17.71 Suggested use of
turntable Rail and bogie system The vehicle is moved along railway-like tracks with bogies under each of its four wheels. When cleaning portable electrical appliances be careful not to get water on the plug, this could cause a short circuit. That is one is low risk; 25 means somebody is likely to be killed. Always brush on weld-through anti-corrosive
primer before welding. As well as these basic checks an additional gauge is available, known as a diamond detector gauge (Figure 14.59b), which is specially made to fit on the build-up of fumes given off by the welding process,
which could be dangerous to health when welding in a confined space. The sealant itself is either one- or two-component polyurethane. Therefore it is of considerable importance that before the pressure is taken off, these buckles or creases are hammered out with the use of heat and hand tools. Highly stressed underframe gussets, truss panels 0.000
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023 5 Vehicle panelling where panel beating is required; mouldings and trim. Also, working from the outside of the vehicle, remove any windscreen chrome mouldings which may be fitted into the weatherstrip. Curing time The time needed for liquid resin to reach a solid state after the catalyst has been added. radiator side LH Bar front end upper
Bulkhead front pillar lower Bulkhead front pillar side sill Bracket crossmember 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 4 Reinf. Considering the extensive use Figure 14.111 Before and after repair (Glas-Weld Systems (UK) Ltd.) Major accident damage 473 Figure 14.112 Damaged windscreen (laminated safety)
glass) (Glas-Weld Systems (UK) Ltd ) Figure 14.114 Fitting injector to the windscreen (Glas-Weld Systems (UK) Ltd ) of plastics on current models, coupled with an even greater anticipated usage, it is therefore important that engineers and repairers are knowledgeable in the
various types of plastic that are being used and are aware that some plastics can be repaired. 2 Help with implementation, including training for management and staff, production of company literature, contact with suppliers and customers. Hoses are available with internal diameters of 5–20 mm and are coloured red for acetylene and blue for
oxygen to prevent the risk of hose interchange. Zinc becomes malleable between 100 and 150 °C, and so may be annealed by immersing it in boiling water. 3.14 Rivet set is made of tool steel. MGR is valuable where components are supplied to the user with holes already punched or drilled, or where the sheets to 202 Repair of Vehicle
Bodies Figure 7.7 Types of POP blind rivet (Tucker Fasteners Ltd ) be joined are folded or curved, making it difficult to match up two holes of the deflected Figure 14.32 Beam splitter and laser guide (Dataliner, Geotronics Ltd )
beam when the unit is moved to other locations on the rail. The metal in courses over a suitably shaped steel stake or wood block, using floating blows which are struck slightly off the stake with a boxwood pear-shaped mallet. Unified support system
The unified bracket system enables Car Bench users to repair any vehicle using a bracket repair technique but without the necessity for hiring brackets. The phenolics are hardly ever seen in motor vehicles, but they do have a significant residual use in the assembly of brake shoes. Thermosets cannot be welded; most can be bonded using a suitable
bonding agent or glue. The assessors are looking for a system that will identify problems at an early stage and take action to solve them. Cylinder labelling To comply with the Classification, Packaging and Labelling To comply with the Classification and Classi
designed to give more safety information. However, in the motor body industry the specifications which apply are those pertaining to cold forming steels, namely BS 1449: Part 1: 1983. 7.2.3 Types of riveted joint The simplest form of riveted joint as ingle row of rivets
along the Figure 7.1 Small rivet heads (BS 641) Table 7.1 Rivet sizes and hole diameters for solid rivets Rivet diameter (mm) (in) 2.38 0.094 2.43 0.096 3.17 0.125 3.25 0.128 3.96 0.156 4.03 0.159 4.76 0.187 4.85 0.191 6.35 0.25 6.52 0.257 7.93 0.312 8.02 0.316 9.52 0.375 9.80 0.386 12.70 0.5 13.10 0.516 Methods of joining
199 Figure 7.2 Single-riveted lap joint Figure 7.3 Butt joint centre of the lap. When removing the damaged section of laminate, cut the panel back to form a rectangle. Short circuit. Bodyshops purchasing more than 2 tonnes of solvent per year
will be required to register under the classification of Part B 'The Respraying of Motor Vehicles' of the Act. It can be used neat, but it is better to dilute it with at least 50 per cent zinc chloride. 5 Compile a list of safety measures which should be applied in the preparation and use of gas welding equipment. Each type of blow has its uses for particular
purposes. Glass fibre Glass filaments drawn together into fibres and treated for use as reinforcement. 2 Use applicators of some form when necessary. 1 Resistance to tyre tread motion, which varies with the coefficient of tyre friction over the ground and with the vehicle's mass. First cover the bonnet to protect the paintwork. Clean top edges
completely. Flashback Occurs when the flame disappears from the end of the welding tip and the gases burn in the torch. Today wheeling is still used to produce panels for prototype vehicles; one-off assemblies which are specially built to order, and small-volume production, where the panels are prepressed to somewhere near the finished shape and
then finished off by wheeling (Figures 13.8 and 13.9). The following substances are non-corrosive fluxes: Resin and linseed oil, forms a good flux where non-corrosive fluxes: Resin and linseed oil Resin, finely powdered and dissolved in linseed oil, forms a good flux where non-corrosive fluxes: Resin and linseed oil Resin, finely powdered and dissolved in linseed oil, forms a good flux where non-corrosive fluxes: Resin and linseed oil Resin, finely powdered and dissolved in linseed oil Resin, finely powdered and dissolved in linseed oil Resin, finely powdered and linseed oil Resin 
can be moulded in much fewer sections, minimizing panel assembly times and costs. Certain metals are welded very easily by all recognized methods; some metals can only be welded by special welding processes; and other metals are welded very easily by all recognized methods; some metals can only be welded under any circumstances. 25 State the health hazards associated with the use of GRP for
repairs. However, the presenter may be asked to open lockable compartments and remove engine covers, inspection/access panels, trims or carpeting. 1.2.3 Production of models Scale models Once the initial designs have been accepted, scale models of such a design. (d) KPI
(SAI) The KPI or SAI is the angle formed by a line drawn through the king pin or ball joints with a line drawn vertical. 292 Repair of Vehicle Bodies Figure 10.25 Copper shrinking attachment (Stanners Ltd ) Figure 10.25 Copper shrinking attachment (Stanners Ltd ) Figure 10.27 Captive nuts welded on to panel (Stanners Ltd ) Figure 10.27 Captive nuts welded on to panel (Stanners Ltd ) Figure 10.27 Captive nuts welded on to panel (Stanners Ltd ) Figure 10.27 Captive nuts welded on to panel (Stanners Ltd ) Figure 10.27 Captive nuts welded on to panel (Stanners Ltd ) Figure 10.27 Captive nuts welded on to panel (Stanners Ltd ) Figure 10.27 Captive nuts welded on to panel (Stanners Ltd ) Figure 10.27 Captive nuts welded on to panel (Stanners Ltd ) Figure 10.27 Captive nuts well at the context of 
correctly on the panel being welded. 5 The tip and electrode will require changing when they have become pitted and the arc will not strike. 11 Describe a repair situation in which each of the following special hand tools would be used: (a) impact driver (b) panel puller (c) edge setting tool (d) door skinner. The exact nature of the annealing process
used depends to a large extent on the purpose for which the annealed metal is to be used. A slight case of blooming appears as a surface haze on a freshly dried paint film caused by moisture precipitation. Figure 7.47 Set screw (European Industrial Services Ltd.) 7.6.8 Nuts A nut is a shaped block of metal internally cut to form a thread. Fastening
thin sheet poses problems with conventional selftapping screws, and Taptite offers two solutions. The vehicle then becomes the responsibility of the painter, who will carry out a close inspection of the paintwork. When replacing rivets be sure to use the correct type. 12.5.3 Gas supply The inert gas, argon or helium, is supplied to the
welding torch from the storage cylinder via a gas pressure regulator and a gas economizer valve (Figure 12.7), which may be a dual-purpose valve when cooling water is used, and a special flow meter calibrated in cubic feet per hour or litres per minute of gas flow. Consequently, if stainless steels are scratched or cut or drilled, the passive film is
automatically and instantaneously repaired by the oxygen in the atmosphere. The upper wheel has a flat face and revolves freely on its own bearings. Square head bolt is used mainly for heavy engineering and structural work. Advanced fibreglass technology makes it possible to injection mould glass reinforced thermoplastics that
provide a wider variety of mechanical, chemical, electrical and the resin - called the interface. In the case of aluminium the wheeling lines are difficult to see, but by smearing the surface of the panel or sheet with mineral turpentine or very light oil these tracks
become more easily seen and are therefore more easily lapped. The welding rod is 476 Repair of Vehicle Bodies Figure 14.122 Main plastic welding operation (Welwyn Tool Co. Ltd.) Figure 14.121 Welding rod trimmed to a point (Welwyn Tool Co. Ltd.) inserted into the speed-weld
nozzle, and as soon as the edges show signs of melting the weld can be carried out (see Figure 14.122). It can be avoided by using demineralized water for the final rinse prior to painting. It should be noted that, following sanding down with these coated abrasives, the surface should be cleaned with a proprietary spirit cleaner to remove particles of
the stearate coating from the surface before applying paint. However, if masking paper is applied it should be of a fairly stout nature and laid in two or three thicknesses to ensure that any paint remover accidentally deposited on it does not immediately penetrate to the paintwork beneath. With proper control it is possible Figure 10.7 Continuous
resistance seam welding Electric resistance welding 281 Figure 10.8 Seam welding (stitch welding) to obtain air-tight and water-tight seams suitable for such parts as fuel tanks and roof panels. Amorphous plastics basically are of three major types: ABS: acrylonitrile butadiene styrene ABS/PC blend PC: polycarbonate. First a hole
is drilled in the appropriate panels, then the self-tapping screw is placed through the panels and pushed into the spire nut or clip, making sure that the prongs point outwards. The position of the gear lever made an early change from the floor. 16.9.7 Important points in
reinforced composite material repair 1 The strength and ultimate surface finish of a repair will depend to a great extent on thorough preparation of the damaged area. The equal-pressure torch is designed to operate in the high-pressure system (Figure 9.7), and will operate when acetylene is supplied from cylinders. An arrester is Figure 9.10
Flashback arresters for oxygen and acetylene regulators (Murex Welding Products Limited ) fitted to the pressure regulator outlet of a cylinder with its opposite end connected to the hose leading to the welding torch. Body hardware Functional accessories of vehicle body, e.g. door handles. In this case a hammer and special dolly block are used in
conjunction with one another. To form a strong surface Anaerobics Often known as sealants or locking compounds. 15 Sketch and identify a safety sign used in a bodyshop. 26 Why is it important to clean the underside of a damaged panel before commencing repairs? 4 Provide quality training as required by the participants. The aim is to heat both
members of the joint evenly so that they reach the soldering temperature at the same time. Minimum welding pitch The strength of individual spot welds is determined by the spot welds is determined by the spot welds. 3 The vehicle manufacturer paints a number of car bodies with the colour to ensure that the paint is suitable for mass
production application. The program is simple to understand and requires no special knowledge of computers. Tack welds are local welds used to hold parts in their correct relative positions ready for welding. At this stage the normal processes of planishing, dressing up, filing and picking up low spots should not be adopted until the job is completed
The cause of this defect is usually insufficient inter-run cleaning, incorrect welding parameters or incorrect gas shielding. The various stages of the design process are as follows: 1 2 3 4 5 6 7 Vehicle styling, ergonomics and safety Production of scale and full-size models Engine performance and testing Wind tunnel testing Prototype production
Prototype testing Body engineering for production 1.2.1 Vehicle styling Stylin
aerodynamical designs involving flush glazing and the removal of sudden changes in vehicle designs. As already stated, common metals used for panel work have a certain degree of elasticity. Short marks at each end are sufficient for bend lines. Burnishing compounds
are also used during the carrying out of local paint repairs to remove overspray. 9.12 Gases: characteristics and colour coding The following is a summary of gas characteristics and cylinder colour codes. RRIM provides low-cost tooling, low-pressure moulding and design flexibility to accommodate inserts or encapsulations of structural supports.
Normal Room temperature with occasional excursions to about 80 °C. 10 Explain the working principle of a single-acting, two-stage, piston-type compressor. Figure 3.37 Combination and offset combination spanners (Facom Tools Ltd ) Adjustable wrench An adjustable wrench has one fixed jaw and one movable jaw. When working on a painted
bumper it is necessary to sand off any paint in the vicinity of the area to be welded; a mask for facial protection is then necessary. First motor race in Paris. These tops are much smaller and lighter than the conventional brackets, and so are easier to insert or remove when the vehicle is on the jig. This is applied to the bare metal prior to the paint
system. This process uses only inert gases, such as argon and helium, to create the shielding around the arc (Figure 12.2). Locate the highest point in the stretched section of the panel with which you are working. Then fill the holes with polyester stopper or filler. by work hardening such as planishing, wheeling and cold rolling. 2 The intake valve is
clogged. Figure 14.30 Laser beam passing through the transparent scales underneath a vehicle (Dataliner, Geotronics Ltd ) When the measuring equipment has been connected to the bench, the long rail is positioned on the least damaged side of the vehicle and the short rail on the front or rear of the vehicle. The smallest corrosion bubble will look
unsightly if it is in the centre of the bonnet or other highly visible panel. 16 State the effects of parallax error when measuring with a steel rule. A thermistor is temperature operated, its resistance may increase with temperature or it may be of the negative temperature or it may be of the negative temperature operated, its resistance may increase with temperature or it may be of the negative temper
strands are widely used to reinforce thermoplastic compound (GRTP), polyester bulk moulding compounds (BMC) and in the manufacture of wet-laid glass webs. In open-coated abrasive discs, the backing is from 50 to 70 per cent covered. It Figure 13.3 A panel being shaped by hollowing (Frost Auto Restoration Techniques Ltd ) may be necessary
during the beating-up process to anneal the work-piece to restore its malleability, because the hammering tends to harden the metal by work hardening. Steel wires are often given a light coating of copper to prevent them from rusting and to improve the electrical contact and current pick-up when passing through the welding apparatus. It is dual-
purpose equipment, suitable both for jig repair using brackets and for repairs using a measurement system. Reinforced composite materials 563 On that definition depends the original construction and therefore the repair method to be employed. Airbags can not be repaired, and any tampering is probably on a par with taking the pin out of a hand-
 grenade and hoping that the handle will stay in place. Mobile lift The lift is an extremely versatile unit which can be easily moved around the underside of the moulding is an intumescent fire barrier which is a major safety factor
for an engine compartment cover (see Figure 16.22e). 11 What are the essential components of a highpressure welding system? When no metallic ring is heard the hammer is not hitting the metal in alignment with the dolly. 5.1.8 Fatigue Most metals in service suffer from fatigue. To determine whether a paint is suitable for repairing a particular job
a flat area should be chosen and a wet coat of the paint sprayed on to it. This is a method of fitting a glass unit to a vehicle by chemically bonding it to the prepared aperture using specialized compound sealants. Some alloys, such as magnesium and zinc, can be added directly to the melt, but higher-melting-point elements such as copper and
manganese have to be introduced in stages. On occasion it is impossible to reach both sides of a damaged panel. All that is needed to make the system operational is a flat smooth surface, a measuring bridge, the electronic measuring arm and a hand terminal (Figure 14.45). There are different types of thermoplastics, each having a specified
temperature for welding operations. This can then be further converted mathematically into length and width measurements for the target locations. Spray the underbody from every direction to prevent shadow areas (Figure 17.67). 602 Repair of Vehicle Bodies 17.13.3 Treatment with phosphating liquid Following the removal of the paint by either of
the methods described, the bare metal should be treated with a proprietary phosphating liquid. The other joints commonly used in manual metal arc welding are the lap joint and corner joints. Bringing up low spots with a pick hammer is more difficult than by the use of a rounded corner of a dolly block. Then with a clean rag wipe the tinned area to
spread the tinning over the cleaned surface, making sure that every part to be soldered is perfectly clean and completely tinned. This is a form of logic gate so that the airbag and seatbelt pre-tensioners can be activated only if both sensors agree. A VIN The Single Vehicle Approval (SVA) scheme is a pre-registration inspection for cars and light goods
vehicles that have not been type-approved to British or European standards. Chemical reaction The resulting change when two or more chemical substances are mixed. condition, although poor condition may make it impossible to assess whether some construction requirements are met. If equipment has been well chosen and well maintained there
should be little need to do more than follow the guidance on the Regulations. The filler can then be applied to the damaged area after making sure that the surface is absolutely clean and free from any trace of oil (Figure 13.47). Your wholesale supplier will provide you with this information as set out by the manufacturer in the form of either single
sheets on individual substances, or a small booklet covering all the products in a range. After filing, the solder can then be rubbed down with emery paper to give a finer surface finish for painting. For MOT purposes garages must have a customer viewing area. 3 The vent velocity of the extract duct must achieve a minimum of 15 m/s for dry filter
systems. A comparison of hardness can be made with the aid of material testing machines such as those used to carry out the Brinell or Vickers Diamond tests. Resistance This is measured in ohms. That's how we make a profit, you might say; but you could make more profit by repairing the damaged plastics part, this would reduce the cost to the
customer and reduce the waste of precious natural resources. This ensures that the welding voltage is altered at the same time as any current alteration, so allowing the welder to respond immediately to variations in weld gaps and misaligned joints. This type of composite is also known as Fibre reinforced polymers (or plastics) (FRP). The program
selects the adhesives that are most suitable for the job from among different types in order to join two of the numerous possible surfaces. They can, however, differ in their mode of operation, and bend rolls fall into two main types: pyramid rolls and pinch rolls. Spray cellulose primer surfaces to stopped up areas, and flat with P600 grade paper.
Exterior applications include moulding, wood grain, striping, and vinyl roof. This is achieved through consultation with the vehicle manufacturer, other specialist engineers and very often the experienced skilled tradesman carrying out the work. This may be achieved by effective shielding and the prevention of leaks, the ingress of air or moisture to
gas lines, and joint surface contamination from oil, grease, moisture or paint. They also contain mild abrasives to 'cut down' the final coat of enamel and promote a good lustre. Consequently hand-made panels, 346 Repair of Vehicle Bodies Figure 13.8 Sports car panel being shaped by wheeling (Autokraft Ltd ) Figure 13.7 Wheeling a panel to restore
a vintage vehicle (Frost Auto Restoration Techniques Ltd ) which were usually made by wheeling, were replaced by pressed panels made on power presses with mating dies, which very speedily produced accurate panels having a good surface finish. The various heads enable the tool to be used as a square, a protractor or a gauge. Always wear
goggles of the type used for oxy-acetylene welding. Also the iron and steel industry has hundreds of years of practical experience in shaping and forming steel compared to the other materials which could be used to make vehicle bodies. As a result of its strength, toughness, formability and weldability, the car body manufacturers are using this
material to produce stronger, lighter-weight body structures. This hammer is used for roughing out and dressing out damaged sections on panels to restore them to their correct shape and curvature before planishing begins. The choice of welding current is determined by the material to be welded. 8 Why have the COSHH Regulations made the use
of respiratory equipment mandatory? The weathering properties of translucent sheeting are considerably improved by the use of surfacing tissue (Figure 16.11). This tool is designed solely to be used in conjunction with a dolly block; it must never be used for chiselling or any other work which might mark or impair the faces of the hammer, for if the
face of the hammer became marked the marks would be transferred to the surface of the panel. That is, until it suddenly melts. The first is soft and made from cloth or vinyl coated. Body skin panels have been reduced from around 0.9 mm to 0.7 mm, with structural components reduced from 3 mm to between 1.2 mm and 2.0 mm. 516 Repair of
Vehicle Bodies 15.6.1 Statutory legislation Petroleum (Consolidation) Act 1928 Petroleum (Mottures) Orders 1929 and 1947 Factory Act 1961 Weights and Measures Act 1972 (MOT) Abrasive Wheel Regulations 1974 Control of
Pollution Act 1974 Protection of Eyes Regulations 1974 Health and Safety at Work Act 1974 Fire Precautions (Factories, Offices, Shops and Railway Premises) Order 1976 Motor Vehicle Construction and Use Regulations 1978 Control of Pollution (Special Wastes) Regulations 1974 Fire Precautions (Factories, Offices, Shops and Railway Premises) Order 1976 Motor Vehicle Construction and Use Regulations 1978 Control of Pollution (Special Wastes) Regulation (Special Wastes) Regulat
Regulations 1984 Control of Substances Hazardous to Health (COSHH) Regulations 1988 Environment Protection Act 1990 Management of Health and Safety at Work (PPE) Regulations 1992 Manual Handling Operation Regulations Regulations 1988 Environment Protection Equipment at Work (PPE) Regulations 1992 Manual Handling Operation Regulations
1992 Workplace (Health, Safety and Welfare) Regulations 1992 The bodyshop is most affected by the legislation described in the following sections. As well as being easier to fit on the production line, the majority of direct glazing is now done by robots. This time delay is called burn-back and causes the welding wire to burn a little way back from the
molten pool, thus preventing it from sticking to the workpiece. In some grades of high-strength steels, cracking within the vicinity of the heat affected zone has appeared after the welding operation. It tightens the general obligations of an employer under Section 2 of the Health and Safety at Work Act by specifying comprehensive rules on how
substances should be controlled. The terms 'left hand' and 'right hand' used for snips in this country have the continental meaning. It should be fully understood that the vehicle manufacturer uses high-bake materials, whereas the refinisher cannot. After the required shape has been formed and the solder built up to a level slightly above the existing
panel, the final finish is gained by filing the body solder with a flexible panel file, being careful to ensure that the level does not fall below that of the surrounding area. Currently there is no standard system in Europe, nor indeed the UK, for identifying plastics. However, since all pressed panels have some degree of tension in the material structure, it
is important that this should be taken into account by the body repairer. The properties of plain carbon steel are determined principally by carbon content and microstructure, but it may be modified by residual elements other than carbon, silicon, manganese, sulphur and phosphorus, which are already present. It should not be used in areas on a
panel or body surface which are continually in direct contact with water. Firm securing of vehicle during repair. Dataliner laser check has introduced a system for checking car chassis. Other sound absorbing materials are now used for insulation in the automotive industry. Manual metal arc welding Either DC or AC is suitable
providing the supply is steady and capable of fine adjustment. Single Vehicle Approval checks that vehicles constructed for non-European Economic Area markets comply with British law. (a) (b) (e) (c) (f) Figure 3.3 (a) Pick and finishing hammer (crowned face) (b) pick and finishing hammer (flat face) (c) straight pein and finishing hammer (a) (d) (e) (e) (f) Figure 3.3 (e) Pick and finishing hammer (flat face) (e) straight pein and finishing hammer (flat face) (flat fac
(crowned face) (d) straight pein and finishing hammer (flat face) (e) curved pein and finishing hammer (crowned face) (f) fender bumping hammer (Sykes-Pickavant Ltd.) surface on a round face of 112 in (38 mm) diameter; it is well balanced and weighs 14 oz (395 g). 554 Repair of Vehicle Bodies Figure 16.25 Orientation of fibre reinforcement to
other weave patterns; this also means that it does not drape very well. 1.5.15 Boot lid or tailgate This is really another door which allows access to the luggage compartment in the rear of the car (Figure 1.46). Although glass reinforced laminates are characterized by high strength/weight ratio, it is well known that they do not offer the same flexural
strength as steel and aluminium. Lighter car means better fuel economy. Whether water or oil is used for quenching depends upon the use to which the steel is to be put. Guide to spotting areas, and where two or more panel parts over lap each other. This
condition, essential for brazing, arises when there is mutual attraction between the liquid flux and solid metal due to a form of chemical affinity. Having prepared the door and the work bench, an inspection can then be made of the door frame to determine the accessibility for the use of hand tools and hydraulic equipment. 6 What method should be
acetylene valves, and these are used to control the passage of oxygen and acetylene when heating the metal. Depending on the shape of the panel, the grid cells may be of different shapes between square and oblong. Surface plates should be kept covered at all times when not in use. This is an accurate jig made of Kersite, which is a very dense and oblong.
durable material capable of withstanding a large amount of hammering and beating into shape by the panel beater using highly individual hand tools (Figure 13.18) and his special skills. Immediately before welding aluminium panels the areas to be welded must be de-oxidised clean - the best technique is to use a stainless steel wire brush which as
been dedicated for use only on aluminium panel work. Pedestrian impact test A series of tests (Figure 1.28b) are carried out to replicate accidents involving child and adult pedestrians where impact occurs at 40 kph (25 mph) - maximum speed in build up areas in France. Owing to the ever-increasing demand for private transport, competition
increased between rival firms, and in consequence their body engineers began to incorporate features which added to the comfort of the driver and passenger. The edges of the panels are stiffened either by flanging reinforcing members, or by joining to the adjacent panels. This jig or former can be made in either wood or metal, but preferably in
should be scraped before connecting the earth clamp. 9 Explain the advantages of the Hemlok system of structural fasteners. A round tube gives very high strength, but the length to diameter ratio of these tubes is such that they can be layed up on curved surfaces, then when the resin sets they are firmly held
in place like roof beams for maximum strength. Figure 16.43 Removing lower quarter panel on Lotus Elan (Lotus Engineering). In Great Britain the type of glass which is principally used for glass which is princi
are a must for all severe mono constructed body damage because the impact has stressed the body metal. The Metals and non-metals used in vehicle bodies non-heat-treatable alloys can be supplied either as fabricated (F), annealed (O) or strain hardened (H1, H2, H3). VOCs generate photochemical oxidants and suspended particulate matter (SPM);
these are sources of air pollution which most countries are seeking ways to reduce. 9 Identify hazards. 3 The acetylene from the cylinder is always of the highest degree of purity, which enables the operator to make welds of the best quality. They are not suitable for brush application. However, items for ESVA (other than seatbelts) cannot be tested at the operator to make welds of the best quality.
design, and strength with lightness (Table 16.1). 2 Have a suitable fire extinguisher available close by at all times. Electrical cables and earth connections should show zero or very small amounts of resistance. If a large repair is being attempted, do not prepare more than half a pound (0.2 kg) of resin at a time to avoid the mix curing before it can be
used. Helium has a high specific heat, so that a given quantity requires much more heat to raise its temperature by 1 °C than does air; therefore the weld temperature is reduced and so distortion is minimized. Gas welding, gas cutting Table 9.1 Welding data (BOC Ltd.) Swaged nozzle, 6.3 mm. 10 m hose, resettable flashback may be a first temperature by 1 °C than does air; therefore the weld temperature is reduced and so distortion is minimized.
the single-stage. An automatic burner fires into the mouth of the emitter tube, providing rapid warm-up without any need for preheating. These dispensers take a 10 kg tin of polyester filler together with a matching cartridge of benzoyl peroxide hardener (Figure 13.44). 3 There is grease or dirt between coats. After allowing the gun to heat up for at
least two minutes, the tacking operation can be carried out. 2.2.4 General precautions to reduce fire risk (a) Good housekeeping means putting rubbish away rather than letting it accumulate. It has an important role to play in such applications as the assembly of caravans and trailers. If the job is a large one which combines several panels and canno
be readily calculated, a paint combination time (paint comb.) is listed in the single panel part of the matrix. Depending on the type of damage involved, it used to be common practice to replace an entire sheet metal panel; by means of a part panel repair it is possible to replace only those panel sections which are actually damaged. These are usually
designed to give a clearance of 0.05 mm to 0.13 mm between the rivet and the hole, and in the case of rivets capable of only limited radial expansion these recommendations must be followed if maximum efficiency is to be achieved. 10 Allow the repair to cure and then remove the temporary moulds (Figure 16.41). 4.13.5 Safety Having described the
different plastics materials and the manufacturing processes you should be able to start identifying them. 13.16 Repair of component motor body panels To repair damaged motor body panels requires great skill in the use of hand tools and repair techniques, and an ability to assess the cause, extent and sequence of the damage sustained. In some
cases it may be possible for the joint to be self-jigging. Positioning the vehicle is achieved with the help of rolling ramps. When using the dolly block, start by holding it so that it can strike the underneath of the low spot on the panel with one of its rounded corners. Allow any vapours to evaporate. The latter method is quite convenient in such cases as
pulling across the width of a body from an undamaged door pillar which has been bowed outwards. A flex lock arm will fix and hold panels in position during assembly and welding. In addition, woven and unidirectional glass reinforcements are used in areas where more specific loadings are required. 334 Repair of Vehicle Bodies Figure 12.33
Application of MIG welding in body repair work (Migatronic Welding Equipment Ltd ) 12.13.2 MIG/MAG welding of low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steel and HSLA steels Until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steels until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steels until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steels until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steels until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steels until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steels until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steels until the mid 1970s most if not all vehicle bodies were constructed from plain low-carbon steels until t
structures. Will collect at the highest point in any enclosed space unless ventilated there. Figure 16.9 Rovings (Owens-Corning Fiberglas) 16.4.5 Chopped strands of 6 mm, 13 mm, 25 mm or 50 mm lengths. Although the base metal is never actually melted, the unique characteristics of the bond formed
by the bronze rod are such that the results are often Aluminium filler alloys for brazing Nominal composition (wt%) (balance aluminium) BS 1845 ref. A visual inspection is used to measure the strength of a
weld. The sandbag is used with the pear-shaped mallet or the blocking hammer to create panels by hand to a double curvature shape. In cases where the sections are very badly corroded and welding is difficult, the section can be cleaned of surface rust and sometimes brazed to form the joint. It should be noted that e-mail can be sent using either a
mobile telephone cell network, or a portable satellite link, both of which are currently more expensive than a land-line link. 18 State the advantages of a dual alignment and repair system. 10 If leaks are not present, fit the windscreen finishers. Kevlar A synthetic aramid fibre used as a reinforcement for resins. Always wash your hands and any other
actual working pressure or line pressure Figure 9.8 Oxygen regulator (Murex Welding Products Ltd.) at the torch. This is a very popular type of spanner as it enables the nut to be tightened quickly and can be used where
movement is restricted. State the repair procedure to reinstate these panel assemblies. 15.6.3 Health and Safety at Work Act 1974 places a duty upon employers to ensure, so far as is reasonably practicable, safe working conditions and the absence of risks to health in connection with the use, handling, storage and
transport of articles and substances. There are also substances which carry within their own structures sufficient oxygen to sustain combustion. The dye is then washed off and the surface dried. Vanadium Increased toughness and resistance to fatigue. Another method of tempering small articles is to polish one face or edge and heat it with a flame.
When making a silver solder joint between dissimilar metals, concentrate the application of heat on the metal which has the higher heat capacity. Countersunk head A bolt of this type has a head shaped to fit into conical recesses in the work surface so that it lies level and flush. A more effective sound deadener than 146 Repair of Vehicle Bodies Table
4.12 Undersealing and protection materials used in vehicle body repair work Type Base material Application Coatings for underbodies, spray type Bitumen/rubber Coating for underbodies, wheel arches, new and repaired parts. Although it is possible to remove the buttons, they are not normally reusable (see Figure 7.61b). 3 The straightening bed is
hydraulically lifted. Fires can be started if catalysed but uncured resins are thrown away. An adhesive, usually gelatine, was used to hold them together and install the cartridge in the applicator gun. Therefore if the particular
panel is a load-bearing panel, it must be welded in fully to obtain the maximum strength for the particular panel assembly. The boxwood type is an all-purpose mallet and can be used on either mild steel or aluminium with equal success. They are composed of macromolecules, which are large chain-like molecules consisting of many simple repeating
units. Then ensure that you plug it into the correct voltage outlet. The window mechanism in use today did not begin to develop until well into the safety device used on oxy-acetylene welding equipment to stop the risk of the flame travelling back
down the torch supply hose. Most kinds of mechanical fastener (nuts and bolts, (Facing page) Figure 16.22 Composite moulding processes (Owens-Corning Fiberglas) (a) Hand lay-up is a low-to-medium volume moulding method suitable for making boats, tanks, housings and building panels and other large parts requiring high strength. After each
blow the disc is turned and the next blow struck near the first one, and so on until a series of overlapping blows is made round the circumference of the blank. Aluminium and aluminium alloys are produced for industry in two broad groups: 1 Materials suitable for casting 2 Materials for the further mechanical production of plate sheet and strip, bars
tubes and extruded sections. However, natural hide has to go through many complex processes before it attains the form familiar to the upholsterer trimmer or motorist. Certain parts of the car will be sheltered from the heat, and consequently paint applied to these parts will not be fully cured. It cannot be used as an intercoat stopper over etching
primers, or between enamel coats. When a panel becomes damaged due to impact, the resulting force on the metal causes buckling in the form of creases or ridges which are created because the panel has gone beyond its elastic limits to become non-elastic, therefore establishing unwanted rigid sections within the damaged area on the panel. The
plastics powder can cause respiratory diseases and the dust from carbon fibre can cause lung and other internal diseases. When welding in a normal workshop there is no problem, but if welding in a tightly enclosed area, such as inside the boot of a car, make sure that the area is well ventilated. 15.7 Quality Management for the bodyshop: BS EN ISC
9001-2000 The motor industry is under increasing pressure from its customers to show that it is able to guarantee a high standard for its repairs. Fluid control screw This is an adjustment control which limits the length of travel of the fluid needle, governing the flow of paint from the fluid tip. A closed luxury car with small windows which allowed the
occupants to see without being seen. Care should be taken when MIG/MAG plug welding to avoid an excess build-up of weld metal, to reduce the necessity of dressing the finished weld. For heavier sections, therefore, a forward and backward swinging motion of the torch is employed. In America there is the United States Department of
Transportation (DOT). In the case where the wing has been heavily coated with cellulose, it is advisable to remove this coating using the sander fitted with an open-coated disc suitable for paint, or with paint remover; the latter must be neutralized to stop the burning action on the paint. The following paragraphs discuss the different types of HSS and continuous the sander fitted with an open-coated disc suitable for paint, or with paint remover; the latter must be neutralized to stop the burning action on the paint.
AHSS steels. 13.2.2 Raising Raising is another method of shaping metal by hand into a double-curvature shape (Figure 13.4). Health surveillance techniques exist. The left-hand one indicates low air pressure, and the right-hand one that thermal
cut-outs have operated. 37 With the aid of a sketch, show the techniques involved in the manufacture of a small doublecurvature panel by hand. Charred weld Welding speed too slow; temperature too high; repair area overheated. Apply resin and chopped strand mat to the rough surface of the cured laminate, leaving the centre free. 5 Explain the
reason why corrosive and noncorrosive fluxes are used in soft soldering. 2.8.2 Identified hazards in the immediate working environment are removed where possible You must work in a safe manner or you are breaking the HSWA and are liable to a fine of up to £2000 and/or imprisonment. Once the former has been built, the next stage is the making
wrinkling at the corners of the box. Nickel Increased tensile strength, toughness, hardness and resistance to fatigue. Check for low and high spots using a panel file taking care not to remove too much metal. Figure 15.7 Tool extraction systems is available: a choice can be made
from a simple drop system through to the rail system (Figure 15.9), which allows vehicles to be driven whilst maintaining at-source extraction with both advanced infrared remote controlled and electrically motor driven reels. The lifting unit of this system makes many phases of the job comfortable, such as the removal of mechanical parts and the
avoid damage to the electrical equipment of the car. Isolating sealers are more heavily pigmented and are used to avoid a reaction between different types of paint systems, e.g. when applying a lacquer-type paint over a synthetic enamel. To repair a thermoset component you need to bond or glue on a patch. A minor non-conformance would be a
small error which would be acceptable in isolation. This adjustment cannot be made if the wing is welded to the main body structure. Fuses You will find up to 20 or more individual fuses on vehicles. Always start with light blows, and as the repair nears completion, inspect the work after Figure 13.37 The technique of spring hammering (Sykes-
Pickavant Ltd ) 362 Repair of Vehicle Bodies each blow. 5 Fit the suction cups to the outer face of the windscreen and place the screen in the vehicle. Therefore any spilled brake fluid should be wiped off immediately and the paint surface washed and polished if needed. Do not replace a blown fuse unless you are sure that the circuit fault which
caused the fuse to blow as been repaired. Double V preparation is used for material thicker than 15.9 mm, which must be welded from both sides of the plate; for this reason a V must be provided on each side. In practice many different combinations, torch 12.11 MIG/MAG welding techniques In the operation of a MIG/MAG welding
machine there are two parameter settings which must match each other: the wire speed and the welding voltage. They are fitted by stretching over self-tensioning frames which are clipped into position for easy removal, or alternatively the headlining is fastened into position with adhesives. The gas cover depends on the shielding efficiency of the
torch and the physical properties of the gas. The boot floor is also strengthened to become the luggage compartment, carrying the spare wheel and petrol tank. Figure 14.35 A downward pull using a chain wheel (Dataliner, Geotronics Ltd ) severe major damage several independent hydraulic units can be used simultaneously at any angle round the
bench frame (see Figure 14.36). The use of a filler rod requires coordination of the two hands. The air bag module, comprising the airbag cover, the pyrotechnic device and its fitting must be treated with extreme care when working on the SRS, or any other related system. Air sometimes becomes trapped in the oil track, in which case it is
necessary to bleed the pump. It also has some horizontal adjustment controlled by a gauging device known as the stop. 17 Evaluate the effectiveness of the control measures. 41 State the main purpose of a vehicle subframe. Typical values are a tensile strength of 35–75 MN/m2 and a modulus of elasticity of 1550–3250 MN/m2. Laminated glass is of a vehicle subframe.
sandwich construction and consists of two pieces of thin glass one on either side of, and firmly united to, a piece of transparent reinforcing known as the interlayer (Figure 14.103). 2 Obtain the correct adjustment of welding gun electrodes and arms. Movement of welding torch Straight along seam, with side to side movement reduced to a minimum
These steels are less ductile and are harder. 13.17.7 Heat application Aluminium panels can be heated in the same way as any other panel; but the working temperatures are very low compared to steel. That way the life of the roll and the amount of material left can be seen without removing the roll from the freezer. Some monomers form simple
closing it to blow out any particles of dirt that may be present; if the gas is acetylene, care must be taken to guard against any possibility of it becoming ignited. When spraying the chassis legs try not to get any overspray in the engine compartment. The fewer disturbances which occur as air moves past the vehicle, the lower its drag. The boot floor
(7), which extends from the back of the rear squab panel to the extreme back of the body, completes the floor unit. However, Of all the tools and techniques used in paint shops, the spray gun and spray painting have provided the most satisfactory method of applying paint. 5.2.1 Work hardening and annealing Most of the common metals cannot be
hardened by heat treatment, but nearly all metals will harden to some extent as a result of hammering, rolling or bending. Injection moulding (Inj) is used for items such as grille panels, air vents, dashboard panels, wheel covers and lamp units. Surface fusion Temperature range: 183-310 °C approximately. For vertical upward welding start with the
electrode at right angles to the plate, then lower the rear of the electrode 10-15° with the horizontal. Another advantage arises from the automatic feeding of filler material into the weld pool, which results in better penetration in all wind positions. 60/39.5/0.5 (tin/lead/antimony) solder, the eutectic composition, has the lowest melting point of all tin-
lead solders, and is quick setting. Applications of AHSS TRIP and CP steel is ideal for use in crash zones. Fire and explosion hazard. In addition, the resetting of door hinges must not be used as a method of rehanging doors without first checking for and correcting any misalignment. This speed is essential because aluminium is a good heat conductor
metal. On completion of the weld allow it to cool slowly. These must be worn at all times when welding. Bolts are available in mild steel, alloy steel and brass, and can be made of other metals and alloys for special applications. This includes: 1 Consultancy support to develop company action plans and the production of quality manuals
including standard operating procedures, policy statements and all other mandatory documentation required by the BSI. Failure to comply to the approved code of practice by an employer may lead to prosecution Skin contact
isocyanates, extraction acids or inadequate polyamides may be present Skin contact with Gloves solvents Eye contact with Gloves solvents expaurs, solvents or paint splashes Washfiller 580 Carry out in a well ventilated area or with local exhaust ventilation to minimize vapour build-up. Two types of clamps are used, the pull clamps for attachment to
flat edges and the wing clamps which have deep throats or lipped edges. Both components are zinc plated and gold passivated to ensure good corrosion resistance. Major accident damage 459 Figure 14.94 Four wheel alignment: steering wheel straight ahead (Sun Electric UK Ltd ) welded into place. This arch is stored at the rear end of the booth and
is sheltered from overspray. Lotus mould their complete bodyshell in a few pieces, each of which has an integral moulded structure. Measuring and marking-out instruments 191 (a) (b) Figure 6.11 (a) Reversible depth gauge (Figure 6.12) is used to
measure small clearances between two objects, and in some cases to establish the amount of wear or distortion of a component part. From this it can be controlled throughout the traction. These polishing cloths must not be put down on the
floor or dirty work benches, for if grit should be picked up on them, damage to the new paint finish will occur. The valley formed is almost certain to grow. The first step in body
soldering is to clean the surface to be soldered to a bright metallic finish. Feathering the gun To ease the pressure on the gun trigger whilst spraying, thereby reducing the volume of paint passing through the fluid tip. On very complicated shapes it is sometimes necessary to use joints; therefore the exact location on the panel should be considered
very carefully, taking into consideration facts such as the length of the joint, and its position in relation to accessibility for planishing with hand tools when assembled. Bonded, fully cured felts are similar blends of fibres bonded together with synthetic resins. 7 As soon as possible, inform your gas supplier of the incident. The site area should allow
separate parking for vehicles waiting for vehicles waiting for collection, in addition to turning space. Parent metal The material of a part to be welded. Having determined the type of damage, the actual location is found by visual inspection. The glass and resin mix applied in this way is consolidated, and the air pockets or bubbles are removed
by manual rolling, as in simple hand lay-up. Initially the sheets were not formed into complex shapes or contours, and the first bodies were very square and angular with few curves. 14.4.11 Windscreen repair: Glass-Weld Pro-Vac This system of repair involves extracting all the air from the damaged glass and replacing the void with a resin which,
when cured with ultraviolet light, is optically clear and is stronger than the glass that has been replaced. Once the tops and towers of the bracket system are fitted they give immediate visual indication of the location and extent of damage, and continue to do so throughout the course of the repair (see Figure 14.14). 19 Explain what is meant by the
                        peration Regulations 1992. Single-sided spot welding is therefore an alternative to conventional double-sided spot welding, or can be used in conjunction with it. They also tend to be fairly flexible. Although every panel assembly has its own individual repair procedure, the basic approach is the same for all minor repairs and is as
follows: 1 Carefully inspect the damaged area and analyse the severity of the damage and its ease of accessibility for repair using hand tools. An increase in wire feed rate increases the welding current, at the same time reducing the length of arc, resulting in a shorter arc. The pins are removed by breaking them from the panel surface and sanding
down their residue. It can be used for the removal of paint to reveal production spot welds or tack welds in awkward locations such as wing and inner valances, floor pans and inner valances.
out the surface whilst imparting a fuller gloss and revealing depth to the colour (Figure 17.64). 8 Suggest reasons why stainless steel is sometimes used for trim and mouldings. Car body design demands careful choice of the sheet metal, which was, until recent years, all mild steel. If a glass matting is used you can usually see the woven layers of
glass on the underside of the component. 3.15.2 Monodex cutters This tool is designed for cutting thin sheet metal. 20 Explain how to repair a deep scratch in a GRP body panel. After all damaged areas have been removed, the cut edges should be feathered on the non-weathering side and then the surface is roughened for about two inches back from
the cut. The same care and precautions should be practised when polishing as when burnishing (see Section 17.12.2). Soft soldering can only be used on metals that are lapped one over the other to form the joint. 12.15.2 Non-destructive testing Non-destructive testing of weld samples is normally carried out using the following methods. Heat and
temperature Temperature is the hotness or coldness of a body measured in degrees centigrade (C, also called Celsius) or absolute temperature in Kelvin (K). The process may appear to differ little from annealing, but as its name suggests the effect of normalizing is to bring the steel back to its normal condition and no attempt is Figure 5.1 Changes in
structure of carbon steel with temperature and carbon content 165 made to soften the steel for further working. On the other hand, if the pressure of either gas is too low a backfiring of the welding torch will result. The many variables involved in projection welding, such as thickness, kind of material, and number of projections, make it impossible to
predetermine the correct current. 'Adequately controlled' means that repeated exposure must not cause damage to health. The Electricity at Work Regulations cover the care of cables, plugs and wiring. In use, the surface plate is covered with a special marking compound and then lightly rubbed on the workpiece to be tested. Cylinder Steel
containers used for storage of compressed gases. If it were water you would refer to it in gallons or litres. These cutters are normally available with air-cooled torches using clean workshop or bottled air (see Figures 9.29 and 9.30). Capacitor (also called a condenser) storage of compressed gases. If it were water you would refer to it in gallons or litres. These cutters are normally available with air-cooled torches using clean workshop or bottled air (see Figures 9.29 and 9.30).
Mandatory Mandatory signs have a blue circular background (Figure 2.15c). So the waterproof clothes must be of such a manufacture that they will protect the wearer from 84 Repair of Vehicle Bodies the high temperature, high pressure steam. With the right amount of heat they can be bent, softened and welded. Employee's duties 1 To take
reasonable care for his/her own safety and the safety of others who may be affected by his/her acts. When cars were chassis built, the chassis built, the chassis built, the chassis Major accident damage 413 Figure 14.12 System 5000 pulling tower and frame (Celette UK) tended to be relatively flat, so that the repair was mainly two dimensional. They compensate for tolerance
variations 2 Double locked position A self-energizing spring lock is created by the compression of the arch in both the prongs and base as the screw into nut Figure 7.57 Nut grip (Forest Fasteners) 1 Insert one spring steel leg of nut into hole and snap in other leg
using a suitable tool 2 Complete assembly with bolt 1 Nut pressed into position: locating tongue snaps into predrilled hole and locks nut into position 2 Assembly completed with screw where it remains captive. It is important therefore that the wire speed and welding voltage are adjusted to conform with each other. T-rivets are designed for
exceptional strength and versatility; they can be reliable and vibration-proof in holes as much as 0.8 mm oversize. 14.2.10 Dataliner repair system Dataliner repair system Dataliner repair system Dataliner repair system Dataliner.
facilities should be adequate and made attractive by either landscaping or the addition of planters. It is estimated that 90 per cent of corrosion on vehicle bodies is of the 'inside-out' type. Overwelding, that is the use of more weld metal than is needed to meet the strength requirements, may involve a significant higher cost. The procedure for
removing a windscreen fitted with self-sealing weatherstrip is first to locate the joint in the filler strip which runs right through the centre of the weatherstrip. Joining of two glass fibre reinforced plastic components to each other can be effected by adhesive or mechanical means, or by a combination of both. 50 State the safety precautions necessary
when carrying out pulling in repair. A maximum economy is obtained if the combined thickness of sheets to be joined does not exceed 3.2 mm. 35 With the aid of a sketch, identify the BS symbol used on power tools to indicate double insulation. If you are right-handed, start the weld at the right edge of the metal and bring the inner cone of the neutral
flame to within 3 mm of the surface of the plate. 32 Describe the body work styling of a Sports or GT vehicle. 6 Explain the significance of headwear and footwear while workshop. Bronze welding resembles brazing, but only up to a point. 2 (1.6 mm 161 in) to no. It also covers mixtures and preparations. The characteristics of the
leftward welding technique are as follows: Position Flat. In areas where critical colour matching is regularly performed, it is definitely worth while to change lamps on a regular basis about once a year and so to avoid the problems of lamp failures and the colour variations which occur with age. Spray foam Unlike conventional foams, aqueous film
forming foam (AFFF) does not require to be fully aspirated in order to extinguish fires. They are used extensively in panel work, and also for forming, pressing and machining, and can be welded without much difficulty. Whichever of the above materials is chosen, the final coating must be rubbed down wet, and following drying and tacking off, the
colour coats can then be applied. Where the diameter is going to be small and the article deep, the raising method will have to be used to shape the work. 11.5.1 Flat position (downhand) Although welding can be done in any position the operation is simplified if the joint is flat. Chalk is good for cleaning the rule. Close the cylinder valves. However
copper, though less 164 Repair of Vehicle Bodies soft than lead, is more malleable. By applying a small current to one terminal a larger current to one terminal a la
stored pressure extinguishers the main body is constantly under pressure from dry air or nitrogen, and the extinguisher is operated by opening the squeeze grip discharge valve. That person may be your supervisor or another senior member of the staff. For contact moulding, the equipment is relatively simple and inexpensive. Work in short bursts
rather than spraying continuously, and always remember to hold the gun upright. Toughness is also a requisite for steel motor car bodies, which must be capable of withstanding heavy impacts and must often suffer severe denting or buckling without fracture occurring. Polish door aperture paintwork with clean cloth. A negative castor is the
opposite. The same applies where improved lighting is required in an 512 Repair of Vehicle Bodies with a tube missing than to temporarily substitute a non-matching tube. 4.12.5 Plastics applications Plastic products can be decorated by vacuum metallizing and electroplating. Toughened structural adhesives These materials span both the acrylic and
epoxy technologies, where a specific technique is used to prevent catastrophic crack propagation when joints are overloaded. It is also used for cutting solid bolts and rivets. Obviously, most fabricators use the woven variety of glass fibre for those structures that are going to be the most highly stressed. 8 Make two welds approximately 51 mm apart.
Consequently body repair establishments must make provisions to deal with any such vehicles which may be brought in for repair. To check progress at any moment the computer can provide either a visual display or a printout verification of the vehicles which may be brought in for repair. To check progress at any moment the computer can provide either a visual display or a printout verification of the vehicles which may be brought in for repair.
Windscreens made from float glass should be a maximum of 6.8 mm thick, whether toughened or laminated. (b) Kit comprises: six flat plates, two profiled plates. In the consumable electrode process MIG/MAG, it is also necessary to consider the potential loss of alloying elements in the filler wire owing to preliminary oxidation in the arc atmosphere.
15.1.5 Basic principles and dimensions for bodyshops Refer to the workshop layout plans in Figures 15.1 and 15.2. Entrances The minimum opening width for entrance and exit doors should be 4.5 metres for cars and 5.0 metres for commercials. The pump comprises reservoir, pump handle and hose, and is controlled by a simple open and close
release valve. Mandrel type The break-stem mandrel is usually chosen where the rivet is to act as a waterproof plug, and also where it would be inconvenient to eject the mandrel head on the blind side of the enclosed structure. 3.4 Body spoons These tools are made from a high-grade steel which has been drop forged and heat treated. The software is
modular, see Figure 14.145. Developments in welding techniques that help to simplify the practical problems posed by bodies made from a mixture of low-carbon and highstrength low-alloy steels. Some ammeters which do not have a centre zero
have a button to change the polarity to show charge or discharge. This led to the combination of PC and PBT to form Macroblend PC/PBT, which is used for drifting bearings? 15.3.4 Conventional industrial central heating systems are to be found in many
bodyshops. 31 Explain the difference in manufacture between a medium-bodied mass-produced vehicle and a high-quality coach-built limousine. Hazard, reversing and fog lights are now fitted to most vehicles to improve safe driving. There are natural as well as manmade adhesives; for example, spiders use adhesive to spin and stick their webs and to
catch their prey, and limpets and shell fish use adhesive to anchor themselves to rocks. in position, and the metal is beaten over by a mallet to hold the wire in position. The SRS rotary coupling consists of a length of wound wire ribbon which is permanently connected at both ends so that there is no risk of a bad connection. A ferrule is used to
squeeze the hose around the union shank to prevent it from working loose. Specialized research projects are set up to establish the effect of such materials, tools and equipment on repair methods, times and costs. (b) Figure 3.22 Temporary sheet metal fastener: (a) system (b) in use (Frost Auto Restoration Techniques Ltd.) 98 Repair of Vehicle
Bodies Figure 3.23 Apprentice basic toolkit (Sykes-Pickavant Ltd ) Figure 3.25 Tradesman basic toolkit (Sykes-Pickavant Ltd ) replacement panels and sections are not readily available. The resultant high-intensity heat source permits very rapid welding. 16 Discuss volatile organic compounds (VOCs) and their effect on the environment. It is important
to see that just sufficient copper is removed to get rid of the many aerosol sprays which are available for this purpose, but the volatile fumes which are given off must not be breathed in. These items usually have a smooth surface finish and carry markings
which show that they have Metals and non-metals used in vehicle bodies been in a mould, typically the lettering is raised. Small intakes of exhaust fumes will give you bad headaches, and over time can cause lung and/or brain diseases so ensure that you do not run a vehicle in a workshop without an exhaust extractor. In destructive testing, the test
samples are destroyed in the process. It is found by testing a sample to failure: the load applied, divided by the cross section of the sample, gives the compressive strength. This means that only minor repairs can be carried out with the bonnet in place, and if hydraulic power tools are necessary it is advisable to remove the bonnet from the car. 13.17.5
Oxidation Oxidation on aluminium panels is invisible to the naked eye except as there may be a slight dulling of colour. The airline used in most garages operates at between 100 and 150 psi (7 and 10 bar), this is a very high pressure, so it must be handled with great care. First, in the manner with which it readily unites with oxygen to form silica,
silicon provides a covering for the molten metal which prevents zinc volatilization and serves to maintain the balance of the deposit. 2 Cleanliness. Requirements of the Highly Flammable Liquids Regulations 1972 Paints governed by these
Regulations will be labelled 'Flammable'. The stiffness of the roof is built in by the curvature given to it by the forming presses, while the reinforcements, consisting of small metal strips placed crosswise to the roof at intervals along the inside surface, serve to stiffen the front and rear edges of the windscreen and rear window frames. The optimum
layout should allow vehicles to move easily from one area to the next in a logical sequence. These assemblies are installed through the large apertures in the middle of the inner panel. Their use reduces man hours to a minimum and they also enable the operators to achieve better results than those possible using hand tools. When using this second
method with the base-coat-and-clear materials, it is best to coat the panel with further coats of clear. A typical composition utilized for a micro-alloyed high-strength steel (HSS) is as follows: Percentage Carbon (C) Manganese (Mn) Niobium (Nb)
0.05-0.08 0.80-1.00 0.015-0.065 The percentage of niobium used depends on the minimum strength required. A better method would be tailor-made to suit the needs of the particular bodyshop. The torch contact
tip must be of the correct size for the wire to be used. Figure 12.34 Residual stress in a simple butt weld (BOC Ltd.) Distortion may take the form of a change in dimensions of the joint, transverse or longitudinal shrinkage, angular movement, or out-of-plane buckling Figure 12.35 Types of distortion: (a) longitudinal and transverse shrinkage
(b) angular distortion (c) out-of-plane buckling distortion (BOC Ltd ) Gas shielded arc welding? In the early days the dingman was the tradesman who worked on completed bodies to remove minor
imperfections without injury to the high gloss lacquer or varnish. 15.3.2 Electric spot heating allows comfortable heat to be concentrated where and when it is wanted. 3 A digit indicates the temperature for a minimum average impact value of 28 J (see Table 11.2). The widths of the wheel 3 tracks are flat 25 mm (1 in), medium 10 mm
(8 in), and full curve 5 mm (163 in). Supplementary restraint systems to protect the driver and passengers in the event of an accident are designed to work in conjunction with the vehicle body crumple zones, the idea being to slow down the vehicle occupants in a controlled manner. (b) Hot sprayed: one light coat; allow 30
minutes and apply a double-header coating. The second method of rust repair, which is only a temporary measure and not recommended for longevity, is to fill the corroded section with either body solder or a chemically hardening filler. DC electrode positive With DC electrode positive there is a tendency for the electrode to overheat and fusion of the
workpiece is poor. P max. Should the damage to the panel be too severe for satisfactory or economical levelling up with cellulose stopper, the two-pack polyester resin stopper described in Section 17.5.2 could be used. If the joint or the final contour is not satisfactory this can be corrected using body filler in the normal way. A borax type of powder
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flux is used, which fuses to allow brazing to take place between 750 and 900 °C. Care must be exercised to insure adequate adhesion between the laminate and the core material used. Table 4.7 Chemical composition limits1 and mechanical properties of aluminium alloy plate, sheet and strip (non-heat-treatable) (BS 1470) Others2 Elongation on 50 and 900 °C. Care must be exercised to insure adequate adhesion between the laminate and the core material used.
mm 0.2% Tensile strength Materials thicker than proof stress min. Plastic spreaders are to be preferred to metal knives when laying on the stopper, as these cause less damage to surrounding areas of paintwork. An expensive evacuator and re-filler is needed to re-charge the air conditioning system. Wait a further 30 minutes and check again: if
any part of the cylinder feels warm to the touch, reapply the cooling water for 30 minutes and repeat the procedure until cylinders remain cold for one hour. With both of these methods it is important to be aware of the fire risks. Current assets are money tied up in the work in progress and in stocks held within the stores department. Here the
reverse takes place and an external pull is applied to pull apart or draw outwards areas that have been pushed or drawn in towards each other. Polymate is a round bodied, twin-threaded selftapping screw with a closely controlled critical helix angle and thread pitch. The reason for this is that the successful fitting of a replacement section will depend
on the correct alignment of the surrounding areas, which can best be achieved by restoring them to as near the true shape as possible before the removal or cutting away of the sections beyond repair. For light-gauge material too much hollowing or blocking is not to be recommended, as it tends unduly to thin the metal. Injection moulding of
thermoset resins offers the capability to produce high volumes of very complex parts with good mechanical properties and impact strengths. High-speed steels These are mostly used for cutting tools because they will withstand intense heat generated by friction and still retain their hardness at high temperatures. Alignment The operation of bringing
into line two or more specified points on a vehicle structure. 51 Describe a computer-based estimating system. A typical welding control panel (Figure 12.15) has the following features: 1 Selection switch This selects between the functions seam, spot, stitch and latch as described above. HSS came about because of the need to make vehicles lighter
following the 1970 fuel crisis. The universal gauging system gives a fast positive visual alignment analysis before and during repair. In addition to this, some pigments combine very well with a synthetic medium but not so well with cellulose-based vehicles. Synthetic latex, styrene butadiene rubber, is made as a byproduct of the oil cracker plants.
Truss panels in buses Tanker shells and divisions Pressurized bulk transport at ambient or low temperature Heat-treatable alloys 6082 H30 (a) Other forms may be available by special arrangement. On others it extends downwards around the windscreen so that the windscreen opening is actually in the roof. Plasticut blades are 6.5 tpi and used for
plastic body fillers only. During an accident some panels may flex sufficiently to cause the effort required to turn the steering. Pressure-feed guns are used where a large quantity of
a particular paint is to be sprayed, or where the material is too viscose or Figure 17.13 Pressure-feed spray head 585 586 Repair of Vehicle Bodies heavy to be siphoned from the fluid container as in suction-feed guns. 15 Explain why a GRP panel may offer better resistance to minor damage when compared with a low-carbon steel panel. Each joint in
the shell and between the shell and the floor was made by a pair of steel plates, one on each side of the joint and bolted through both pieces of timber, leaving a slight gap between the two pieces. Catalysts for polyester resins are usually organic peroxides. These paints provided a hard glossy finish, required fewer coats than the cellulose materials
and were more chemically resistant. Dynamic pressure 1/2 air density vehicle velocity squared 1/2 V 2 As you can see, the speed (velocity) of the vehicle is important for these calculations. 17.19.10 Pin-holing This is the sudden appearance of small vortices (pin-holes) over the painted surface during drying. There are waterless hand cleaners
available which will remove heavy dirt on skin prior to thorough washing. The element controls the ductility and strengthens the steel, thereby improving the properties of the material. If the vehicle is wet then it should be blown dry prior to sealing. SVA recognises certain non-European technical standards as acceptable alternatives to the SVA
requirements. Reinforcement Filler material added to plastics (resin) in order to strengthen the finished product. In this method the torch nozzle is in contact with the workpiece or the operator. They are made of cast iron with vees machined
accurately to 90° into the top of the block to hold the work (Figure 6.18). Cold riveting plates cannot be as tight as with hot riveted because there is no contraction of the rivets to protect the driver. From the viewpoint of safety as well as
mechanical efficiency, proper welding is vital in this kind of repair. 6 A fume extractor reduces the risk of adjacent working areas being contaminated and protects the operator. Use a marker to define the lines on which it is proposed to cut the section or panel. The diameters of these cables are governed by the voltage and Figure 11.5 Welding
accessories showing electrode holders and earthing clamps (Murex Welding Products Ltd ) 298 Repair of Vehicle Bodies cable should be as near to the work as possible. The areas outside the side members and the wheel houses must also be treated with underbody protection material. Indirect types of glazing systems can be identified for each
specific model by referring to the body section of the relevant manufacturer's repair manual. 31 What purpose do nuts and bolts serve in vehicle body repair work? 14.3.2 Checking a mono constructed underbody, the first step is to assess the extent of
the damage, the probable amount of force involved which caused it, and the direction of that force. Industry data points to the fact that over 50 per cent of the total cost of a motor body is in the area of assembly. (Courtesy of SPSystems) Each weft thread passes alternately under and over each warp fibre. It may also be formed by moisture from the
air being deposited on a cool surface. Cloth materials are used for some main trim items and are therefore a potential fire hazard. 4 When wheeling, the panel should be held without tension, allowing it to move freely without twisting or jerking it. The presence of hose check valves will prevent the oxygen and fuel gas mixing in the hose and
subsequently causing fire, injury and damage. These have either a clear acetate or a polycarbonate lens with BS impact grades 1 and 2 (Figure 2.3). Figure 1.46 shows a complete underbody assembly. A particular property may often be improved by the selection of a suitable filler. As the cord is pulled out, the rubber lip is seated firmly over the body
flange. As soon as the gas between the tip and the nozzle is ionized, the main arc will ignite. A single layer of chopped strand mat and polyester resin is then laminated into the roughened area. The rear windscreen glass may be used as a template, butthis must be handled with great care in case of breakage. Feed the lance into the section gradually,
keeping thumb and forefinger around the tube, close to the hole. Cowl panels usually have both inner and outer construction, but in certain construction construction, but in certain construction construction construction construction construction construction construction.
symmetrical points on it, which may be factory formed holes, mounting points, or any part of the underframe which has identical positions on both sides of the vehicle (Figure 14.59a). (d) Commence resuscitation if trained to do so. Others have either two fusible plugs fitted on the shoulder near the cylinder valve, or a bursting disc. Surveillance may
include biological monitoring, clinical examinations and review of health records. 10 Explain the function of an AC metal arc welding transformer. Up to three times as much lift or stretch is obtainable with aluminium than with steel, and much more shaping by wheeling is possible in the case of aluminium than with harder metals like mild steel. The
crumplability (impact energy absorbing) design of car bodies makes new demands on welds. Because of its toughness and durability it is used in the motor body repair trade, where it is chiefly used on metal. Welfare arrangements (washing facilities, first aid). For instance, if you are replacing the indicator or ignition switch, you will
probably need to disturb the airbag module. Then bend the panel or top section upwards to make the outer panel accessible for the use of hand tools. A twostage compressor consists of an electric or fuel oil motor, the compression unit itself, and a storage tank. If current engines and transmissions are to be used for a new model, a programme of
refining and adapting for the new installation has to be initiated. Companies specializing in the manufacture of mastic compounds have developed a range of materials which are now used not only for welding and for general putty application but also for floor pans, drip rails, body joints, exterior trim and many other points, leading to well sealed car
bodies equal to any produced elsewhere in the world (Figure 4.2, Table 4.10). Those which have a waxy finish will not even let superglue stick to their surface. Second, the shape is maintained while the panel is in position, and this allows the edges of the panel to be lined up with such parts as bonnets, doors and boot lids. Figure 17.50 Method of
fixing abrasive paper into rubbing block As an alternative to rubbing down by hand, power tools can be used to speed up the process. The welding transformer is dimensioned so as to achieve optimal welding properties. An outcome of these two lines of development has been a situation in which although the area of glass has increased, the total
weight of glass has remained constant or even decreased. A body repairer will need sets of 14, 38 and 12 in drive sockets. In some situations you must rust-proof: for instance, when fitting a new body panel which is supplied untreated or when you do service bodywork repairs. Therefore remove as little as possible of the cathodic primer coating on
replacement panels during sanding or other abrading operations, e.g. on spot weld flanges or in areas where welds are to be made later. To fix this type of fastener it is, of course, necessary to have access to the back of the panel, but if assembly is possible from one side only a tubular type can be used which consists of a small spring steel split tube.
9.13.1 General gas storage procedures 9.13.3 Oxygen cylinders 1 Any person in charge of storage of compressed gas cylinders as well as the characteristics and hazards associated with individual gases. This includes the exterior form, all applied facias, the
complete interior, controls, instrumentation, seating, and the colours and textures of everything visible outside and inside the vehicle. Other factors affecting the choice are weight, high temperatures and corrosion resistance, especially electrolytic corrosion which can occur when different metals are joined together. The most common technique used
to relieve residual stress in thicker materials is post-weld heat treatment. Roughing out is the reshaping of the area by hand with the aid of a heavy dolly, which forces back the damaged section to its original shape (Figure 13.31). Use brushes with vacuum nozzle to clean crevices and air vents (Figure 14.133). Durable. Pneumatic activators (air
bellows) align the system to key datum points on the vehicle using respective adaptors from the range supplied. The solder has to possess the following characteristics: 1 It must remain plastic over a large temperature range, so that it stays workable. 6.3.2 Surface plate A flat surface is one of the fundamentals of engineering, and the flatness of
surface can be verified by testing it against the flatness of a standard surface, i.e. the surface plate. 5 The wheel tracks must be carefully overlapped to achieve a smooth curved surface. Remove the air cap and immerse it in clean solvent, then dry it out by blowing with compressed air. 33 Explain the reasons why some tools have a built-in dust
extraction system while others are connected to a centralized dust extraction system. A boxwood mallet, in conjunction with a suitable dolly block for the shape of the panel being repaired, should not be used as an initial smoothing or levelling step prior to the final planishing. This means that the repair of any of the panels will probably require
contact with an electrical component or the power supply to a nearby component. In case of doubt it may be possible to promote the appearance of the crazing by applying gentle heat. For complete ozone resistance, it is necessary to use either butyl or neoprene rubber; both satisfy atmospheric and ozone ageing tests. Alloy A mixture of two or more
metals with, or without, other metallic or non-metallic or non
It is extremely well (a) (b) (d) (c) (e) Figure 3.2 (a) Heavy dinging hammer (flat faces) (b) light shrinking hammer (crowned faces) (c) heavy shrinking hammer (serrated flat faces) (light shrinking hammer (flat faces) (light shrinki
d, e) are similar in design to a normal planishing and refinishing a Apply finishing a Rapply finishing a Rapply finishing enamel: (a) When brushed, no thinning is required. In this
defect the existing paint on a surface wrinkles and then can be scraped or peeled off following the application of a fresh coating on to it. On account of the absence of flux, gas is used to shield the arc and weld pool from atmospheric contamination. The ability of Cold Front to act as a total heat barrier is demonstrated by holding a strip of 20 SWG
metal in the bare hand after applying a line of Cold Front halfway along the strip, then heating the portion of the strip above the line to red heat. Rods are obtainable in sizes ranging from 1.6 mm to 5.0 mm diameter. When cured, is resistant to water Applied by means of an air pressure pistol. The shape of the rivet head is selected according to the
intended use of the workpiece to be riveted. This temperature is not high enough to cause damage to the paint film. The first actual arc welding, meaning the melting of metal by means of electrodes and thus fusing them together, was developed by Bernardoz in 1885; he created a
mechanism using a carbon electrode which produced an arc between the carbon and metal, melting the edges and thus performing a weld. In many cases corroded areas can be repaired by fabricating new sections for replacement purposes. Blisters which extend over a considerable area may also indicate that the resin is undercured, and this type of the carbon area can be repaired by fabricating new sections for replacement purposes.
blister may not form until some months after moulding. If they are soft they will break without forcing the assembly to crumple, but if they are hard the welds will unbutton and the assembly will fly apart instead of folding 321 up slowly. 5 Temporary moulds are prepared, usually in metal, but before fixing these in place a layer of cellophane is applied
to the working area to prevent adhesion of the repair to the mould. The Regulations require that employees and of anyone else who may be affected by the company's work activity. 10.9.2 Welding procedure 1 Prepare the panel surface by removing any paint, primer and in general any
insulating material covering the surface to be welded. 15.2.3 Parts department Within the vehicle repair industry a considerable number of parts are received, issued and used every working day. The wing panels are fitted and the doors, boot and bonnet are individually fitted on to their particular chassis frame. After cure, remove the cellophane and
proceed with normal filling, flatting and painting. In order to deal with the major damage which occurs to the mono constructed vehicle, specialist equipment has been developed. The measuring unit is then perfectly located and parallel to the zero plane and the manufacturer's datum line. A liquid flux such as zinc chloride or resin or linseed oil is
generally used to assist the solder to flow and run smoothly into the joint (Figure 8.3). In most integral underbodies a suspension member is incorporated in both the front and rear of the body. The essential function of this system is to pull and realign simultaneously and rebuild the damaged sections with absolute precision while they are held in
place by the brackets. Some levels are shown in Figure 6.19. If the grade is above 12, two dots identify the 12 o'clock position (Rover Group Ltd ) Figure 7.51 Clinch nut fixing procedure (European Industrial Services Ltd ) 1 Insert shank of nut into predrilled hole 2 Rivet by closing spigot down with hammer. 8 Describe, with the aid of a sketch, the
principle of the Korek system. 16.11.2 Operating precautions Most polyester resins contain monomeric styrene, which is a good grease solvent and may cause irritation to the skin. The mushroom is used in thin sheet metal which would be weakened by the use of countersunk rivets. Workshop equipment is usually cleaned and inspected on a monthly
basis unless there is reason, such as a fault, for a more regular treatment. Around 1935 cellulose-lacquer based paints were combined with other synthetic materials to produce a paint which dried in thirty minutes, had better 'build' qualities and thus required fewer coats. Round dolly is light and small and very easy to hold. A comparison between an
electrical spot weld and a forged weld shows that in both these processes a union is formed by an amalgamation of the metal molecules. As a flux, olive oil is sometimes called Gallipoli oil. Prior to 1980, toughened glass, which shatters into tiny, relatively harmless pieces when broken, and which can dangerously obscure a driver's vision, was used by
many vehicle manufacturers. Rivet length Manufacturers also specify the correct rivet length to be used on a given thickness of material. As to the correct air pressure to use when spraying, this will vary according to the type of spray gun being used, the paint viscosity, and the type of paint. 464 Repair of Vehicle Bodies 3 Always apply the material as
close to the area of repair as possible. 7 Apply the laminate complete with cellophane to the inside of the repair is cured). This is because of the costs which may be involved if the fire service is called out wrongly and the damage which may occur if
staff and/or customers panic. Tools for the fly press fit into a central spindle which is moved down in order to pierce, blank and to a limited extent form the metal parts required. The central spindle which is moved down in order to pierce, blank and to a limited extent form the metal parts required. The central spindle which is moved down in order to pierce, blank and to a limited extent form the metal parts required.
covered, making the file marks parallel to one another. From this a set of universal towers was developed to suit the wide range of different vehicle models. 14 Explain the term 'spray transfer'. Free air delivery is in consequence the prime factor to consider when purchasing a compressor. Questions 1 Describe the forming and fabricating properties
of the steels used in vehicle body manufacture. Up to that time steel had been shaped by hand, but it was known that metal in large sheets could be shaped using simple die tools in presses, and machine presses were introduced to the steel industry to form steel sheets into body panels. The choice of each of the types will be dependent on the site for
application, on the eventual conditions of exposure and often on price. At this point you must remember that plastics are made from petroleum-based chemicals and are therefore easy to set on fire and burn at very high temperatures, so avoid matches and other naked flames when handling them. 2 To prevent the escape of waste which is, or at any
time has been, under their control (this has implications for waste storage facilities and waste containment). 2 Weight reduction. They are used in conjunction with the planishing hammer or beating file and act as a support or anvil to smooth out the surface area of panels that have been damaged. Yes, that is 3.6 billion calculations for each speed and
of course the air density varies with altitude; at sea level the value is 1.226 kilogrammes per cubic metre. The golden rule of hand-made panels is that an allowance should be made all the way round the developed size; in other words, the developed blank should be made all the way round the developed size; in other words, the developed size; in other words, the developed blank should be made all the way round the developed size; in other words, the developed size; in other words, the developed blank should be made all the way round the developed size; in other words, the developed size; in other wor
component after shaping than to have to weld pieces to it. Nevertheless, the panel beater's craft still retains its place in body work and as yet is irreplaceable by more modern methods; in spite of the tremendous developments in recent years of mechanical methods of forming, panel beating remains an essential means of fabrication of special parts.
Underbody seams, joints, brackets and attachments must all be coated with the fluid. Another major advantage of using filler dispensers is that the filler is kept clean and uncontaminated from the beginning to the end of the tin because there is no need to replace the lid every time the filler is used. For cold riveting the closure of the rivet is similar to
that of a hot rivet except that the metal is not as plastic and greater difficulty will be encountered in swelling the rivet shank to fill the hole. Aramid is better known by its Dupont trade name Kevlar. If the bumper has been holed, then cut a patch to fill the hole as you would for a thermoplastic bumper and additionally cut another patch which is larger
than the hole. Any trim or chrome which appears on the side of the wing is usually held in place by special clips or fasteners which allows easy removal of the trim. This type of steel can be used for moving parts such as connecting rods, gear shafts and transmission shafts, which require a combination of toughness and strength, but it is being
replaced in the car industry by high-alloy steels. The measuring can be carried out using the Mark 5 mechanical system or the Car-O-Tronic electronic system, for fast and accurate measurements of any vehicle damage. The wet sanding of high-build undercoats and fillers has long been the accepted method of levelling these materials in order to avoid
the creation of excessive dust. Remove the fascia's protective covering. When using machines for burnishing, the precautions set out in Section 17.12.2 should be observed. The object of the Act is to reduce and eventually eliminate the use of volatile organic compounds (VOCs) in surface coatings, using the best available techniques not entailing
excessive costs (BATNEECs). mm (in) 1 1a 2 2a 3 3a 4 4a 5 Centre of front bumper position hole - LH Centre of front sidemember positioning hole - LH Centre of front sidemember positioning hole - LH Centre of front sidemember position hole - LH Centre of front sidemember position hole - RH Centre of front sidemember position hole - LH Centre of front sidemember position hole - LH Centre of front sidemember position hole - RH Centre of front sidemember position hole - LH Centre of front sidemember position hole - LH Centre of front sidemember position hole - RH Centre of front sidemember position hole - LH Centre of front sidemember position hole - LH Centre of front sidemember position hole - RH Centre of front sidemember position hole - LH Centre of front sidemember position hole - RH Centre o
- RH Centre of front floor sidemember positioning hole - LH Centre of rear floor sidemember positioning hole - LH Centre of rear floor sidemember positioning hole - RH Rear portion of rear seat crossmember position hole - RH Rear portion of rear seat crossmember position hole - RH Rear portion of rear seat crossmember position hole - RH Rear portion of rear seat c
portion of rear floor sidemember extention positioning hole - LH 梶 - 9 mm (0.354 in) 梶 - 15 mm (0.59 in) 梶 - 16 mm (0.629 in) 梶 - 17 mm (0.354 in) 梶 - 18 mm (0.84 in) 梶 - 18 mm (0.854 in) 椛 - 18 mm (0
(0.708 2.637 in) 14.3.7 Vehicle body alignment: upper structure Damage to the inner construction of a car body might be quite severe although not obvious. This hammer is designed for turning small flanges on highly curved work and is normally used in conjunction with a stake. The equipment consists of: 1 Laser guide with electronic calibration
and digital measurement display 2 Hand unit for registration of data and specification for all car models. 22 Repair of Vehicle Bodies Figure 1.14
Scale model maker at work (Ford Motor Company Ltd ) This replica is then evaluated by the styling management and submitted to top management for their approval. They are generally classified into two major categories: Low-alloy steel possesses similar microstructures to and requires similar heat treatments to plain carbon steels (see Section
4.3.2 on micro-alloyed steel). It is essential to use an efficient and correct flux. The main advantage is the fact that the pulling is done externally from any angle while the car is anchored securely. It was considered necessary for the rear wheels to be larger than the front, a legacy from the elegant horse-drawn carriages. 4 Never attempt to shrink a
panel until it has been roughed out. These comprise a circular spring bow which joins the legs at the top and acts as a spring and pivot. It is also on the increase in the manufacture of public service vehicles, luxury coaches and caravans. Therefore, when necessary, the electrode should be redressed back to its correct shape. Lighter-guage steel can
therefore be used without sacrificing strength, resulting in a substantial weight saving even with the zinc added. The chassis assembly is built up of engine, wheels, springs and transmission. These particular hammers are generally made with one face square. This making and breaking, or arc interruption, takes place from 20 to 200 times per second
according to the setting of the controls. 4 Damage can be caused by radiant heat as well as conducted heat. Apart from the major bonus of speed, a computerized estimating system will greatly enhance your company's image as a professional organization. To remove the glass from the vehicle, the bonding material has to be cut. Replace the lid,
unscrew the air cap a few turns and, holding a piece of cloth over the air cap, pull the trigger. ELF rivet is an aluminium 3.5 per cent magnesium alloy with an aluminium 3.5 per cent magnesium alloy with the other by scratching with the trigger.
barrel section of the torch. Typically, the amount of time is 120 ms (0.120 sec) - the time it takes to blink. The scales are mounted on special attention must be given to adhesively fixed or bonded areas. If there is no resistance the meter needle will move across the scale and read zero. Rivets are
best applied with a rivet gun, however copper rivets can sometimes be used and closed using snaps which are hit with a hammer. Look for body panels with pronounced sharp swage lines. They are manufactured from austempered carbon steel, and normally supplied in phosphate and black finish (see Figure 7.64). This process is especially adapted
for welding light-gauge work requiring the utmost in quality or finish because of the precise heat control possible and the ability to weld with or without filler metal. The plunger extends until it touches the point at which the load is to be applied, and as pumping is continued pressure is built up to overcome the resistance of the metal at the point of
application. The diameter is selected according to the required strength and thickness of the component to be riveted. All emergency telephone exchange at the telephone exchange are recorded on tape at the telephone exchange. A site that is relatively cheap may have distinct disadvantages such as a narrow road, steep hills, a particularly bad surface, sharp corners, one way in
and one way out only; all these affect access to the premises. Next the arm can be inclined in the sideways direction to give the optimum pulling angle, then locked in position. Allow to dry (Figure 14.134). 12 Describe how the following four power tools could be used by the body repair worker: (a) power saw (b) spot-weld remover (c) bonded
windscreen cutter (d) miniature belt sander. It has unlimited Figure 10.10 Resistance butt welding 282 Repair of Vehicle Bodies is applied during the heating process, which eliminates flashing. 2.8.10 Injuries resulting from accidents or emergencies are reported immediately to a competent first aider or appropriate authority If a person is injured thereof the sander. It has unlimited Figure 10.10 Resistance butt welding 282 Repair of Vehicle Bodies is applied during the heating process, which eliminates flashing.
first action must be to ensure that first aid is given by a competent first aider or other suitable person. Fender American term for wing. The edges can be finally closed by using a wiring hammer or by passing through a swaging machine fitted with wiring rolls (Figure 13.27). The basic anti-corrosion tool is the spray gun with its four attachments. This
could cause a manual transmission to jump out of gear and might result in permanent clutch failure. The history, development and construction of the car body Figure 1.23 Volvo crash test (Volvo Concessionaires Ltd.) Extensive durability tests are undertaken on a variety of road surfaces in all conditions (Figure 1.24). The machined base enables it to
slide over the surface of the table while the scriber retains its accurately set position. It uses a precision universal gauge measuring system and special pulling and anchoring attachments in conjunction with the main frame platform (see Figure 14.47). It will be found that where most flammable liquids are concerned, reducing the oxygen in the air
from 21 to 15 per cent or less will extinguish the fire. Ultrasonic inspection This method uses sound waves which are passed through the weld. Any masking off that may be required should be done between stages 2 and 3. In some models there is no handle or external locking mechanism; instead the hinges are spring loaded or use gas-filled piston
supports, so that when the lid is unlocked internally it automatically rises and is held in the open position by these mechanisms. The principal functions of the coating are to: 1 Stabilize the arc and enable the use of arc welding 2 Flux away any impurities present on the surface being welded Manual metal arc welding 3 Speed up the welding operation
by increasing the rate of melting 4 From a slag over the weld in order to protect the molten metal from oxidation by the atmosphere, slow the rate of cooling of the weld and so reduce the chances of brittleness, and provide a smoother surface. Filler and paint dust generated in the preparation area is best collected as soon as it is produced by 514
Repair of Vehicle Bodies Figure 15.6 Portable dust extraction system used in the workshop (Nederman Ltd ) using off-the-tool extraction (Figure 15.7). Take the information into an auto parts store for help in finding the right part. This provides extra sighting pins to help to detect sideways movement (sway) and diamond damage (when the underbody
has been forced into a diamond shape), which may not be evident when using self-centring gauges only. 2 Protect engine air intake and sensitive electrical equipment (distributor cap, fuse box) with plastic sheet. 17.19.2 Blooming Figure 17.73 Two-track rails requiring long bogies This defect can be slight or severe. 39 What is the electrode made
from in a plasma arc cutting torch? Pay attention to fully coating the wheel arch seam area. There are three main types. In the process of Gas welding, gas cutting and plasma arc cutting 261 Figure 9.18 Edge preparation welding it is necessary to consider and make allowances for this distortion which, unless controlled, may buckle the work to such
an extent that it is useless. A special trolley is placed under the damaged vehicle, enabling it to be moved easily along the frame to meet the locating points on the jig bed. The general requirements are as follows: 1 Cleaning bath - rubber protective gloves which extend over the user's wrists, goggles and plastic apron. From 15.9 mm upwards: as
above but step weld, using multipass technique. A positive castor is when the top ball joint is behind the bottom ball joint. The history, development and construction of the car body 2 The passenger area is kept intact as long as possible. It offers a variety of useful faces, and is found ideal for working in confined spaces. The challenge is getting the
correct replacement part. This gives a truer indication of the swing of the door as the opening is being corrected with the use of hydraulic equipment. 20 What is the function of a spring washer when used as a securing device? If the system is correct the light will go out. In case of concern over this point, consultations should be held with the factory
inspector. At one time this type of repair was effected by either riveting a patch over the rusted or torn parts, or renewing the part concerned. 3 A passenger vehicle undergoing repair on a fixed jig requires a floor space of approximately 4 metres. Primary or active safety This refers to the features designed into the vehicle which reduce the
possibility of an accident. Apart from the doors, bonnet, boot lid and 42 Repair of Vehicle Bodies Figure 1.42 Body constructional details of Austin Rover) 1 2 3 4 Main floor unit Main centre floor panel Access holes Bottom sills 5 6 7 8 Rear seat heelboard Rear seat panel Boot floor Cross member 9 10 11 12 Wheel arch panel
Rear squabs Boot lid lock striking plate Roof structure 13 14 15 16 Windscreen or canopy rail Cantrails Front standing pillar (A-post) 19 Quarter panels The history, development and construction of the car body 43 front wings this completes the structure of the average body
shell. Two types of track are available: (a) those with sets of two rails, and (b) those with sets of two rails, and current assets. Mass production Large-scale, high-speed manufacture. Silver solders Zn Mn Ni Cd Sn Melting range (°C) Cadmium-containing alloys AG1 49-51 14-16 14-18 - - 18-20 - 620-640 470
AG2 41-43 16-18 14-18 - -24-26 - 610-620 470 AG3 AG9 37-39 49-50 19-21 14.5-16.5 20-24 13.5-17.5 - -25-3.5 19-21 15-17 - -605-650 635-655 - 480 AG11 AG12 33-35 29-31 24-26 27-29 18-22 19-23 - -25-3.5 19-21 15-17 - -605-650 635-655 - 480 AG11 AG12 33-35 29-31 24-26 27-29 18-22 19-23 - -25-3.5 19-21 15-17 - -605-650 635-655 - 480 AG11 AG12 33-35 29-31 24-26 27-29 18-22 19-23 - -25-3.5 19-21 15-17 - -605-650 635-655 - 480 AG11 AG12 33-35 29-31 24-26 27-29 18-22 19-23 - -25-3.5 19-21 15-17 - -605-650 635-655 - 480 AG11 AG12 33-35 29-31 24-26 27-29 18-22 19-23 - -25-3.5 19-21 15-17 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 - -605-650 635-655 
large-area body panels, the automotive industry demands the following properties: Temperature resistance Low-temperature impact resistance Stiffness. This is caused by the strong solvent used in cellulose finishes penetrating the still soft synthetic primer surfacer and acting as a paint remover. Fairly
franchises will dispose of these liquids either through a private waste collection company or through a scheme in conjunction with the local authority. It is common practice in some shops to oil or grease the newspaper, but this cannot be recommended because of the risk of grease contamination to those areas to be sprayed. The first essential when
considering the repair of a reinforced composite moulding is to ensure that the area to be repaired is clean and dry, including the rough edge of any torn portion. The chances of injury can be reduced both outside and inside the walls, and
wall space should be used to promote the bodyshop by displaying framed certificates of the staff's qualifications, association memberships, and insurance company approvals. 62 Repair of Vehicle Bodies (a) (b) Figure 2.4 (a) Face shield (Racal Safety Ltd ) (b) Face shield (Racal Safety Ltd ) (c) Face
2.5 (a) Standard visor-type welding helmet (b) Standard welding goggles with hinged lenses (Racal Safety Ltd ) Health and safety 2.1.7 Respiratory protection (lungs) One of the most important hazards faced by the bodyshop worker is that of potential damage to the lungs. Gas cylinders are designed and constructed in accordance with Home Office
specifications and/or British Standards. This definition determines the original construction and therefore the repair method employed. Burnish and polish. That is, from Edwardian to modern times. It must be noted that if the operator does not hit exactly in the centre of the low spot, he will raise metal in some unwanted place. 5 Always hammer the
stretched section outwards before applying heat. In practice the square end, which is usually flat, is used for planishing on a curved surface of a panel, or in corners, or against swaged recessed sections, and the crowned end for reasonably flat panels. Three men may be required to move an average car. Failure to do so may result in the appearance
of 'fish eyes'. This product is produced mainly by the hot dip process. The mutual position of the welding torch and workpiece in relation to each other is of importance to the appearance and quality of welding. Body The structured part of a vehicle which encompasses the passenger, engine and luggage compartments. 23 In case of electric shock: (a)
Avoid physical contact with the victim. Anti-burst door locks are to prevent unrestrained occupants from falling out of the vehicle, especially during roll-over. Each tower is equipped with a 5 tonne hydraulic ram to provide the pulling power, and an adjustable collar to enable precise pulling angles to be achieved. The flanged ends prevent electrolytic
corrosion at metal-to-metal assembly points. The purpose of castor is to cause the front wheels to maintain a straight ahead position and to return to the automotive industry has led to all major manufacturers adopting the use of
MIG/MAG welding on a very wide scale. 526 Repair of Vehicle Bodies Employers will have to make sure that any workplace within their control complies with the Regulations. Also, very accurate alignment jigs have to be manufactured to hold these parts, after they are formed to the template size and shapes, so that they can be welded together into
the finished component. The RAC was formed, largely through the efforts of F. It is highly effective in long narrow sections which would otherwise be inaccessible or awkwardly positioned and where its flexibility enables it to operate even where there are bends and restrictions which would prohibit the use of the rigid lance. Therefore always have
adequate fire-fighting appliances available. If the panel is of a complicated curved nature and requires flanges, it is sometimes necessary to make a flanging jig of two identically shaped pieces of wood. It is the essential practice to master, and develops as a result of continuous experience. Figure 14.131 Drying engine (Autoglym) 14 Use air line and
chamois leather to remove excess water from bodywork or trim strips which may trap water (Figure 14.132). It gives a high clench action and a positively locked nut or collar which is proof against vibrations. Box sections are used in conjunction with U-channel construction in the manufacture of car chassis frames, underbodies, subframes, cross
members and any construction where great strength is necessary. After closing the tools the resin is injected using a machine which dispenses precise quantities of the main floor unit and supports the cantrails of the roof unit. Very low ignition energy. On
panels that are reasonably flat, such as door panels, parts of roof panels and bonnets, this method of raising low areas is quick and, if carried out correctly, does not unduly stretch the metal. Carbonizing flame An oxy-acetylene flame adjustment created by an excess of acetylene over oxygen, resulting in an excess of carbon in the flame. Electronic
control unit (ECU) Vehicles are fitted with at least one ECU. In order to obtain consistent performance on a particular joint it is important that the same vertex angle is used. The 264 Repair of Vehicle Bodies metal should be first preheated and then welded. Direction of damage, or line of impact, is particularly important to the
body repairer. Synthetic A substance produced artificially. Figure 11.6.3 Correct arc length 11.6.3 Correct speed of travel This must be slow and even to ensure sufficient penetration without excessive build-up of bead. It is ideally suited for the rapid welding of thick sections in the downhand position and the positional welding of aluminium and its
alloys. To prove main weld strength, allow it to cool then attempt to pull it from the groove by the attached welding rod. 13.16.7 Minor repairs to bonnets The bonnet of a car is firmly fastened when closed. Ductile properties are also necessary in metals and alloys used in the following processes: The degree of malleability possessed by a metal is
measured by the thinness of leaves that can be produced by hammering or rolling. Green for halon (BCF). Furthermore, with soaring building costs and high rateable values, coupled in some cases with restricted space for expansion, it is important that floor space be kept to a minimum. The bright golden yellow fibres have high strength and low
density giving a high specific strength. Along each side of the block runs a groove into which a clamp can be fitted in order to secure round-shaped work in place during marking off with scriber, try square or scribing block. Toughness is an essential property in rivets. This has resulted in the range of micro-alloyed steels known as high-strength steels
(HSSs) or high-strength lowalloy steels (HSLAs). Pay particular attention to difficult to polish areas behind bumpers (Figure 14.130). The reinforcement is basically a top-hat section, to give rigidity to the bonnet. The binder is often referred to as the medium of the paint. This problem necessitates a much more sophisticated lighting system than the
rest of the bodyshop. 12.2.3 Carbon dioxide This gas is used as a shielding gas in the MAG welding process. Inconsistent gaps around these panels show that the panel assembly has been moved during the collision. This means that if you are involved in the creation of waste, then you are responsible for its safe and proper disposal. There are usually
three main parts to the frame - a bed and two side frames. 5 There is poor natural adhesion in the top coat. 2.5.2 Check list Before using electrical equipment the body repairer is advised to the resin it will generate heat chemically. Cutting
can be started anywhere on a panel without the need for pilot holes. The keyless type uses either an infrared or a wireless signal to a sensor on the vehicle from the key-fob control, or 'zapper'. They can also be used for controlling the pull in certain directions during alignment and as a welding fixture when new parts are to be welded in. The dolly
block is held in place under the panel by hand, while the blows are directed on to the panel surface and transmitted through to the dolly block. After compounding, remove residue and buff lightly to a shine with a clean, dry, good quality mutton
cloth. Hold the roughing-out dolly lightly in the hand and strike the hardest blow at the centre of what appears to be the lowest point of the damaged area, then direct the blows around the first one and gradually work outwards, decreasing the force of the blows until all the damaged area has been roughed out (Figure 13.32). 5.13.1 Sheet metal
drawing operations Drawing operations are classified according to the shape of the part drawn, as follows: cupping, box drawing shallow and panel drawing deep. 2.8.22 Machinery, equipment and work areas are cleaned according to locally agreed schedules In your company's Health and Safety Policy document there will be
reference to the cleaning of the 83 floors and equipment in the garage and general amenities such as toilets and rest areas. This slow, laborious and costly painting process continued almost without alteration right up to the end of the nineteenth century and the birth of the motor car. This is a problem of tensile strength and homogeneity of the weld
nugget itself. To speed up the hardening process and to add extra strength to the component it is normal to use an oven. Calibration is complete when the laser beam passes through the target areas on the scales on three undamaged measuring points. The blade should match the slot: an oversize screwdriver will not Hand and power tools 109 reach
the bottom of the slot and an undersize screwdriver will float in the slot, and either condition could result in damage to the tool and the fastener. Spray gun technique is very important. The most common moulding, injection moulding
thermoplastics, injection moulding thermosets, pultrusion, and reinforced reaction injection moulding. Identify the plastic to be repaired. Often in an accident repair a plastics headlamp binnacle is scrapped because one of the lugs is broken off. 38 Repair of Vehicle Bodies Figure 1.35 Front end construction (a) integral or mono (b) composite and (c)
front sub-frame, this is bolted separately to body assembly A designer in a small coach building firm will consider methods necessary to build the body complete with trim and other finishing processes. This means that there is now no longer a need to make a buck, or a mock-up, of a car to be able to visualize the design. Low-bake finishes These are
modified stoving paints which can be completely cured at a temperature between 66 and 93 °C. The most commonly used alloy is of copper and zinc, which is, of course, brass. 11 Name the flux and detail the composition of the rods used in the brazing process. Before removing the lower quarter panel it will be necessary to remove the boot lid, rear
top shell and rear transom. Issue staff with respirator and eye protection Arrange for extraction to be installed in mixing room Ethanol 15-30% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl isobutyl ketone three times a day to once daily 30-45% OES Reduce mixing from Methyl is
from acid hardener No respirator or eye protection used whilst mixing Conclusions: Bodyshop planning Remarks: High risk Carried out three times daily Products used Products contain (Continued ) Precautions Activity Hazard Application Spray mist Inhalation of containing solvent vapours solvent and, or spray mists depending on the particular
product, isocyanates, zinc or strontium chromates, polyamides or acids Risk Skin contact with solvent vapour or spray mists Eye contact with solvent vapour or spray mists Remarks: High risk Process carried out daily Personal General Products used Products used Products used Products contain Remarks Respirator suitable for solvent vapour or spray mists Eye contact with the eye contact with the eye c
be carried out in a properly ventilated spray enclosure As above Issue replacement charcoal respirator, set up inspection and maintenance records. All collision damage repair work which makes use of the body jack equipment is carried out by using one or another of a number of simple set-ups or, in the case of more complicated repair, a combination
of set-ups (Figure 13.52). are Major accident damage 471 Locating the leak Locating the source of the water leak involves a logical approach together with a combination of skill and experience. In the majority of cases it is essential that the flux residues should be removed from the surface of the metal after the welding operation has been completed
The equipment is either single phase (130-240 A) or three phase (250-500 A). As soon as a door or window is opened, warm air is pushed out by the heavier cold air streaming in from outside. Body sill The panel directly below the bottom of this arises from the time and labour expended in picking up and putting together a
number of parts, some of them relatively small, and this is where spring steel fasteners achieve marked savings compared with earlier methods. Glass has no definite melting point, but when it is heated to approximately 600 °C it will soften and can be curved. Place the entire unit in the windscreen opening with the cord ends hanging inside the
vehicle. 5 Explain briefly the function of (a) the releasing agent (b) the gel coat (c) the catalyst. You should then stand in a variety of positions as if you were the paint operative: if, in any one of these positions, you are receiving direct light from one or more of the lighting tubes installed in the booth, you will be suffering from some degree of glare,
which will probably be disabling and will certainly be tiring. They are also used for removing dents, buckles and creases from sheets or panels previously shaped, for reducing the thickness of welding in that the
outer metal panel has a predrilled or punched hole which is filled up with the weld metal to form the 'plug'. Polyester resins can be coloured to any shade by the addition of selected pigments and pigment pastes, the main requirement being to ensure thor- ough dispersion of colouring matter throughout the resin to avoid patchy mouldings. Certain
minimum standards are laid down with regard to seat widths, kneeroom and headroom. 4 Make sure that the correct distance is set from the edge of the sheet metal panel to the nearest spot weld. In addition to strengthening purposes, swaging is often used to relieve plain surfaces; this kind of decorative effect is a common feature on motor vehicle
bodies. Basically the glass is manufactured from sand or silica and the process by which it is made proceeds through the following stages: 1 Initially the raw materials, including sand, china clay and limestone, are mixed together as powders in the desired proportions. They are used in finishing operations with non-toxic paints, but not with isocyanate
paints. It can, however, be coated over with most standard paint systems used in refinishing, including should not be damp and it should be adequately heated and ventilated. This provides the support for the rear seat squab in a saloon car; if the
vehicle is a hatchback or estate car, the two back seats will fold flat and the seat squabs will not need support. During repairs brackets were found to yield further benefits. Do not interrupt the welding sequence, and carry out the weld as quickly as possible. If you hear a fire alarm a typical evacuation procedure is: 1 Shut off the electricity by
pressing the emergency stop button. With its controlled lowering speed and integrated safety system it is ideal for any shop needing a mobile lifting bays (Figure 14.21). 3 Give a brief history of the development of the vehicle body style, illustrating the
significant changes which have taken place. A rubber mallet can be used to tap the entire Figure 14.106 Using pull cords to fit windscreen assembly firmly in place. Go to an automotive store. Heat is generated by the resistance of the parts to be joined to the passage of a heavy electrical current
Later came mobile jig benches and lift operated systems with pulling attachments. It also provides an alternative to type-approval for vehicles manufactured in very low volume; vehicles for civilian use. In order to facilitate the loading and unloading of a
damaged Figure 14.19 Metro 2000 measurement system (Celette UK) vehicle that cannot be driven on to the bench, a winch is provided. A removable version of this clip is also made for applications which have to be taken apart from time to time. The use of silver solder on metals and alloys other than silver has grown largely because of the
perfection by manufacturers of these solders which makes them easily applicable to many metals and allows by means of the oxyacetylene welding torch. Apply one coat and allow to dry for 15-30 minutes. Motor vehicle body panels are subject 13.4.3 Swaging A swage is a moulding or indentation raised upon the surface of sheet metal by means of
male and female rollers, the rollers being made in a variety of contours. Screwdriver attachments are also available for use with socket ratchets. These steels have a high strength and impact resistance and are used for road springs and valve springs. Oxygen is supplied at a maximum pressure of 200/230 bar at 15 °C. The art
of wheeling a panel to the correct shape and contour requires a highly skilled craftsman, who is known in the trade as a wheeler. The design of the decking plate enables the sill clamp outriggers to be left permanently in place which gives the benefit of a drive-on and drive-off pulling facility. If you are cleaning an engine or electrical eq
important not to get water inside. 4 As the gas is highly flammable, all joints must be checked for leaks using soapy water. To quote one section: 'On passenger vehicles and dual-purpose vehicles first registered on or after 1 January 1959, the glass of all outside windows, including the windscreen, must be of safety glass'. This means that the material
has exactly the right amount of resin applied to it. 7 Walkways should be a minimum of 1 metre. Stainless steel A welding rod having the same composition as stainless steel should be used. It is supplied in rolls in a variety of widths, but the most widely used are those measuring 20 mm and 25 mm. It is also necessary to determine whether any
underbody misalignment exists which requires repair before attempting to correct body alignment and damage. Be careful when using caustic soda as a cleaner, always wear rubber gloves, goggles and apron as the minimum PPE. They have housings made of high-impact GRP, which makes them light in weight and suitable for prolonged usage
without operator fatigue. Figure 7.8 POP blind rivet: sealed type (Tucker Fasteners Ltd.) Methods of joining 203 special carbon steel mandrel. (h) Optimum appearance. While supporting the torch securely, use a forward movement to move the torch continuously at a
constant speed, checking the weld bead frequently as you progress. Unlike steel, aluminium does not change colour when heated and, because of the melting temperature differences, great care must be taken not to melt holes in the panel while it is being heated. Ouarter light The window directly above the guarter panel. The use of a sealer coat at
stage 9 may be eliminated if the surface is carefully prepared. During the past few years some manufacturers have made improvements which have reduced the rusting of bodies. (d) Once the pins have been welded to the section, use the inertia weight tool to pull the dented section back into its proper shape. In an effort to prolong the life of a car
body and provide an additional selling point, most manufacturers now carry out a rust-proofing process as part of the finished product or as a chargeable extra. 5 Implement and monitor the system over a period of at least three methods by which heat can be transferred from one body to another. Fillers are manufactured
to suit the method of application: there are spraying, brushing and knifing types. Misalignment of car underbody can also cause tyre wear and may affect the brakes and steering control, which will not be cured however much checking and adjustment is carrried out. This is achieved either by applying a very high voltage at a high frequency between
the electrode and the tip and work, causing a high-frequency spark, or by momentarily touching the electrode and the nozzle together and then quickly breaking the contact, causing a high-frequency spark, or by momentarily touching the electrode and the nozzle. 11.2 Electrical terms used in arc welding Circuit A circuit is the path along which electrode and the nozzle together and then quickly breaking the contact, causing an arc between the electrode and the nozzle.
the linseed oil coatings, and later the nitrocellulose coatings, of yesteryear are almost forgotten in the march of 147 progress. 14 What is meant by a carburizing flame? 24 The spray pattern of a spray gun is top heavy. Cartridge filter mask The cartridge filter or organic vapour type of respirator, which covers the nose and mouth, is equipped with a
replacement cartridge that removes the organic vapours by chemical absorption. The installed fastener breaks flush with or below the surface of the lowprofile Hemlok head, leaving a clean finish and appearance. 5.2 Heat treatment of metals and metal alloys Heat treatment can be defined as a process in which the metal in the solid state is subjected
to one or more temperature cycles, to confer certain desired properties. Small body repair establishments have no separate estimator and therefore it is usual for the man who prepares the estimate to be responsible for carrying out the repair work as well. Head boards and drop sides. Use the manufacturer's existing access hole, or open extra access
holes. Care must be taken when selecting a ram anchor; for example, if a ram was placed between two chassis members and it was intended to push from the undamaged member, the force applied would not rectify the damaged member to straighten the damaged member, the force applied would not rectify the damaged member to straighten the damaged member.
pushing anchor point is stronger than the point which is receiving the corrective force. Figure 14.81 Vehicle on jig showing damaged sections removed (Motor Insurance Repair Research Centre) Figure 14.82 Vehicle on
jig being pulled before cutting out damaged sections (Motor Insurance Repair Research Centre) Figure 14.85 New inner wing section welded in place (Motor Insurance Repair Research Centre) Figure
14.86 Front panel positioned and welded in place (Motor Insurance Repair Research Centre) 7 Replace windscreen and rear windows if necessary. The defect results from poor joint preparation and unsuitable welding operating parameters, especially current settings (Figure 12.40). Special colour treatment on each side of the gauges provides easy
analysis of the datum plane; yellow stripes on one side and orange stripes on the opposite side can be alternated to provide contrasting colours for siting. 10 Describe how the vector principle is applied in repair work. (%) Elongation on 5.65 VSo over 12.5 mm thick (min.) 0.2 0.2 0.2 0.0 40.0 60.0 90.0 115.0 0.2 0.2 1.6 0.2 1.6 0.2 0.2
----16-14-914-1210----Table 4.9 Standard aluminium alloys: availability, physical properties, and applications Nominal composition: % alloying Physical properties elements Related BS/GE (remainder specification aluminium Standard forms Purity or (BS 1470-1475) and normal Melting alloy (new (old BS alloy impurities) Hollow
Density range °C nomenclature) designation) Mg Si Mn Sheet Plate Extrusions Tube g/cm3 lb/in3 (approx.) Coefficient of linear expansion per °C (20-100°C) Typical road transport applications Non-heat-treatable alloys 1200 IC - - 2.71 0.098 660 3103 N3 - - 1.2 b b b 2.73 0.099 645-655 0.000 023 5 5251 N4 2.25 - 0.4 - 2.69
0.097 595-650 0.000 024 5154A N5 3.5 - 0.4 - 2.67 0.096 600-640 0.000 024 5 5454 5083 N51 N8 2.7 4.5 - 0.8 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 024 5 0.7 1.0 0.5 - 2.65 0.096 580-635 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0
taken and alignment work to be carried out simultaneously. A twisted underbody is recognized by the gauge Figure 14.59 (a) Gunsight gauge frame (b) diamond detector gauge (Blackhawk Automotive Ltd.) Figure 14.59 (a) Gunsight gauge frame (b) diamond detector gauge (Figure 14.59 (a) Gunsight gauge frame (b) diamond detector gauge (Figure 14.59 (a) Gunsight gauge frame (b) diamond detector gauge (Figure 14.59 (a) Gunsight gauge frame (b) diamond detector gauge (Figure 14.59 (a) Gunsight gauge frame (b) diamond detector gauge (Figure 14.59 (a) Gunsight gauge frame (b) diamond detector gauge frame (b) diamond detector gauge (Figure 14.59 (a) Gunsight gauge frame (b) diamond detector gauge 
line in addition to the bars not being parallel (Figure 14.60c). The thinner of the paint, being water, acts as an electolyte; the paint solids, i.e. pigment and 576 Repair of Vehicle Bodies binder, are ionized and are attracted to the earthed car body.
electronically with the minimum of presetting. Most of the items inspected in the SVA scheme are those that are tested when manufacturers apply for type-approval of mass-produced vehicles. If the vehicle was struck by another, or if it has hit a low obstacle, it will have sagged. Dry powder This type of extinguisher is highly effective against
flammable gases, open or running fires involving flammable liquids such as oils, spirits, alcohols, solvents and waxes, and electrical risks. Generally, they harden in seconds. If motor engineers are to build extremely lightweight vehicles, they will have to consider the application of adhesive engineering. Thatcham continues to influence and improve
repair technology, keeping pace with the ever-increasing sophistication of the modern motor vehicle to the benefit of the motoring public. Voltage The force (electromotive force or EMF) that causes electrons to flow in a circuit is known as 11.3.1 DC generator.
which is driven by a petrol or diesel engine (Figure 11.2) or alternatively by an AC or DC electric motor. This is caused by the fact that the contact area between hammer and metal is greatly reduced by the serrations on the face. The main requirement of BS EN ISO 9001-2000 is the procedures manual. 625 17.20.3 Hints on colour mixing and
matching Never try to match a colour by dabbing a sample of the colour on to the vehicle and making adjustments. 24 Implement measures. The cylinder valves must be opened at least two full turns to ensure that the flow of gases to the regulators is unrestricted. 16 What is meant by a veteran vehicle? This problem can be solved by using the
principle of parallel lines. 25 Explain the precautions to be taken when welding aluminium. This steering wheel has an energyabsorbing hub which incorporates six deformable metal legs. 15 What is the best type of priming paint to use on an aluminium surface? These are often used ion conjunction with polyester-based GRP. This is because the
surfaces of the vehicle, once painted, will be of a very high gloss and hence reflective, exacerbating any disability glare and masking faults in the paintwork. This give a thicker fabric which has a rougher surface texture and very good porosity. Additional molten metal from the tip of the electrode is deposited into the molten pool, and when solidified it
results in a strong welded joint. 13.6.4 Spring hammering This is another technique of using hand tools to smooth and level a panel surface. The flame is then played uniformly over the joint until the flux has dried and become first powdery, then molten and transparent. It has been found that the use of multiple hydraulic pulling equipment used
simultaneously is the most effective method when dealing with the majority of major collision work, together with standard hydraulic body jack equipment (Kroll (UK) Ltd.) secondary pushing/pulling facility to aid the
repair of the damage. The length of an electrode should be within 2 mm of the nominal value given. 2.8.15 Selection of fire extinguishers in common use in garage premises, these are identified by their colour, as given in the following table: 82 Repair of Vehicle
Bodies 2.8.16 In the event of warnings, procedures for isolating machines and evacuating premises are followed If you hear a fire/emergency warning you must follow the company's evacuation procedure - this is usually stated on the workshop wall. The alloy is soaked at 490 °C for fifteen minutes and then quenched immediately in cold water. 24
Explain how an adhesive can be selected for use. The disadvantage of this regulator is that as the cylinder pressure drops, the actual working pressure also falls and thus needs continual readjustment. In cases where hinges have been subjected to collision damage, the hinge transmits the damaging force to the pillar or door frame, causing twisting
and misalignment. This creates an unacceptable appearance or surface finish and would require weld dressing. The welding torch should be reasonably light and easy to handle, with provision for gas shield shrouding, control switch, easy wire changes and good insulation. Compartment shelf panel The horizontal panel situated between the rear seat
back and the back window. The only indication of a diamond condition would be that the two pins of the diamond detector gauge would be out of line with all other self-centring pins. As these penetrants and magnetic test liquids give off harmful vapours, the work must be carried out under well ventilated conditions. The black carbon dioxide (CO2)
extinguisher will put out the fire and not leave a mark anywhere. DC generators usually have a polarity switch which enables the welder to reverse the polarity, as is occasionally required when welding with special electrodes. A 41 or 38 scale model is produced from the stylist's drawings to enable the stylist designer to evaluate the Figure 1.13
Driver and front passenger airbag systems in use (Du Pont (UK) Ltd ) three-dimensional aspect of the wehicle. Of the metals used for general work, aluminium and copper are outstanding for their properties. If you spill petrol or oil when you disconnect a pipe from the engine you should clean it up immediately or else you, or a colleague, may slip and
fall. Tensile strength The resistance to breaking which metal offers when subject to a pulling stress. A further advantage was that the finish required no burnishing or polishing. Large panels can be made considerably more rigid by the
employment of a sandwich form of construction, whereby two layers of glass fibre reinforced plastic are separated by a thick but relatively weak lightweight material. Multiple pulling positions around the Autorobot L mean that two or more pulling towers can be used at any one time for both minor and major repairs. The electrode diameter is
determined by the current and 318 Repair of Vehicle Bodies Table 12.4 Electrodes for TIG welding Electrode tungsten DC electrode tungsten DC electrode tungsten DC electrode tungsten Electrode tungsten Electrode tungsten DC electrode tungsten DC electrode tungsten DC electrode tungsten Electrode tungsten DC electrode tungsten DC electrode tungsten DC electrode tungsten DC electrode tungsten Electrode tungsten Electrode tungsten DC electrode tungsten DC electrode tungsten DC electrode tungsten Electrode 
diameters are given in Table 12.5. The angle to which the electrode is ground depends on the application. The first automotive airbags were made more than 20 years ago using nylon-based woven fabrics, and these remain the preferred materials among manufacturers. The rule can be locked in any desired position by a thumbscrew. When this occurs
the result will be crabwise running in which the car seems to travel in a sideways manner, commonly called dogtracking. Penetration Depth of fusion or weld penetration. Pre-alignment check This breaks down into two areas: tyre inspection and steering component inspection.
between these two and the jobs they perform. Questions 1 Describe the differences between the following classifications: (a) total fusion (b) skin fusion (c) surface fusion. Much depends on such factors as the manufacturer, the make of the car, the series and the body type or style. 2.2 Fire precautions The Fire Precautions (Places of Work)
Regulations 1992 replaced and extended the old Fire Precautions Act 1971 as from 1 January 1993. 15.2.2 Administration offices The bodyshop manager's office should also be adjacent to the reception office for easy access to liaise with the customers. Category A is integrated pollution control (IPC) operated by HMIP in England and Wales and
HMIPI in Scotland. In the other grip, the torch is held like a hammer, with the fingers lightly curled underneath. Basket Twill (Courtesy of SPSystems) One or more warp fibres alternate by passing over or under two or more warp fibres. The remaining areas of flat floor are ribbed below the seats and in the foot wells to add stiffness (Figure 1.46)
Convertible or cabriolet This can have either two or four doors. The abrasives used are silicon carbide and aluminium oxide, and these are attached to a treated paper backing by means of waterproof resin glue. Availability of accurate data information which should be constantly reviewed and updated. The packing can be lubricated with a drop or two
of light oil, but fitting new packing is strongly advised. The guide coat should obviously be of a contrasting colour to that over which it is applied. This reduces the risk of accidentally spraying the interior trim and fittings by withdrawing the lance too rapidly. Provided repairs are expertly carried out, all repair procedures using part panels will result
in the same standards of strength and operational safety being maintained as for a new vehicle. An anti-lock braking system (ABS) enhances a driver's ability to steer the vehicle during hard braking. Puddle The small body of molten metal created by the flame of a welding torch. If possible pre-heat the panel before welding to give better weld quality
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and reduce the risk of distortion. 4.13.6 Repair procedures As a general rule thermoplastics can be welded and thermosets bonded. Spot welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds may be made one at a time or several welds.
to any cylinder where some difficulty has been experienced in maintaining a good supply of cooling water. The front end of the main floor is fixed to the toeboard panel and the sides of the main centre floor are strengthened by the bottom sills (4) and/or some form of side members which provide the necessary longitudinal strength. The procedure is
to find the nearest combination in Section B, each dot in the column denotes a panel. Styling departments vary enormously in size and facilities, ranging from the individual consultant stylist to the comprehensive resources of major American motor corporations like General Motors, who have more than 2000 staff in their styling department at Detroit.
Lotus body design and construction The body structure comprises a moulded composite floor pan reinforced with steel in key areas to form stiff box sections. The interior of the car is sprayed over in black and is Craft techniques and minor accident damage 353 vehicle's interior trim and seats, provided in a special colour at the request of the owner,
detailed fittings, body items and carpets (Figure 13.21). At this point the vehicle should be anchored to the main frame by the use of chains and clamp attachments to hold it against the corrective pulling forces. The choice of the thickness of sheet steel will vary according to the load for that particular panel. Using the hook nozzle, deposit a generous
Automotive finishing and refinishing 619 Figure 17.67 Sealing underbody (Tuff Kote Dinol) routing of sealant all the way round. Marked-out templates, which are usually in thin metal sheet, cut and then filed to a very accurate size, are used when one is working to rolling radii so that
the curve can be checked as it is rolled. Welding galvanized steels (zinc coated) can reduce rust resistant properties around the weld areas if they are not correctly treated. The availability of the mains supply is obviously a criterion. The alloy is weldable by the inert gas arc process, but there is a considerable loss of strength near the weld owing to
the annealing effect of the welding process. It is based on the principle whereby intense heat is obtained from an electric current which creates an arc between a metal electrode and the plates which are to be welded (Figure 11.1a). Use appropriate cleaner before polishing. Finally extend and secure the webbing on inertia reel seatbelts and spray these appropriate cleaners are the welding process. It is based on the principle whereby intense heat is obtained from an electric current which creates an arc between a metal electrode and the plates which are to be welded (Figure 11.1a).
surrounding areas with great care. The aims of the centre are as follows: 1 To advise on repair methods and prepare accurate job times for panel replacement 2 To minimize the effects of road accident damage and liaison with manufacturers in the interests of better vehicle design 3 To pioneer quicker, more cost-effective methods of damage repair.
Release sensors Most vehicles are fitted with two negative acceleration (deceleration) sensors wired in series. This is surrounded by two other zones, the outer one of which is 70 mm wide all round the edge of the windscreen. Such a protractor may also be used for marking out when the marking lines do not form one of the usual angles. As already
explained, it is difficult to hold a panel firmly when it is not attached to the body, and to beat a panel that moves with each blow is most unsatisfactory. Moulds are usually made of reinforced plastics. As a consequence of adhesive glazing is now printed with a ceramic fired-in black band to protect the polyurethane adhesive
from ultraviolet degradation, and also for cosmetic reasons so that the adhesive cannot be seen. The absence of flux also means that the welder has a clear view of arc operation and weld bead appearance and is not subjected to excessive fumes. The
evaporating solvent at the spray tip of the gun. To replace this type of windscreen the metal lip on the body aperture is sealed with a sealer, the appropriate channel in the weatherstrip is then placed over this lip and seated all the way round that by adding tungsten to carbon steel, an alloy steel is formed which
will retain a hard cutting edge at high temperatures. Work the glass into the glass channel of the weatherstrip and be sure it is properly seated all the way round. These ribs, which are often used in large boat hulls, can be solid or hollow; for solid ribs a permanent core of glass fibre, wood or plastic foam can be laminated in, while hollow ribs are
achieved by use of removable tube or simple former of cardboard or similar material (see Figure 17.24) depends on the following: 1 2 3 4 Figure 17.21 HVLP spray gun using a remote fluid cup (DeVilbiss Automotive
Refinishing Products) Volume of compressed air available Type of paint to be sprayed Size of the fluid tip (air caps are usually designed to operate with a particular fluid tip) 5 Nature and size of the surface to be painted. Dinging hammer used for dinging or removal of dents. It is
only in these localized areas that any structured change occurs within the metal itself. The cutting action of the thread reduces the size of the hole after the pilot point has passed through. Burr The resulting condition left on a metal edge after cutting or filing. Some of the double-ended scribers have points which can be 6.2 Basic marking-out and
measuring instruments 6.2.1 Rules A length may be expressed as the distance between two faces (end measurement) or as the distance between two faces (end measurement). Give examples. Chapter 15 provides further information about these regulations. 13 Explain how rigidity and strength are achieved in monoconstruction. Although sheet and
plate glass are manufactured satisfactorily for use in doors, rear lights and windscreens, float glass has now largely superseded their use for reasons of economy and improved flatness. The centre of the scale has a target area through which the laser beam passes when the measuring point is at the correct position. These are also normally urethanes
 and are used in more structural applications such as cores in sandwich constructions. Any radical change in the angle of transmission to the rear axle may cause excessive wear in the universal joints, noise in the rear axle may cause excessive wear in the universal joints, noise in the rear axle or axle failure. This material is used for dough moulding compounds, and in casting resins to prevent cracking (Figure 16.10). The
first of these fillers developed were released some years ago and many disappointments were associated with their use; problems encountered were poor bonding to panels, too much delay in hardening and too hard to file when dry. It is advisable to place the tip of the lance into the section being processed and to fog spray on both inward and
outward strokes. seat belt side LH/RH Bracket anti zipper Sill front floor side inner LH/RH Reinf. 6.2.19 Radius gauges These are used to measure small internal and external radii. It is different from the type of pulling previously described, which was a method of applying force to pull towards one another, sections which have been forced apart. The
use of water-based paint also allows the reduction of carbon dioxide (CO2) by giving a faster drying time. As the control handle is moved, a calibrated dial shows the current setting in amperes. The main use of the flexible lance is for treating sills, underbody box sections, strengtheners and pillars. However, the traditional nut and bolt is still in use,
and for many applications it is difficult to imagine how it can be replaced. Use heat sparingly as required to remove severe wrinkles. All cylinders containing gas at high pressure are fitted with a cylinder valve which must not be removed or tampered with at any time except to tighten the gland nut when necessary. It is best to weld small sections at a
time, planishing with a hammer and dolly whilst the weld is still hot; this allows the weld to be flattened easily and it gives the weld inherent strength. It supports the vehicle, the pulling arm and the measuring system. Alternatively, dry sand with a dualacting sanding tool using P80-P150 grade paper. In the body building trade, panel beating is still
used to a large extent where new vehicles are being built either in aluminium or mild steel. This provides optimum performance opportunity. These diodes will be damaged if the alternator is not disconnected before carrying out any form of electrical resistance welding. 17.14.10 Quick air drying synthetics This type of material offers special
advantages for low-cost resprays and rapid finishing of commercial vehicles. This polished surface will be seen to change colour as the heat is absorbed. Because aluminium is easier to work than steel ones. It is necessary to prevent
contamination of the weld pool by atmospheric gases which cause deterioration of the weld bead quality, by surface oxidation, porosity or embrittlement. Shear strengths range from 400 N for 2.4 mm diameter aluminium, care must be taken not to apply too much
pressure by the bottom wheel as this could have the effect of overstretching the material. With the development, however, the edges of the material can be heated locally until they melt, and then fused or welded together. The damaged vehicle can be either driven or pushed on to the bench using a trolley jack
Next the spindle is locked in position by turning the locking ring and the reading is taken. Socket set accessories multiply the usefulness of the socket set accessories multiply the usefulness of the socket set. 15.1.3 Legal requirements for the planning stage When building a new bodyshop, the following factors are important: the best location possible, high profile, easy access and
sufficient space. 6.2.7 Bevel protractors The alignment of planes or surfaces designed to form a definite angle may be checked by the universal bevel protractor. Many chemical compounds act as accelerators, making it possible for the resin-containing catalyst to be cured without the use of heat. 6 Describe, with the aid of sketches, the general
principles of composite and integral methods of body construction. 13 Explain the use of the vee block when marking out. (d) Materials left over from a specific job should be put back into a labelled container so that not only you but anyone (and this may be a fireman) can tell what the potential risk may be. Such tubular clips permit the assembly of
badge to the grille as a final operation. This lack of resistance is due not so much to poor compressive strength as to lack of rigidity. This process burns out impurities and reduces the carbon content from 4 per cent to between 0.08 and 0.20 per cent. (g) Pultrusion is a continuous process for the manufacture of products having a constant cross
section, such as rod stock, structural shapes, beams, channels, pipe, tubing and fishing rods. Premises, equipment and chemicals used in cleaning and valeting to ensure that nothing is inadvertently missed. It also helps to support the engine and suspension
units (see Figure 1.45; key figure references 13, 15, 16, 20, 22). Large areas of almost flat sections running into gradual return sweeps are incorporated in the designs of most bonnets. 13.16.5 Reskinning door panels This process affords considerable saving in time and cost compared with the practice of replacing complete door assemblies. Either a
standard Taptite screw can be driven into holes which have been rim extruded to provide more 214 Repair of Vehicle Bodies Figure 7.40 CA Taptite screw (European Industrial Services Ltd.) Figure 7.41 Polymate screw (European Industrial Services Ltd.) Figure 7.41 Polymate screw (European Industrial Services Ltd.) Figure 7.40 CA Taptite screw (European Industrial Services Ltd.) Figure 7.41 Polymate screw (European Industrial Services Ltd.)
thermoplastic. 19 Describe, with the aid of a sketch, the formation of a weld nugget during the spot welding cycle. This type of machine uses an endless sanding belt, which is 3 in (16.1 mm) wide, instead of the normal round disc. In the latter type a boom, which can be moved over the car body, has all the facilities that the worker requires, e.g.
compressed air supply hoses, extraction hoses, and electrical supply for both 240 V and 110 V tools. All accredited companies are permitted to display the easily recognizable BSI symbol. Single-part epoxies (ESP) are a development in epoxide technology. The surface of the lead must be first scraped clean before the flux is applied and the joint
soldered. It is used to advantage on panel edges to stiffen, to make the edge safer and to improve its appearance, and in many cases to perform the function of a flanged joint where one metal panel is joined to another. Check body channels and rubbers. The types of pulling, alignment and repair systems described in this chapter include the following
1 2 3 4 5 6 7 8 9 10 11 12 13 Portable pulling equipment (Dozer system) Stationary pull-post systems (Mitek) Stationary floor mounted rack (Korek system) Stationary floor mounted rack (Korek system) Stationary floor mounted rack (Korek system) Stationary floor mounted rack (Korek systems) Stationary floor mounted rack (Korek system) Stationary floor mounted rack (Korek systems) Stationar
mounted pulling systems (brackets, mechanical measuring, electronic measuring, laser measuring) Mobile bench-type jig mounted pulling system with pulling equipment (brackets/measuring) Scissor-type hoist jig system with pulling equipment (brackets/measuring) Four-post ho
(mechanical or electronic measuring) Drive-on bench systems with tower ram pulling (mechanical or laser measuring) Multifunctional repair systems with pulling and measurement systems with tower ram pulling (mechanical or laser measuring) Multifunctional repair systems with pulling and measurement systems with pulling and measurement systems. 118 Repair of Vehicle Bodies Figure 3.63 Impact air screwdriver (Desoutter Automotive Ltd.) Hand and
power tools 3.24.3 Bonded windscreen electric cutter This cutter (Figure 3.65) greatly simplifies what was formerly a time-consuming task for two people. 3 Apply borax flux either to the surface. It is usually referred to as polyester. They should be stored in a
 separate area, preferably in a well ventilated fireresisting compartment. This book is an excellent starting point providing the basic essentials as well as the more advanced skills and knowledge needed to equip students for a successful career in the body repair industry. 18 Glass cleaning. It is ideally used to hide a lapped joint in the construction of a
body shell, and is very useful to the panel beater repairing a windscreen or door pillars, or when a dent or crease is backed by a bracket or is double skinned, which prevents the placing of a dolly behind the panel such as those
encountered on furniture vans require a different approach. Turntable This gives an excellent means of utilizing what would otherwise be a dead corner, or may permit the spray booth to be sited in an otherwise impossible position (Figure 17.71). Note: this categorization is given in relation to the types of application usually seen in association with
the materials nominated. 558 Repair of Vehicle Bodies Table 16.5 Resin comparison (Courtesy of SPSystems) Material Advantages Disadvantages Polyester Easy to use; lowest cost resin Vinylester Very high chemical/environmental resistance; high water
resistance; long working times available; temperature resistance up to 220 °C; low cure shrinkage Only moderate mechanical properties; high styrene emissions on open moulds; high cure shrinkage; limited range of working times Postcure generally required for high mechanical properties; high styrene content; double cost of polyester; high cure
shrinkage rate Critical in mixing; corrosive; dangerous to handle; triple cost of polyester Epoxy Table 16.6 Properties of reinforcement fibres and other materials (Courtesy of SPSystems) Material type Tensile modulus (GPa) Density (g/cc) Specific modulus (GPa
Aramid UHM Glass - E glass Glass - S2 glass Glass - E glass Glass - E glass Glass - Gass - Gass - Gass - E glass Glass - E glass Glass - E glass Glass - E glass Glass - S2 glass Glass - S2 glass Glass - S2 glass Glass - Gass 
2.5 \ 2.5 \ 2.5 \ 2.5 \ 2.5 \ 2.5 \ 2.5 \ 2.5 \ 2.5 \ 2.5 \ 2.6 \ 2.5 \ 2.6 \ 2.5 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 \ 2.6 
wall-board storage, and on trolleys incorporating a small press or in the form of a bench rack (Figure 13.50). The hammer should bounce back of its own accord so that it is ready for the next stroke. The blades are made from heat-treated forged chrome steel and are radiused in order to maintain a constant cutting angle from the back of the jaw to the
front, allowing good cutting pressure for the user. to handle and usually require specialized mixing equipment. A good example is the motor car. The handle of the Figure 3.35 A set of open-ended metric spanners (Facom Tools Ltd ) ring spanner can be straight or offset to provide hand clearance. The floor area should be divided into sections as
follows: preparation of reinforcement, mixing of resins, moulding, trimming and finishing. • The properties of the resin. Manganese High tensile strength, toughness and resistance to wear. The requirements for upgrading are as follows: 1 Filtration systems have to ensure that the concentration of paint particulate matter in the final discharge to
atmosphere from the spray booth does not exceed 10 mg/m3. If sanding down is not necessary, the finishing material can be applied following the flash-off times listed in point 5. Environmental Protection (Prescribed Processes and Substances) Regulations 1991 These identify the respraying of road vehicles as a category B process (local authority air
pollution control) if the process may result in the release into the air of any particular matter or of any volatile organic compound (solvents) where the process is likely to involve the use of 2 tonnes or more of organic solvents in any 12 month period. At all times the dolly block must be held loosely against the underside of the panel, exactly centred
under the heat spot. Another version of the Taptite screw is CA Taptite (see Figure 7.40), designed in response to the increasing use of thinner-gauge materials. The surface profile will often be smooth and less likely to produce stress than over-penetration; however, it may result in unacceptable loss of cross-section. Defects
reflect these pulses back to the probe through a flexible cable which is attached to the ultrasonic test set, where it is displayed on an oscilloscope screen as deflections of a trace. When it opens from water ingress - all laminates
permit very low quantities of water to pass through in a vapour form. The real beginning of the all-steel body shell came in 1927, when presses became capable of producing a greater number of panels and in more complex shapes; this was the dawn of the mass production era. General body repair area This is where minor repairs, general repair
 work, and work not requiring a jig can be carried out. 7 Vacuum clean all interior surfaces. Using a waist-belt-mounted miniature fixed-pressure regulator and a pre-filter, the equipment supplies breathing quality air through a small-bore hose to a variety of face masks and visors to provide respiratory protection for paint spraying (such as with
isocyanates), cleaning and grinding (Figure 2.9a, b). Cleanliness within the booth or spray room is essential if high-class finishes are to be obtained. It is designed for use when damage occurs which is not severe enough to necessitate jigging. Systems must also be in place to show that if faults do occur, positive actions are taken to ensure that they do
not occur again. min. causes damage to the ozone layer and can poison the operator. Applied with a spray pistol Suitable for underbodies, touching up and subsequent treatment of all protective coatings Long-term corrosion protection even when thinly applied. Gold is extremely malleable and may be beaten into very thin leaf. The motor drives a
flywheel through a multiplate friction clutch and single or double gearing. Special composite swages are also available for use on panels (Figure 13.25); the rollers are made in sections so that their width may be adjusted. 4.7.2 Aluminium alloys used in bodywork The choice of material and the condition in which it is required must depend largely
upon design requirements and the manufacturing processes within the factory. This fact makes planishing ideal for the vehicle body panels (Figure 13.14). 20 How can misalignment of a car body affect the control of the vehicle body panels (Figure 13.14).
fit snugly into the crack. However, this trouble can usually be very quickly rectified if the operator knows where to look for its source. Name and describe three such vehicles. For ease of use the adhesive is supplied as a layer of hardener inside a plastic tub; the two layers will not react until mixed with the stick provided. This
is ideal for general usage from a central store, as missing tools can be quickly identified. 36 How are vehicles made safe against side impact involvement? Landaulet or landaulet or landaulet and fit the precut nozzle. It is also
the method usually adopted for cast iron and non-ferrous metals. A flashback should be suspected if there is a squealing or hissing noise, sparks coming from the nozzle, heavy black smoke, or if the welding torch gets hot. Apply two coats as follows: (a) Brushed: allow at least 6 hours between coats, the time depending on workshop temperature. The
weft is the shorter part, running at 90° across the warp. Construction and setting action is similar to the standard open type. In this system of measuring the body is divided into two basic section, which is the area from the centre pillar
backwards to the rear boot compartment (Figure 14.73). However, if a booth is excellent in all other respects, the lighting can be modified by a specialist company without causing too many problems. Carbon dioxide Cylinder colour: black, or black with two vertical white lines for liquid withdrawal. The annealed coil is decoiled and passed through a
single-stand temper mill using a specially textured work roll surface, where it is given a light skin pass, typically of 0.75-1.25 per cent extension. To change materials, release the pressure and replace the can. The metal surrounding the iron is heated to the melting point of the solder by conduction of heat from the soldering iron, and the solder will
start to flow. 1 Panel bays should be 6 metres 3.6 metres. The calculations The following are some of the calculations which an aerodynamist may be concerned with; it should be remembered that these calculations are often carried out on about 10 000 000 (ten million) individual grid squares, or cells, on the car body, a slight change of design will
need a new set of calculations. They cannot be welded; any more heat applied to them will break down their molecular bonding. 5 Low-speed wobble may show up a separated tyre tread. To repair this, secure one end of the vehicle, provide a support at the point of the bend, and pull down the raised end. HSS are also known as re-phosphorized -
 added phosphorous; isotropic - added silicone and bake hardened - strain age hardened. By tradition all Aston Martins have had aluminium bodywork because aluminium is a medium ideally suited to small production runs and for hand building; it is also light in weight. For zonal heating, the heating requirement should be calculated on the basis of
150-300 W/m2. Surfacers and fillers are more porous than enamels, and when the surrounding panel is sprayed with the finishing colour only the repaired area can be detected by a slight variation in colour and texture. The method by which the priming coat on modern vehicle body shells is applied is known as electrodeposition (Figure 17.1). 2 If fire
starts, regardless of cause, can it spread? The softened paint is then removed with a stripping knife and the surface washed down with a generous quantity of water. That part of the weld where the parent metal has been melted, if filler is used and interdiffusion has taken place, is called the fusion zone, the depth of which is termed the weld
 penetration. Most composite exterior panels are bonded to this structure using a flexible polyurethane adhesive, but the frontal panels are secured by threaded fasteners for ease of service access and collision repair. The welding torch is given a forward motion, with a slight sideways movement to maintain both edges melting at the desired rate, and
the welding wire is moved progressively along the weld seam. Concentrate the flame on the base metal and not on the rod. The spraying viscosity of the finishing enamel is more critical than the half-hour enamel, and only the thinner recommended by the paint manufacturer must be used. However, the engineering definition of resistance is such that
the higher the clamping force, the greater the current needed to produce a constant heat. However, as a professional in the motor industry you should be able to preserve the scene, that is, prevent further injury and make the injured person comfortable. To skilled and experienced operators this does not mean that any additional restrictions are
imposed on their activities, but merely that they should carry out their tasks with constant regard for the health and safety of themselves and their fellow workers. Although fluxes will dissolve films of oxide during the soldering operation, sheet metal that is clean is much more likely to make a stronger, sounder joint than when impurities are present
This can be done for mild steel having a dissimilar thickness ratio of 3:1. Chief precision alignment gauge system. Vehicles can be propelled into a static crash barrier or impacted by a 1000 kilogram mobile crash barrier. These requirements apply equally to
 existing welding techniques, usually manual metal arc and oxy-acetylene, to give superior welding conditions and economies. Helium is more often used in reels of 5-15 kg. Open circuit When a wire breaks or becomes disconnected and the circuit is no
 longer complete an open circuit is produced. 2 Over-three-day injury - if as the result of an accident connected with work an employee is 76 Repair of Vehicle Bodies absent for more than three days an accident form must be sent to the HSE. Shrinking dolly block is designed for shrinking welded seams and reducing stretched areas prior to filling
Torx screwdriver The Torx fastener is used quite a lot on vehicle bodies. 5005 A 0.30 0.7 0.20 0.50-1.1 0.10 - 0.25 - - 0.05 0.15 Rem. The glass fibre reinforced plastic, having characteristics of high strength, low weight, resistance to corrosion, good electrical properties and design flexibility, together with its suitability for a wider range of
moulding methods, has resulted in a rapid growth of its use. 2.5 Electrical hazards The Electricity at Work Act 1989 fully covers the responsibilities of both the employee and the employee. 6 Falling a distance into a dangerous substance. Instead of a body built on to a chassis, the whole unit is constructed round a framework of light sheet metal box
matching pair of vee blocks, before using them always check that each of the blocks is stamped with the same number. This tool has been designed to pull out dents and creases from the face side of the panel without the necessity of removing the trim and lining materials to gain access behind the dents. Usually available only in narrow widths in cold
rolled material A blue/black oxide finish; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment; applicable to hardened and tempered strip A polished finish oxidized to a controlled blue colour by further heat treatment for the finish oxidized to a controlled blue colour by further heat treatment for the finish oxidized to a controlled blue colour blue finish oxidized to a controlled blue finish oxidized to a controlled blue finish oxidiz
polished finish oxidized to a controlled yellow colour by further heat treatment; applicable to hardened and tempered strip A surface finish for vitreous enamelling of material of specially selected chemical composition Other finishes by agreement between the manufacturer and the purchaser body structures, and safety legislation requiring greater
protection of occupants through improved impact resistance, are bringing about a change in materials and production technology. Third, since only the skin of the parent metal is fused, a capillary gap is formed in the lap joint and the molten filler metal is fused, a capillary gap is formed in the lap joint and the molten filler metal is fused, a capillary gap is formed in the lap joint and the molten filler metal is fused, a capillary gap is formed in the lap joint and the molten filler metal is fused.
or be composed of several cylinders of different diameters, or have tapered walls with spherical bottoms or flat bottoms. 5.12 Brake presses (Figure 5.20) are devices for bending sheet metal quickly and accurately, and their rapid development in the past twenty years has resulted in a very wide capacity range of up to 1500 tonnes.
Flash welding is used to butt or mitre sheet, bar, rod, tube and extruded sections. 3.20 Metal cutting shears and nibblers usually lighter, smaller and easier to handle. This pattern can be made in strong brown paper or special template paper. A small amount of body filler on the underside to blend the patch into the surrounding material will make the
job look neat. Similarly, if the vehicle suffers from any fire damage, the SRS wiring harness must be replaced. 4 The use of sanding machine in finishing produces injurious lead dust. Ensure that the differently shaped blocks are located correctly. This is a complex business often involving not only planning officials but also building and sanitary
 inspectors as well as the environmental health department officer; therefore it is usually advisable to employ an architect. The Dozer (See Figure 14.2) is designed for heavy major frame and body Figure 14.2 Damage Dozer (Blackhawk Automotive Ltd ) 1 2 3 4 5 6 7 8 Basic frame assembly Air hydraulic unit Extension beam Support stands and cross
tube (set) Underbody clamps (pair) Cross tube clamps (pair) Chain positioning loop Multi-direction, self tightening clamp 9 10 11 12 13 14 15 16 Pull clamp Pull ring Multiposition anchor post Multipull dozer hook Frame horn puller Chain with two hooks 2.70 m Chain with one hook 2.70 m Tram track gauge 408 Repair of Vehicle Bodies damage, for
light frame and body straightening, and for use in conjunction with a repair bench. Pressure is applied to the blank holder by springs, air, or an outer ram of a press. 18 Steel panels can be strengthened with absorbent paper towel. It is used for
metal and wood cutting tools, turning tools, turning tools, taps and dies, and forging and press dies because of the introduction work, an inspection will allow the vehicle to go forward into the paint shop. Left hand means that the lower
blade, which should be on the underside of the sheet of metal being cut, is on the left-hand side. Light, low-cost forms (cardboard mailing tubes, folded cardboard, balsa wood) pressed into the mould during spray-up give stiffening shape to fibreglass. Figure 16.21 Hot press moulding 16.6.4 Production composite moulding processes There are many
fibreglass reinforced plastic moulding processes available to the designer. Not only that, but over-heavy use can wear the motor, causing it to burn out. An exception is plug leads which have an inbuilt resistance for radio suppression purposes, typically 30 000 ohms per meter of length. This toxic vapour if inhaled into the lungs will cause dizziness,
nausea, and even vomiting. 24 Explain the following abbreviations: COSHH, EPA, HASAWA. This is pushed into a hole in the panel, where it remains captive and ready to receive the study of the badge or nameplate. The mother shouted for help. No short-circuiting takes place; the welds are hotter, and the depositing of weld metal is faster. 38 Explain
the principle of the Nyloc and Cleveloc nuts. These materials, such as Kevlar, carbon fibre, glass fibre, non-woven, unidirectional forms, can produce moulded structures with a variety of properties. The edges of the crack are then shaped into a V with a burring bit which has a cutting edge on both its circumference and its
face (see Figure 14.119). Sometimes a backfire may pass beyond the injector and travel back into either the oxygen or fuel gas hoses. If the module would go down to the floor. Rear wheel alignment with a fractional variance from the manufacturer's setting
can now be critical to a car's handling and steering. 3 Apply cellulose stopper where necessary in thin layers, allowing 15 to 20 minutes between layers. Thatcham is unique in that it represents an entire motor insurance market. Having found the location, make absolutely sure that it will be permissible to build exactly what is required. The usual ways
to do this is by means of a control card. First clean the surface to a bright finish with coarse emery paper or steel wool, then immediately apply the flux. 3 Cut away the damaged laminate (Figure 16.36). The purpose of toe on turns is to allow for the greater
distance of travel of the outer wheel when cornering. 16 Explain the meaning of the term 'penetration' in a welded joint. Punched holes are generally slightly conical, and for an efficient joint the work has to be arranged so that 198 Repair of Vehicle Bodies the holes are brought together with their smaller ends adjacent. It provides a body shop with a
 versatile and comprehensive means of undertaking crash repairs accurately and efficiently, with minimal disruption to vehicle components. Using alternating vacuum and pressure cycles, all of the air in the break is withdrawn and the void is filled with resin. 36 State the advantages of having a body jig system incorporated in a lift system. Cord wires
Metal and flux corded wires are available. Your computer system will have the facility to prepare not only a detailed document for the customer, but also a comprehensive breakdown for the insurance company. As iron shrinks approximately 10 mm per metre when solidifying from the molten condition, the tendency to produce distortion is
considerable. The maturing process can be accelerated by post-curing. The common fault with the strip or wire clip is that they become rusty and break, either on removal or on replacement, and plastics have the advantage of being rust-proof. Nowadays the spray painter has the help of the paint manufacturers, who can supply him with literature to
cover every painting process, but his predecessor, the coach painter, had to have a very solid understanding of the materials at his disposal. 4.10 Sound deadening depends on whether or not it is also required to provide undersealing. When
making a close butt weld, exact alignment is ensured by positioning and clamping the new panel outside the old so that a scriber can be run down the edge of the old panel where the joint will come. It must be stressed that the time lapse between applying the base coat and the clear coatings recommended by the paint manufacturer must be strictly
observed if intercoat adhesion problems are to be avoided. 5.5 Shearing theory If a piece of sheet metal is placed on one bottom cutting member or blade, and the top cutting blade is brought to bear on the metal with continuing pressure, after a certain amount of deformation the elastic limit of the metal is exceeded and the top cutting blade
penetrates and cuts the surface of the metal (Figure 5.5). Mutton cloth is available in different grades: coarse, medium and fine. While fibreglass adheres well to itself, additional spray-up is needed to tie into part. First, since the filler metals used in these processes have melting points lower than the parent metal to which they are being applied, a
lower level of heat is needed than in total fusion and in consequence distortion is reduced. 12 Explain the mode of metal transfer used for welding thin-gauge materials. Grades 40 and 50 may be induction or flame hardened and grades 60, 70, 80 and 95 may be supplied in the hardened and tempered condition Metals and non-metals used in vehicle
bodies 4 127 128 Repair of Vehicle Bodies painting characteristics have been developed. Floor carpet for car floors is made either in one piece which is moulded to fit the front and rear sections of the floor respectively. The motor body industry uses many different types of steel. 43 State why GRP
bodywork is normally associated with separate body construction. Open-coated discs are used where the surface being ground is of such a nature that closely spaced abrasive materials would rapidly fill up and become useless. Uneven weld bead width Welding rod stretched; uneven pressure applied to welding rod. Research into competitors'
vehicles, market research to judge tastes in future years, and possible changes in legislation are all factors that have to be taken into account by the product planners when determining the specification of a new vehicle. MIG welding has the advantage of reducing distortion to a minimum, owing to the effect of the inert gas shielding the spread of
heat around the weld zone. A big advantage was the low tooling cost needed for limited production. In early motoring it was used to describe a lightweight car with large spoked wheels, one double seat and usually a hood. 5.1.5 Toughness This property imparts to a metal the ability to resist fracture when subjected to impact, twisting or bending.
13.14.3 Spreading Spreading (Figure 13.55) is a similar application to pushing except that in the latter case there is sufficient room for access for the ram and extension between the two members to be moved apart to Figure 13.54 Pulling with body jack (Blackhawk Automotive Ltd.) Craft techniques and minor accident damage 377 Figure 13.55
Spreading with body jack (Blackhawk Automotive Ltd ) permit a direct push. Computer printouts verify the vehicle's structural Figure 14.49 The Genesis electronic measuring system (Chief Automotive Ltd ) condition by showing overhead and side-view diagrams. This advice also applies when extending an existing bodyshop, when it is essential to
ascertain that extension building plans do not contravene Building Regulations. The last are necessary in order to provide the refinisher with a measurable quantity. 16.5.4 Releasing agents Releasing agents used in the normal moulding processes may be either water-soluble film-forming compounds, or some type of wax compound. They are hammer
driven through light-gauge sheet metal, taking care not to bend or break them, so that the hardened spiral thread cuts into the burr in the sheet metal and then worms its way into the adjustments are unbalanced readjust the atomizing air pressure, fluid pressure, and
spray width control setting until the correct pattern is obtained. The pump will build up sufficient pressure only to overcome the external resistance against the ram. This further research has led to the concept of advanced high-strength steel (AHSS) as the materials have been developed and understood. 6 List the step-by-step procedure for the
process of soft soldering. Hard solders are used in this process, and, as these have greater shear strength than tensile strength than tensile strength than tensile strength of the joint must be increased by increasing the total surface area between the metals. On older cars the air conditioning fluid was R12 - this contains CFCs and must not be allowed to escape as it 3
Compare the differences between planishing and wheeling a panel to produce a smooth surface. The earth clamp (Figure 11.4): Electrodes
holder fitted with a length of flexible cable for connection to the plant. Comparative measurements are universally used and are regarded as the easiest and quickest method of measuring collision work. This makes butt joints in panel assemblies more easy to accomplish, as less dressing up and planishing is required than in gas welding. (c) Integral
29 State the treatment that should be carried out before replacing a spot welded panel. 17.9.4 Lubrication speed is easily understood, and with a little practice the sprayer is able to adjust his speed of movement to suit the distance between the gun and the surface. Sensors monitor how fast the wheels are rotating and feed data continuously to a
microprocessor in the vehicle to signal that a wheel is approaching lockup. The most 168 Repair of Vehicle Bodies Figure 5.2 Strength in crowned surfaces (Figure 5.2); these are called crowns and may be curved either in one direction or in all directions. Each system is a self-contained unit, with
its own measuring system for checking body distortion and its own pulling and pushing equipment for the repair of any damage, whether minor or major. Modern car body designs are constructed with deformation zones both front and rear, and the shear impact properties of the original welding have been carefully calculated to ensure that the
energy of an impact is fully absorbed and contained within the zone. It should be adjacent to and with direct access to the reception office, in order to control the flow of paperwork between the two departments and also to enable the ordering and receipt of the parts necessary to complete the repairs. 5 Explain a repair situation where a body spoor
may be used instead of a panel dolly. Pozidriv screwdriver This screwdriver is like a Phillips in that the head is in the form of a cross, but the tip is flatter and blunter. The beam splitter is designed to make it possible for measuring height, width and length at the same time (Figure 14.32). 14.5.7 Further estimating The Motor Insurance Repair
Research Centre at Thatcham, Berkshire, usually simply referred to as 'Thatcham', have produced repair time schedules for most cars. The pulling attachments, though it is also possible to use chain plates and chains for obtaining a pull with a push ram. These
 undercoats are multipurpose materials which can be used as primers or non-sand surfacers. Though the colours did not fade drastically, they did, however, fade sufficiently to give the refinisher a difficult job to obtain a perfect match. For spot heating, the heaters should be positioned about 3-5 metres apart, at a height of approximately 2.5-3.5
metres from the floor, depending upon the heater rating. Close the release valve and operate the pump handle until the ram plunger is fully extended. COSHH attempts to follow the principle of good occupations 9, 10, 11). The
development of a new car colour can be broken down into four stages: 1 Initiated by clothing and other fashions, new colours are reproduced in a range of paints. The supply of essential services (electricity, gas, water, drainage, telephone) is also dealt with at this stage. The use of CAE is growing in the automotive industry and will probably result in
further widespread changes. 35 Explain the difference in welding low-carbon steel and aluminium of equal thickness. When a sufficient pressure has been attained, the air is pumped through a chamber (or intercooler) into the storage tank for
subsequent use (Figure 17.7). If this is not possible, then clean the equipment with solvent before use on aluminium bodies and use new discs or abrasives to ensure that there is no cross contamination. This technique also can be applied for panel tensioning to correct indentations in boot lids, bonnets and doors. Fingertip control increases both
productivity and weld quality (Figure 12.19). Polyether foam can now be made in different grades, and the physical properties of the best grades approach those of latex foam. This is achieved by an increase in prevailing torque which comes from the radial pressure interference produced at and around the major diameter and not present on
conventional fastenings because of the need for a clearance fit. In this process the molecules of the adhesive and substrate are brought close together and a variety of forces operate; the most important are atomic forces, which can be likened to magnetic attraction. radiator side RH Stay hood lock Crossmember front end Reinf. It is quicker than
leftward welding and consumes less gas. Can be painted over and has high abrasion resistance. Although laminated safety glass can be cut to size after laminating, toughened safety glass must be cut to size and edge finished before the heat treating process. Advanced mathematics and computer technology mean that this system can be
used without any other special equipment. Figure 17.72 Lateral movement of vehicles using two sets of tracks The third cause can lead to the defect known as 'contamination blistering', which appears mainly on those panels of a vehicle concealing the engine, and which are subject to fluctuating temperatures. Whenever threads become bent or
damaged, they should be repaired so that the proper fit can be obtained when connections are made. The panels are joined to the galvanized frame and doors by rivets or bonding as appropriate. It will not stain surfaces, and any residue can be washed off with cold water once the repair is completed. Treat bare metal with derusting liquid. The jacking
sill clamps ensure that the vehicle's underbody is brought parallel to the measurement frame; this is vital if height measurements are to be accurate. If kept reasonably cool they will not burn or explode. The straightening bench, around which the system is designed, eliminates modelspecific brackets altogether. 2 Fire under the car bonnet, cause
unknown - blue extinguisher using dry chemical powder is safe on both petrol and electrical fires, it is also easily cleaned off and will not damage the engine. For example, a boot seal is a very light touch seal, whereas a urethane screen fitment is at the other end of the scale setting of the equipment and would need a high setting to determine a leak.
Size of filler rod Approximately equal to the plate thickness up to 2.4 mm, and then 3.2 mm for thickness above 2.4 mm. The area can be sanded clean to bare metal and filled using body solder. The equipment consists of a main frame platform which tilts down at the back to form a ramp, up which a vehicle can be driven or winched. It also has the
advantage of not rusting, and, provided that the right treatment is adopted for welding, corrosion is almost non-existent. In use, the legs of the calipers are first opened out to the approximate size and held square with the object being measured. Do not smoke or use naked lights, oil burners or similar heating devices in the working area. The pre-preg
can not be unrolled nor cut when it is in the frozen state, so it must be removed from the freezer and brought up to Reinforced composite materials 559 normal room temperature. The basis of the MZ system is in effect a twopiece bracket set. A set of calculations called the Navier-Stokes equations gives a relationship between pressure, momentum
and viscous forces in three-dimensional space. In some bodyshops it is the normal practice to use a general-purpose filler for the main filling operation; then once shaped and flatted, it is surfaced with a fine filler (30 per cent unsaturated polyester resin plus 70 per cent insert filling material) to bring the repair up to prepaint condition. Normally fourteen the main filling operation and flatted, it is surfaced with a fine filler (30 per cent unsaturated polyester resin plus 70 per cent unsaturated polyes
sets of parallel rails are involved. 7 Connect the earth return clamp as close as possible to the point of welding, making sure of a secure connection to facilitate a good welding circuit. Panhard and Levasser began making cars in France. Remember, if in doubt, don't do it no matter what the reward. I would also like to take this opportunity of offering
my sincere thanks to the following firms and/or their representatives who have so readily cooperated with me by permitting the reproduction of data, illustrations and photographs: AGA Ltd Alweinium Federation Ltd Ambi-Rad Ltd ARO Welding Ltd Aston Martin
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xx Acknowledgements ESAB Ltd European Industrial Services EuroNCAP Express Garage Facom Tools Ltd Farecla Products Ltd Farecla Products Ltd Forest Fasteners Frost Auto Restoration Techniques Ltd Fry's Metals Ltd George
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Journal ICI Autocolor ICI Chemicals and Polymers Group ICI Paints Industrial and Trade Fairs Ltd Jaguar Cars L
 Ltd Land Rover Ltd Lotus Engineering McLaren Cars McLaren Racing Mercedes Benz Mick Ellender Migatronic Welding Equipment Ltd Mig Tig Arc Online Minden Industrial Ltd Morgan Motor Company Ltd Motor Insurance Repair Centre (Thatcham) Motorspart Industry Association Murex Welding Products Ltd 3M Automotive Trades National
 Adhesives & Resins Ltd Nederman Ltd Neill Tools Ltd Nettlefolds Ltd North West Kent College Olympus Welding & Cutting Technology Ltd Owens-Corning Fiberglas (GB) Ltd Oxford Brookes University Partco Engineering Permabond Performance Racing Industry (USA) Pickles Godfrey Design Partnership, Ernest W. nitric acid solution (SG 1.41) at
25 °C Nylon Degrease with solvent Paper laminates Degrease with solvent Paper (unwaxed) Do not use solvent Phenolic, polyester and polyurethane resins Polyacetals Degrease with solvent Roughen the surface with medium grit emery paper Abrade with medium grit emery paper Abrade with fine grit emery paper Requires no treatment before bonding Abrade with medium grit emery paper and polyurethane resins Polyacetals Degrease with solvent Paper (unwaxed) Do not use solvent P
paper Etch in solution of (parts by weight) Water 33.0 Conc. Should more than one coating of the lacquer be considered necessary, allow a flash-off time of 5 to 10 minutes between coats. Even in hand lay-up the spray method may be used for this stage and for the application of the separating agent, so that there is a small element of mechanization
10 Explain the terms 'direct hammering', 'indirect hammering' and 'pick hammering' and 'pick hammering', as applied to body repair techniques. These transverse lines will be at right angles to the centre line if the underbody is in correct alignment (Figure 14.58). Later came oil lamps, acetylene lamps and finally the electric lighting system, first fitted as a luxury extra
and ultimately becoming standard and finally obligatory equipment which must conform with legislation of the day. Therefore it is necessary to use with them certain chemical compounds to act as deoxidizing agents or fluxes, which must be of the correct composition to ensure perfect welds. 13.14.4 Stretching or tensioning The technique of
stretching or tensioning (Figure 13.56) is another means of obtaining a pull using a push ram. In this case the material is much stiffer but still shows the mould lines and has a smooth surface finish with raised lettering. 9 Remove masking whilst the paint is at the tacky stage. As soon as the scales are in place, calibration can be carried out. Questions
 4 Explain the advantages and disadvantages of reinforced composite materials when used as an alternative to low-carbon steel. However, at normal temperature, 20 °C, it will take about 5 days for the resin to become fully hard. This Craft techniques and minor accident damage 363 13.8 Sanding or disc grinding 13.8.1 Use of grinder Several generature, 20 °C, it will take about 5 days for the resin to become fully hard. This Craft techniques and minor accident damage 363 13.8 Sanding or disc grinding 13.8.1 Use of grinder Several generature, 20 °C, it will take about 5 days for the resin to become fully hard. This Craft techniques and minor accident damage 363 13.8 Sanding or disc grinding 13.8.1 Use of grinder Several generature, 20 °C, it will take about 5 days for the resin to become fully hard. This Craft techniques and minor accident damage 363 13.8 Sanding or disc grinding 13.8.1 Use of grinder Several generature, 20 °C, it will take about 5 days for the resin to become fully hard.
rules govern the use of the disc grinder. Do not use the mallet or water in this case. This is followed by the final fit of the Figure 13.21 Fitting interior trim (Aston Martin Lagonda Ltd ) Figure 13.22 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.22 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.21 Fitting interior trim (Aston Martin Lagonda Ltd ) Figure 13.22 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.22 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.23 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.24 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.25 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.26 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.27 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.28 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.29 Final vehicle inspection (Aston Martin Lagonda Ltd ) Figure 13.
methods of forming the edges of sheet metal, panels and components. The shapes of the dolly blocks have been designed to provide a working surface that is highly polished and suitable for use on the many contours found on motor vehicle bodies. Adjust the current setting of the transformer or generator in accordance with the electrode maker's
specifications. To the production engineer this is the only way of consistently reproducing a basic shell fitted with all its mechanical parts in the correct places. As the demand for vehicles increased it became necessary to find a quicker method of production. With dual systems, which combine both brackets and measurement, the repairer can carry
out fast and accurate repairs whatever the degree of damage. The steel to be hardened should be quenched immediately it is uniformly heated to a temperature just above the upper critical point. If the finish area of the weld is important, then it becomes necessary to grind or machine the joint to the proper size. Body sides with thin pillars, large
windows and door openings are inherently weak, requiring reinforcing with radiusing corners to the apertures to give them sufficient constructional strength. Centre link and joints. The preheating flame has two purposes. The sequence of operations is usually as follows: 1 Remove overspray from windows with a razorblade scraper and wash leather.
Hardening Heating to a critical temperature followed by a relatively rapid rate of cooling. Consequently in any body repair workshop the dividing line between repairing and replacing is determined not only by what it is possible to repair and w
types of major collision damage. Ventilation should be good by normal standards, but draughts and fluctuations in temperature must be avoided, so doors and windows should not be used for ventilation control. The trim consists of the window regulator assembly and the door locking mechanism. The file should be applied with long, straight strokes,
pushing it away from you along the length of the panel (Figure 13.39). 7 Name and explain the use of a hand tool which would have the effect of spreading a blow, thus reducing the stretching of the metal. This effort is backed by a professional approach using skilled workshop personnel and engineers recruited from the repair trade and
manufacturers. More mat or cloth is added in order to build up the requisite thickness of reinforced plastics, and the moulding is then allowed to set or cure. The weight is 2 lb 4 oz (1130 g). The line of this notch must not have sharp corners because of the possibilities of cracking. A typical upper body for an integral constructed car is very much the
same as the conventional composite body shell; the major differences lie in the rear seat area and the construction which joins the front Figure 1.33 Composite construction showing a Lotus Elan chassis before fitting the body (Lotus Engineering) The history, development and construction of the car body canopies, container
vehicles, and the bodies of cars such as the Reliant Scimitar. When and only when, a tight joint has been formed, the mandrel breaks at a predetermined position, so that the mandrel breaks at a predetermined position, so that the mandrel breaks at a predetermined position, so that the mandrel breaks at a predetermined position, so that the mandrel breaks at a predetermined position.
socket gives a tight hold on a hex nut, minimizing slippage and rounding of the nut's points. Therefore when adverse drying conditions prevail, such as low temperature, dampness or high humidity, it is advisable to spray a coat of sealer or cellulose surfacer over the job before applying the cellulosetype finish. 8 Soft and hard soldering methods 8.1
Comparison of fusion and non-fusion jointing processes The jointing of metals by processes employing fusion of some kind may be classified as follows: Total fusion Temperature range: 1130-1550 °C approximately. For instance, it will take less time to replace both a front wing and a front panel than a separate wing and a front panel. Folds may be
creased to give a flushed effect on one side of the panel, or doubled over twice to increase the strength. 21 State the disadvantages associated with the use of hydraulic push rams when used on the inside of a vehicle. Common metals vary considerably in elasticity. The short bed allows access for repair and the engine can be removed while the vehicle
is still mounted on the bed. Always pay special attention to these areas both in terms of accidentally applying direct heat or allowing heat to be conducted to reach them. The system is easy to operate: the measuring arm is moved along the Figure 14.45 Car-O-Tronic electronic computerized measuring system (Car-O-Liner (UK) Ltd ) bridge
underneath the vehicle and simultaneously measures the length, width and height at the precise data measuring points, displaying this on the hand terminal and then comparing the results with the manufacturer's data stored in its data bank. Edge fasteners of the D type are lightweight fasteners which are ideal for assembling leather-cloth, soft
plastics and fabrics to metal, rigid plastic or fibreboard panels. Therefore if the desired shape by marking the outline on the surface of the sheet of material. It is most effective on large flat sections, where it will be found ideal for
smoothing and levelling out wavy panels. One edge of the tool acts as a guide while the other forces the metal down into a crease, thus forming a groove. 6.2.11 Dividers These are metal workers' compasses, made of steel with hardened points. It can be easily removed with a damp washleather. This produces a direct pull between the repair and the
beam (Figure 14.89). 11.6.10 Welding joint design Joint configuration The three basic joint types are usually classified as fillet, butt or groove, and lap (Figure 1.15). The hold time forges the metal while it is cooling. Figure 3.42 shows a complete set of all assembly tools. If annealing were carried out in an open furnace this would destroy the bright
Metals and non-metals used in vehicle bodies surface of the coil and therefore oxygen must be excluded or prevented from attacking the metal during the period of heating the coils. Exposure of glass fibre by roughening in each case will enhance bond strength. Limousine with an extended rear roof to cover the driving position.
4.3.5 Zinc coated steels The automotive industry, in seeking to provide extended warranties, is turning increasingly to the use of zinc coated steels. The size of the team varies according to the project. Another development is the hot melt systems that cure after application, either by reaction with moisture or by the
application of heat. Stripped body parts should not be left to clutter the floor but should be labelled for identification (see BS 5750 description later) and stored in the main stored in the metal until the final degree of
raising is reached Craft techniques and minor accident damage 345 Figure 13.6 A pucker or tuck made at the edge of the panel to quicken the raising process Figure 13.5). Its weight is 3 lb 4 oz (1473 g). Everyone has to begin somewhere. When the alignment of the new piece is correct it is welded
into position; since the vehicle is still in the repair equipment, correct alignment is maintained (Figure 14.80), check that all doors, the bonnet and the boot lid fit and operate in the appropriate body shell openings. Extremely durable, with robust all round performance. There is also a special thin-gauge metal cutting chisel for use on panel work, and
a recessing tool which can be fitted on the end of the chisel. For internal structure members which need to be stronger than the outer panels, the heat-treatable alloys usually used are 6063 and 6082, and in odd cases 2014A. Finger penetration. The gloss from the gun is good and no burnishing or polishing is needed unless dirt is present in the finish
On a modern mass produced passenger car the body shell is a relatively low-stressed unit, high stresses imposed by road conditions being carried by subframe assemblies. 13 Be sure tanks, drums or pipelines are completely cleaned of inflammable liquids before welding. Next set the regulators to the required pressure, open the acetylene control
valve on the welding torch, check working pressures when pure acetylene is coming out of the end of the nozzle, and then light the gas. The spoon can also be used for roughing or easing out by wedging the spoon in between panels. In general non-corrosive fluxes are not so active in cleaning the metal and Soft solders, fluxes, and their method of
application for different sheet-metals Solder constituents (%) Sheet metal Flux Tin Lead Other Used with Aluminium Brass Copper Galvanized steel Terne steel Tin plate Tinned steel Zinc Iron Steel Stearin Zinc chloride or resin Zinc et al. (a) Sheet metal Flux Tin Lead Other Used with Aluminium Brass Copper Galvanized steel Lead Monel Nickel Pewter Silver Stainless steel Tin plate Tinned steel Zinc Iron Steel Stearin Zinc Chloride or resin Zinc Iron Steel Stearin Zinc Iron Steel Ste
or resin Zinc chloride Zinc ch
40 Zn8, Al7 Sbl Sbl - - - - Bi5o - - - - - Soldering bit S
chiefly as a measure of protection against further oxidation, when the material is hot. The examination will be limited to parts of the vehicle which can be readily seen without dismantling. The ultrasonic equipment works on the principle of a transmitter creating ultrasonic waves which penetrate the smallest orifice in the vehicle body and are then
picked up by a receiver fitted with a suitable probe, which can in turn pinpoint the exact leak point. 26 State two disadvantages which limit the use of oxy-acetylene welding in vehicle body repair. The greatest care must be taken. Electrodes Include the mechanism for making and holding contact at the weld area. There are many different types of
fluorescent tube on the market, and it is important that the correct type of tube is fitted in each area of the bodyshop. 29 Describe a simple test to determine whether or not an existing paint finish is of the non-convertible type. The trolley itself should be of sturdy construction and should be as narrow as possible so that it can pass through restricted
spaces. The equipment is designed so that the wire automatically feeds into the weld area as soon as the arc is established. After sufficient solder block, which should have previously been greased or dipped in oil or tallow, and commence to push the body solder over the
damaged section of the panel. This can cause the panel to expand which could lead to micro-cracks in the panel and cracks in the panel area. This method utilizes the heat from the tungsten arc to fuse the base material in much the same
way as ordinary TIG welding. Next set the stop to the distance required between the centre of the moulding and the edge of the sheet. General purpose MIG/MAG: plain carbon and low-alloy steels. If they do get blocked, clear out the surplus. Several fillers now available have been vastly improved; they will harden in as short a period as twelve
minutes provided the quantities are correct and the two chemicals thoroughly mixed. Standard pattern straight snips are also very popular, although limited in their use to straight line cutting or large external curves. The lift of the clamping beam and top blade is about 38-50 mm in height. In terms of composition, there is one element common to all
the different grades of stainless steel. By extending the welding gun nozzle to contact the workpiece, one-sided spot welds may be performed using dip transfer conditions. The increase in the supply of oxygen is stopped before the cone becomes clearly defined and while it is still an inch or so long; this results in a carburizing flame, which is
characterized by a dullish white feather surrounding a brilliant, clearly defined white cone. In every case they are compounds of carbon (C) and hydrogen (H). In use, a rule should be held so that the graduation lines are as close as possible, preferably touching, the faces being measured. Alloys used for trimming can be divided into two groups: high-
purity alloys bright finished on one side only, in which the majority of the trim components are made; and super-purity alloys for use when maximum specular reflectivity is an advantage, such as would be required by light units. Second, accuracy became a far more critical consideration than in the past, as suspension systems became less adjustable
and more complex. Then came the idea of repairing a vehicle on an alignment jig using attachable/detachable brackets, so that it was unnecessary to check the repair after every pull. Weld time can range from a fraction of a second for very thin gauges of sheet steel, to one second for thicker sheet steel. Methods of increasing tensile strength It is
possible to increase the tensile strength of both sheet steel and pure aluminium sheets by cold rolling, but this has the added effect of reducing their workable qualities. An extremely wide range of qualities is available, and in recent years there has been an effort to achieve some degree of rationalization. When the flame turns green around the
soldering bit it is at the correct temperature; if the colour is allowed to change into a bright green the copper bit will begin to become red hot. Start using the pick hammer in a manner similar to the dolly block. After a bead is deposited on the metal, the slag which covers the weld is removed with a chipping hammer. The high percentage of the
vehicle or binder provides the glossy effect. Acrylic paints, as well as possessing good colour stability, are durable, have good gloss and are easily polished. This type can be more accurate than the steel straight edge because its weight and robust construction reduce the possibility of flexing. The repair is completed by filling imperfections with
polyester resin, after this has cured, by normal smoothing, flatting and painting, Clamps and jigs are advisable when welding thin sheet, 16,10.10 Leaching This is a serious fault. As this wheel is pivoted it automatically adjusts itself to the angle of pull (Figure 14.35). Unscrew the air cap a few turns, hold a piece of cloth over it and pull the trigger,
When it is an older car the extra cost involved in striving for perfection in the repair is not always justified, since these costs could be more than the current value of the vehicle under repair. There is some interest in the use of bilayer construction which uses 3 mm or 4 mm annealed glass bonded with a load bearing surface layer of self-healing
polyurethane. The lid must always be firmly replaced on the tin or tube of the stopper when not in use, otherwise the stopper will harden in the container and cannot be satisfactorily resoftened. Car-O-Tronic measures either with reference to the Car-O-Iner data sheet or on an absolute basis. In order to achieve this the repairer needs to use his
acquired skill and knowledge and, whilst each accident repair has its own individual features, he or she must be able to assess the damage and make the choice of appropriate methods of repair and the best equipment, two-sided spot welding can be successfully accomplished on
these steels. 4.1.2 Pickling Before cold rolling, the surfaces of the coils must be cleaned of oxide or black scale formed during the hot rolling process and which would otherwise ruin the surfaces of the coils must be cleaned of oxide or black scale formed during the hot rolling process and which would otherwise ruin the surfaces of the coils must be cleaned of oxide or black scale formed during the hot rolling process and which would otherwise ruin the surfaces of the coils must be cleaned of oxide or black scale formed during the hot rolling process and which would otherwise ruin the surfaces of the coils must be cleaned of oxide or black scale formed during the hot rolling process and which would otherwise ruin the surfaces of the coils must be cleaned of oxide or black scale formed during the hot rolling process and which would otherwise ruin the surfaces of the coils must be cleaned of oxide or black scale formed during the hot rolling process and which would otherwise ruin the surfaces of the coils must be cleaned of oxide or black scale formed during the hot rolling process and which would otherwise ruin the surfaces of the coils must be cleaned of oxide or black scale formed during the hot rolling process and which would otherwise ruin the surfaces of the coils must be cleaned or black scale formed during the hot rolling process.
circle cutting and joint cutting machines. Then bring the electrode into contact with the plate by one of the following two methods. (j) Flanged edges bolted together require trim to hide joint. Bodyshop planning 3 To set up some kind of information system on all matters relating to health and safety. This involves extra cost and additional filler
material. They may be crystalline (with shape) or amorphous (shapeless). Curved dolly or comma block has a long curved face, combined with the high- and low-crowned areas and the tapering face; it is extremely well suited to the modern body design, and is comfortable to hold in difficult areas and narrow corners. Spray as far up the pillar as
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possible, then down to the sills. 1.6 Vehicle type approval Figure 1.49 Interior trim (Rover Group Ltd.) 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 Front seat back rest Front seat back rest small section Rear seat centre arm rest
Rear seatbelt buckle assembly Rear seat back rest large section Rear seat back rest large section Rear seat black rest large section Rear seatbelt lap assembly Roof, turret Roof lining, headlining Sill panel, rocker panel Squab
seat back Underbody, floor pan assembly Valance of front wing, fender side shield Vent window, flipper window,
steels. 480 Repair of Vehicle Bodies Figure 14.128 Cleaning wheels (Autoglym) Figure 14.130 Cleaning bodywork (Autoglym) 12 Apply traffic film remover to rubber mats. Where repair work has been carried out which includes the use of polyester fillers and/or surfacers, the repaired area must be carefully sanded prior to applying the non-sand
coatings. A soldering iron or copper bit is usually used to apply the solder, although sometimes a blowpipe is used to sweat the solder into the joint. 2 It must thoroughly wet the surfaces to be joined so that the filler metal may spread evenly and continuously. Styling trends, together with a growing knowledge of stress design in metal structures, have
resulted in a significant increase in the glazed areas of modern car body designs. Automatic centre punch This is hand operated, and a hammer should not be used. 15.4 Bodyshop plays a critical role in the final finish of a vehicle body. The joints should fit closely and the parts must be held together firmly while being
silver soldered, because silver solders in the molten state are remarkably fluid and can penetrate into minute spaces between the metals to be joined. Pearlite A sandwich layer structure of ferrite and cementite. It is possible to convert a welding torch into a cutting the mixing head with a cutting attachment (Figure 9.7). The milled
teeth allow a smooth filing operation and are specially shaped to reduce clogging. Those in common use are wood, plaster, sheet metal and glass fibre itself, or a combination of these materials. 5.2.2 Heat treatment of carbon steel Steel is an important engineering material because, although cheap, it can be given a wide range of mechanical
properties by heat treatment. 11 What would be the resulting effect if the amperage is set too high in manual metal arc welding? The type of core material will depend upon the specific property required. Because of the rubber covering, the kink may not be noticeable, and the application of pressure will eventually cause the strands to break and the
 hose will leak. The work is then carefully removed from the jig, when welding of the joints can commence. A counter-support (blocking arm) prevents the vehicle from moving in the direction of pull, and holds the vehicle so that the pulling forces affect only the damaged zone of the vehicle (Figure 14.34). Room dimensions and space. However, if
customers can see into the bodyshop, it must be kept tidy at all times. The polymer matrix holds the fibres in place so that they are in their strongest position and protects them from damage. Gas consumption of the welding torch 86 l/h (litres per hour) and 3 ft3/h (feet cubed per hour) for 1.6 mm thickness. 17 Describe three types of sheet metal
bench stakes, and sketch one of them. 7 Explain the purpose of pre-accelerated resins. Equipment, details are as follows: 1 High-pressure hot and cold washer, 70-100 bar (1000-1500 psi), with chemical throughput Major accident damage 479 have been newly painted as they may be chemically or water sensitive. Ltd, Pondicherry, India www.integra-
india.com Printed and bound in Great Britain Working together to grow libraries in developing countries www.elsevier.com | www.bookaid.org | www.sabre.org To my wife Jean for her help and support whilst writing, and to my children Rachel, Rebecca and Samuel for accompanying me to shows and rallies to collect information. When topping up
with oil it is necessary to use the correct type of oil, taking care not to allow any dirt or grit to enter the oil track while adding or checking the oil level. Index Adhesion 257 Adhesives 223-4 achieving good results 228 body repair 233 classification chart 143 curing times 227 hot metals 228, 231-2 joint function 227 joint types butt 226 co-axial 226
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abbreviations for strain hardened materials 135 material designations 135 Zinc coated steel 128 double-sided 128 Zone of thermal disturbance 256 16 What would be the most likely result of using two-pack polyester stopper as an intercoat stopper in a lacquer-type paint system? The roof is usually connected to the body side
frames, which comprise longitudinal rails or stringers and a pair of cantrails which form the door openings (14). These faults can render a car outside the uniform standards required by law in respect of the fitness of the car for use on the road. Clean surrounding seals and mirrors. The maximum weight of load that you should lift is 20 kilogrammes
but as a trainee this may still be too heavy for you. Whatever type of heating systems are used, care should be taken to ensure that heaters are placed where they will not interfere with work in progress, will not take up unnecessary floor space, and will provide employees with the maximum benefit. 40 State the letters used in design to identify the
body pillars on a four-door saloon. The cutter blade A is reversible with two cutting edges. The user benefits by the complete resistance of glass fibre vehicles to corrosion, their sturdiness in a collision, and ease of repair. The design of the wheels was at first dictated by fashion. 2 Make arrangements for putting into practice the health and safety
measures that follow from the assessment. This type of welding is probably the most commonly used type of resistance welding. Complete the repair using body filler and P600 paper in the normal way. Provided the extent of the bonded area is taken into account, and thorough cleaning and roughening are carried out, there is no reason why drilled
and tapped metal plates, or special tapped inserts, should not be laminated into the moulding or on the reverse side. 14 Explain the difference between thermoplastics and thermosetting plastics. 18 What is the main health hazard associated with the spraying of two-pack paints? The table includes a section for paint refinishing, may vary. Replace
screws and DVCs. You're done. Do not force into access holes. Typical applications are the mounting of door-pillar trim pads, carpeting or rubber matting, parcel shelves, glove boxes, window cappings, ashtrays and kick plates. Up to and including the immediate post-war years, this headlining was made from a woollen fabric stitched together and
tacked into position on wooden frames. 530 Repair of Vehicle Bodies 15.7.4 Implementation and assessment of BS EN ISO 9001-2000. Having identified the
area of the leak, the repairer must find the actual point where the water is entering the vehicle. There are different sizes of nozzle for different metal thicknesses, and the nozzle manufacturers will state the correct size on their data sheets (Table 9.2). When the dent is out the stud can be snipped off (Figure 13.74), and then its remains filed or ground
down level with the surrounding area. Spray guns can be divided into groups: 1 By methods of paint supply, such as suction feed, gravity feed or pressure feed 2 Those with detached or attached paint containers 3 Internal mix or external mix types 4 Bleeder or non-bleeder types. With other types of adhesive, full bond strength is not achieved until all
the solvent or liquid carrier has evaporated. The relationship of gun distance When spraying a panel, the technique of 'triggering' the gun must be mastered. Also it should be of a rather light weight so that it forms a relatively weak backing for the malleting, thus
reducing the stretching during the levelling operation. Plastics, when bonded with cyanoacrylates, generally need no abrading. However, in heavier metal plate riveted joints often have to be comparable with the surrounding metal, and so the rivets are inserted in the hot state as this increases the strength of the joint. The equipment comprises a
 water-cooled torch with associated cables for argon, water and power, a standard AC/DC welding set and a timer and contact unit. The weld face is a border line where the weld face adjoins a welded part; along this line undercut or wastage of the parent metal in
the Gas welding, gas cutting and plasma arc cutting form of a grooving may occur. 4 What is meant by monocoque construction, and why has it become so popular in motor vehicle manufacture? A gas heater with an electrically heated element is used to prevent freezing of the gas regulator after prolonged use with carbon dioxide gas. Turn off the
acetylene first by the welding torch control valve, then the exygen. Adequate holding facilities to allow the welding in of new panel assembly. The main uses of
the disc sander in the repair shop are sanding sections on panels which are either rusted or have been repaired by planishing and require sanding to a smooth finish in readiness for painting; cleaning sections that need to be filled with Hand and power tools 115 Figure 3.56 Air driven sander (Desoutter Automotive Ltd ) minor paint blemishes; and
codes or personal setting are stored. Using the other laser guide on the short rail, the centre line of the vehicle (Figure 14.33). Grid dolly is similar in shape to the toe dolly but has a large crowned grid face on the upper surface. Control of Substances Hazardous to
Health Regulations 1974 (COSHH) These require that Health and safety substances used in the workplace are correctly labelled and instructions for their safe storage and use are available. 2 Never heat an area greater than that which can be hammered with mallet and dolly. They are very effective in joining most metals. Spatter Spatter takes the
form of small particles of metal which are rejected from the arc or the weld pool and adhere to the surface of the metal being joined. These are modified zone-toughened glasses, having three zones with varying fragmentation characteristics. 47 Name one of the persons who was associated with the early development of the motor vehicle and state his
involvement. Bodyshop planning Alignment and repair jigs for measuring and straightening Pulling equipment for reshaping damaged body sections Hydraulic body jack equipment for panel repair Welding, spot welding, spot welding, spot welding, spot welding equipment for panel repair Welding equipment for reshaping damaged body sections Hydraulic body jack equipment for panel repair Welding equipment for panel repair Welding, spot welding, spot welding, spot welding, spot welding, spot welding equipment for panel repair welding, spot welding, spot welding, spot welding, spot welding equipment for panel repair well welding equipment for panel 
extraction systems (portable and static) Wheel alignment equipment (four-wheel alignment) Combi-booth Panel booth Mixing room with mixing system Infrared driers Wall-mounted breathing air filters Air regulators Respirators and air-fed visors Spray guns (standard and/or HVLP guns) Gun cleaning tank, extracted Combined paper baler and can
crusher Pedal waste bin for solvent contamination waste Plunger cans to dispel solvent Screw compressor (Suitable for the total capacity of air requirement of the workshop). An approved book BI 510 is available from the HSE direct or through most good book stores. With the introduction of high-strength steels, car manufacturers are producing
body panels as thin as 0.55 mm and using gauges of between 1.2 and 1.5 mm for structural members. A boot lid is composed of an outer and an inner panel. 306 Repair of Vehicle Bodies Practical weld constraints Some of the practical considerations which may affect joint design are: 1 2 3 4 Access Welding position Process/consumable/equipment
availability Dissimilar thicknesses. Suitable land adjacent to the premises would be an asset and a good investment for future development. Open-circuit voltage and arc voltage open-circuit voltage is the voltage produced by the welder when the machine is running and no welding is being done. Machines with one or more applicator heads, and
developed for high rates of production, are now available. As this plastic filler does not require heat during its application it has certain clear advantages. That is, a booth which is fully enclosed and heated by this method. 7.4.
Blind rivet types POP rivets The POP rivet comprises a hollow rivet assembled to a headed steel mandrel or stem (Figure 7.5). After each low spot has been raised in this manner, these points can be filed to check that they are level with the surrounding panel surface. Some flow of metal does, however, occur at the straight sections. From the
0.10\ 0.25\ 0.20\ Zr \le Ti\ 0.15\ 0.05\ 0.15\ Rem.*\ 0 Ti 0.15\ 0.15\ Rem.*\ 0 Ti 0.15\ 0.15\ Rem.*\ 0 Ti 0.15\ 0.15\ 0.15\ Rem.*\ 0 Ti 0.15\ 0.15\ 0.15\ Rem.*\ 0 Ti 0.15\ 0.15\ 0.15\ 0.15\ Rem.*\ 0 Ti 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0.15\ 0
digital readout, in either metric (millimetres) or imperial (feet and inches), and are accurate to 1 mm. Wall boards with the necessary clips and tool silhouettes can be used with a specified set of tools. The marking dye is transferred to the parts of the workpiece which actually come into contact with the surface of the plate, and if the surface of the
workpiece is uneven, only the high spots will be marked. The body jack set-up should be applied so as not to push at the deepest point on the damaged section; instead work round the outer edges in ever-decreasing circles which will tend to spring the remaining damage into the final position. Tack welds must be done accurately, as they are very
 important in maintaining proper panel alignment. Satin weaves also drape more easily and are quicker to impregnate. 3 Provide the expertise and equipment needed to work through all the necessary stages to produce a documented quality system which will include a quality manual, supporting procedures, working instructions and other associated
documents. A. It is therefore essential, that spot-welding equipment used in motor body repair takes outside circumstances automatically into account, such as rust, scale, voltage drop in the electric main supply, and current fluctuations. Paddle A wooden tool shaped for spreading body solder. Next, the preassembled engine (which takes 60 hours to
build) is fitted by hand to the vehicle. Hardness may be increased by the following methods: Planishing In addition to increasing the tensile strength of a metal, planishing also imparts hardness may be increased by the following methods: Planishing also imparts hardness. You will also find that certain safety instructions are marked on the equipment. In order to protect the metal surface against oxidation and to increase the
the streets of Paris and Cugnot was thrown into prison for endangering the populace. 2 Analysis is regularly made only for the elements for which specific limits are shown. 5 Gangways between bays should ideally be 4.5 metres. Vehicle during a
collision. The underbody should be checked next. Allow the final coat to dry for 4 to 6 hours before dry scuffing, or to dry overnight before wet flatting with P600 or P400 grade paper. The resulting arc will produce an extreme concentration of heat to the small area on the panel surface. A portable toolbox on top of the chest holds large hand and
 Hooper & Co. This vehicle has been designed for the use of heads of state and world-ranking VIPs. 1.4 Basic body construction A typical four-door saloon body can be likened to a hollow tube with holes cut in the sides. Damaged areas of paintwork can be rubbed down very quickly with these machines, but final feather edging is best done by hand.
Inertia Property of an object by which it continues in its existing state of rest or motion in a straight line, unless that state is changed by an external force. The main centre floor panel (2) should be sufficiently reinforced to carry the weight of the front seats and passengers. When the owner of a car is personally paying the cost of repairs the repairer
will need to come to an agreement with him concerning an acceptable standard of repair for the amount of money the owner is able to pay. 3 Earth connections. It is heavier than air and will collect in ducts, drains or confined areas. Assessment: Regulation 6 An employer shall not carry on any work
 which is liable to expose any employees to any substance hazardous to health unless he has made a suitable and sufficient assessment of the risk created, and the steps needed to achieve and maintain control. A crowned surface is stronger than a flat panel, and whilst it will resist any force tending to change its shape, it also has the ability to return to
its original shape unless distorted beyond its point of elasticity. If the wheels are out of line the vehicle will 'crab', which means that the vehicle will appear to be driving sideways. As the latter have always been the most widely used materials in refinishing, colour matching thus presented problems. This will more easily be seen if the surface of the
metal is first prepared by lightly rubbing it with white chalk or a special colouring agent. If the grinder is not properly earthed it is possible to receive a fatal electric shock when the machine is in use. Measurements are made electronically and are accurately displayed digitally on the laser guide. Basically three methods are employed to extinguish a
fire: removal of heat (cooling); removal of fuel (starving); and removal or limitation of oxygen (blanketing or smothering). 4 Define the term 'direction of the car body 39 Figure 1.36 Motor body panel assembly using GRP: Lotus Elan (Lotus Engineering) Figure 1.37
            ete Lotus Elan SE body shell (Lotus Engineering) unit (1), commencing at the front, comprises a toeboard or pedal panel, although in some cases this may become a part of the scuttle or bulkhead. Mallets Mallets Can be of the round or pear-shaped type made from boxwood or lignum vitae, or can be Figure 3.4 Beating files (Sykes-Pickavant Lt
) 88 Repair of Vehicle Bodies Figure 3.5 Mallets (Sykes-Pickavant Ltd ) rubber, aluminium or plastic faced (Figure 3.5). 1803 Richard Trevithick built a steam carriage and drove it in Cornwall. Polyurethanes Like epoxies, they offer variety in formulation. For instance, if a vehicle has been in a head-on collision, and has suffered a straightforward
crumple, secure the undamaged part of the undamaged part of the underbody or chassis leg and pull out the crumple section in the direct line of damage. By allowing the outer edge of the flange to be drawn in slowly a good deal of creasing is avoided; moreover, the creases which do occur around the edge are carefully worked out as they appear. 17.5.2 Fillers and levellers
Surfacer A surfacer is applied over the primer. Surface crazing itself generally stops at the first layer of glass fibre and is consequently not structurally serious. A technique in which the flame is directed backwards against the completed many
times without becoming slack if reasonable care is taken. Some manufacturers design repair panels specially for these purposes. One of the key areas of knowledge needed to repair plastics components is an understanding of these two classifications and being able to identify them in a vehicle component. 19 What safety precautions must be observed
before using an electric drilling machine? Paint manufacturers had, however, come into being, with a consequent improvement in the range and quality of materials at the disposal of the painter. The design of the system enables it to be used with Celette's MZ diagnostic and repair bracket system.
(Figure 14.17). The metal blank can now be shaped by any hand methods. This action is an electrochemical action similar to that of an electric cell, and results in one or other of the two metals being corroded away. If the rod is too small the heat cannot be absorbed by
the rod, with the result that a hole is burned in the plate. These Regulations are aligned with standard practice in EC Directives in placing the responsibility for compliance on the employers. PPE will only be suitable if it is appropriate for the risks and the working conditions, takes account of workers' needs, and fits properly, gives adequate
protection, and is compatible with any other item of PPE worn. Figure 7.16 Well nut (Tucker Fasteners Ltd.) Chobert Grovit system has been developed so that the widest range of materials (such as wood, plastic, aluminium) may be joined. Explain the reasons for this. Most of the body panels are secured by self-tapping bolts which offer very positive
location and a useful saving in assembly time (see Figures 1.36 and 1.37). 13 Restore paintwork. Self-tapping screws or rivets may be used to hold parts together. 1.2 Creation of a new motor car is an extremely complex process. Use the same technique
when withdrawing the lance. For strands which are not processed into yarns it is usual to apply sizes which are compatible with moulding resins. The planishing hammer should have a true and unmarked face, and it must be kept polished and free from road tar, underseal and paint, which readily adhere to its working faces during use. At all times the
faces of these mallets must be kept smooth, true and free from marks as these could be automatically transferred on to the workpiece. 19 Interior plastic can be dressed to enhance and protect appearance. Figure 17.69 Typical viscosity curve The viscosity of paints can vary in the paint shop owing to changes in the atmospheric and shop
temperatures throughout the working day. This can only be achieved by the use of alignment and repair equipment; visual inspection is not satisfactory and can lead to inaccuracies. Oxidizing flame A gas welding flame which has an excess of oxygen when burning. 17.5.7 Burnishing compound There are both burnishing pastes and
polishing liquids. Amongst the first developed was interweld sealing compound, primarily to prevent corrosion. The basic principle of hot spray where the viscosity is reduced by the addition of a thinner which subsequently evaporates. A typical application for J-nuts in the
motor industry is the replacement of reinforcing rings and blind, bushed-on headlamp assemblies. However, in some cases the flame is detrimental owing to the fact that it deposits carbon; for example, if it is used on mild steel the weld deposit will be higher in carbon and therefore becomes hardenable material, and cracks may result. In the
automotive industry use is made of the good mechanical properties (even at low temperatures), the thermal resistance and the surface finish. Blanking is performed in a press by a die and is a stamping operation. Having designed the virtual car it is possible to observe it in a virtual wind tunnel and carry out calculations both internally and externally.
this is what computational fluid dynamics (CFD) is all about. A bolt is a cylindrical rod having a head on one end and a thread cut along part of its length from the other end. 39 Name three types of blind riveting tools that could be used in assembly work. All data and specifications can be stored in the PC and are easily transferred to and from the
hand unit via an adaptor. They improve the productivity of the operatives and also reduce the amount of remedial work necessary. It acts as a combined tapping hammer, blunt scraper and short lever. Some bodies were built with closed cabs, and the tops were held in place by strips of wood bent to form a solid frame. Three sizes of cage, covering
threads from M3 to M10 are available. The width between the housing must permit the work to pass through the machine, and the order is to use a soldering iron. 3.13 Hand grooving tools The hand groover is used when making a seam joint by
hand between two pieces of sheet metal. (f) Toe on 20° turns The toe on turns angle allows the front wheel is at 20° from the straight ahead. Not only does this eliminate the need for an additional tapping operation, but it also produces inherent resistance to vibrational
loosening, thereby obviating the need for separate locking components. (Some machine and fed to the hose, and the wire is fed at a gentle speed to the torch.) 5 Connect the hose for the shielding gas to be used and set the gas flow regulator between 5 and 15
litres/min. With this in mind, paint manufacturers have developed a type of thinner which, when added to their half-hour enamel (nitrocellulose based), will convert it to a low-bake cellulose enamel. This system of multitowers allows straightening and counterpushes combined with holding positions so that the straightening work becomes easier for
the operator. Where the chalk line does not appear, the boot lid is not sealing properly and realignment will be necessary. Restrict CO2 level for minimum pick-up General-purpose mixture with this method the nozzle is not in contact with the
workpiece, and an even distance must be maintained between them when cutting. In this method the ends of the panel are first sprayed with single vertical strokes, the panel then being completed with horizontal strokes. The residue of the original sealer left in the aperture has to be trimmed to ensure there is a smooth layer for the new sealer to
adhere to, and to allow the glass to seat in the correct position. 304 Repair of Vehicle Bodies 11.6.8 Weld defects Undercutting This is a condition that results when the welding current is too high. To open the cylinder valve, rotate the 252 Repair of Vehicle Bodies Figure 9.6 Identification markings on gas cylinder necks (BOC Ltd.) spindle
anticlockwise using the special spindle key. The Cold Front heat sink chemical compound was originally developed for the American space programme. This is a hollow rivet, preassembled on to a headed pin or mandrel. Some examples are as follows: Figure 7.14 Special POP rivets (Tucker Fasteners Ltd.) Chobert riveting system operates on an
entirely different principle from other blind riveting systems (Figure 7.17). 4 Apply one coat of self-etching primer, either spraying or brushing type. The addition of extra styrene to the gel coat resin is a common cause. Polyurethane flexible moulded foam can be modified or filled to meet different insulating requirements in the vehicle. The
suspension members have very much the same appearance as the conventional chassis frame from the underside, but the front suspension members end at the cowl or bulkhead and the rear suspension members end just forward of the rear boot floor. 15.6.4 Control of Substances Hazardous to Health (COSHH) Regulations 1988 Since 1974 a number
of Regulations have been introduced which describe in detail the require- 517 ments for specific safe working practices. The most important points in soft soldering are: 1 A perfectly cleaned joint. At each end of the hose are couplings for attachment to the transformer and the spray gun. As you can appreciate, the cost of a virtual design and
aerodynamic testing without a wind tunnel is only a fraction of the cost of building a new workshop it is possible to plan this, but if remodelling an existing operation this may not be possible. As a result of soaring energy costs
together with the need for car aerodynamic design, direct glazing of windscreens and fixed body glass was introduced and an adhesive was required to bond glass windscreens to the metal aperture. Steel 3-16 mm thick comes under the heading of plate. The heat-treatable alloys can be supplied as fabricated (F) or annealed (O), or, depending on the
alloy, in variations of the heat treatment processes (T3, T4, T5, T6, T8). 4 Ensure that PPE is properly used. Manually Space requirements are as above but demand on labour is heavier. The operator should not smoke when using paint remover, even though it is not flammable, as it gives off a strong vapour which, on coming into contact with a naked
light, becomes toxic in nature. Aluminium may be annealed by heating to a temperature of 350 °C. Note the following in particular: 1 Do use an adequate overlap, as this gives a stronger joint. The gas (CO2) cartridge operated extinguisher, when pierced by a plunger, pressurizes the body of the extinguisher, thus expelling the water and producing a
powerful jet capable of rapidly extinguishing class A fires. There is little variation in the sequence of operations, which is typically as follows: 1 Using a sharp knife, trim and level off sealer remaining in the vehicle windscreen aperture.
surface that is only slightly stretched (Figure 10.26). The results of the specialized research are published through special reports. A suitable pulling loop or collar is screwed onto the stud. The first thermoset was Bakelite, the heavy dark brown plastics material which was used for distributor caps and ignition coil ends. When the switch on the torch
is depressed, the thyristors come on. An essential piece of equipment for repair work is the hydraulic body jack, which is used to push and pull body shells and component body parts into alignment following an accident. The following points are suggested as ones worth remembering: 1 Switch off any vehicle or power source. Generators are built in
various current ratings ranging from about 100 to 600 amperes, and most 296 Repair of Vehicle Bodies 11.3.2 AC transformer instead of a generator to provide the required welding current. Metal active gas (MAG) This is the same as MIG except that the gases have an active effect upon the arc and
are not simply an inert envelope. 2.8.17 Reports/records are available to authorized persons and are complete and accurate The Social Security (Claims and Payments) Regulations 1979 require employers to maintain an accident book as well as regulation 7 of the HSWA. Crazing is generally associated with resin-rich areas and is caused by the use of
an unsuitable resin or resin formulation in the gel coat. Metal forming processes and machines 1 Loose clothing and long hair can easily be drawn between the rollers. The ability to create these effects in composite vehicle design depends on the skill of the designer. Tank cladding Flat
panelling of vehicles and general sheet metal work. Resins and accelerators should preferably be kept in a brick-built store conforming to the normal fire regulations for a paint store. Castellated nut and slotted nut used where the nut must always remain tight, and slotted to take split pins which act as a locking device. This dolly block is a shrinking
dolly and is shaped like the toe dolly but has a groove running along the full length of its top face. This method is used to advantage in the fitting of new panel sections, where the original was resistance spot welded and access is now difficult to both sides. Figure 14.78 Pulling equipment being used to realign underframe members (Car-O-Liner (UK)
Ltd.) The next stage of the repair is the realigning and reshaping of the body shell structure, and is normally known as roughing out the damage. Tough rubber has great possibilities for certain types of fastenings. Step 2: Attach the new mirror. Every specification, vehicle type, payload, overall dimensions, engine power and vehicle image inspire the
stylist and the design proposals he will make. Wire feed speeds, power settings and gas flow are all preset prior to commencement of welding. In most situations measuring equipment in the form of body jigs must be used to detect concealed damage, because complicated monoconstructed vehicles may hide further damage such as misalignment,
which could therefore affect the steering and roadworthiness of the vehicle. Most metals and alloys can be welded effectively, but there are certain exceptions which, because of their physical properties, are best joined by alternative methods. 38 Describe the four stages of the procedure for dealing with repairs carried out under an insurance claim.
It is not normal for cars to veer to left or right: suspension systems are designed and set up by the manufacturer so that the car will travel straight, regardless of road crown. In some cases the floor of a car is covered with heavy rubber flooring instead of carpet, and this can be removed and replaced in a similar manner. All of these influence the
finished welds and overall results. The platform has 200 tie-down boxes which provide unlimited holding positions for any type of car or light commercial vehicle. The unique character of leather lies in its microstructure, the like of which is not obtained in any manmade material. The normal curing time of a polyester stopper is about thirty minutes at
20 °C. The use of a plastic instead of a metal base for chrome plating eliminates the possibility of the base corroding and damaging the finish before the chromium plating itself would have deteriorated. Allow overnight drying. With the seatbelt legislation in force, however, safety standards were improved, bringing an increased use of laminated glass,
which is the type that remains in place when broken and therefore allows the driver to continue the journey. A particular advantage to the automotive industry is their complete stability against petroleum products and salts. When selecting a dolly block for a particular job, it should always be remembered that as flat a dolly block should be used as
possible for the job in hand; then the dolly will not only cover the panel area quicker because of its bigger face area, but will smooth out the metal without excessive stretching. Reception facilities for customers could include toilets, seating accommodation, tea and coffee facilities, TV. A flux should be used, and the welding flame kept
in the neutral position. The minimum height for cars should be 4 metres, but this must be increased if commercial work is to be undertaken. The tip of the Phillips screwdriver has four prongs that fit the four slots in the screw head. This system is faster, more reliable and more accurate than conventional measuring methods. 10 Explain what is meant
by micro-alloyed steel or HSS. Where two-tone work is carried out, a finer edge can be achieved by the use of gummed paper than is possible to shrink metal without quenching each spot. This atomization is only possible if the viscosity of the liquid is
sufficiently low. Easily fitted without the use of special tools, they are positioned in a keyhole slot in the trim panel, then firmly pushed home into the inner door panel mounting hole. If the area to be filled up is deep, make several applications, allowing each layer to dry before adding more filler. It is clean to use and leaves no residue, thus rendering
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it harmless to delicate fabrics and machinery. Remove all oxide and scale from the weld when it is finished. The jig bed can be fitted with the full range of Celette brackets, including the MZ repair system and the condition of the car (in many
cases due to corrosion) affects the quality of the repair, the possibility of achieving perfection of appearance is limited and a mutual agreement must be reached between the owner and the insurance company on a satisfactory quality of repair. ROBINSON RTechEng, MInstBE, MIBCAM, AWeldl, MISME Formerly Section Leader for Vehicle Bodywork
and Vehicle Body Repair Course Coordinator for CGLI 398 Vehicle Body Competences Course Coordinator for CGLI 385 Vehicle Bodywork at Gateshead College Updated by ANDREW LIVESEY, BEd, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BEd, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BEd, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BEd, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BEd, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BEd, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BED, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BED, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BED, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BED, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BED, FIMI, MIMechE Head of School of Engineering North West Kent College Updated by ANDREW LIVESEY, BED, FIMI, MIMECHE Updated By AN
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1981, 1982 Second edition published by Butterworth-Heinemann Ltd 1989 Reprinted 1990, 1991, 1992, 1993 Third edition 2005 © A. 8 Apply the sealer in a smooth continuous bead around the edge of the windscreen. Resin Resins occur in nature as organic compounds, insoluble in water, e.g.
amber, shellac. In the preparation of an estimate, the crash damage should be itemized into the number of damaged panel sections and assemblies, and therefore it is important to have a knowledge of vehicle Bodies construction.
The end of the welding rod is trimmed into a point to ensure a smooth start to the weld (see Figure 14.121). It is available in a wide variety of sizes to suit machine screws and sheet metal self-tapping screws. The thermoset injection moulding may use a resin (RIM) or a bulk material (BMC). The BSI needs evidence and history, and so the assessors
look at all the paperwork in the relevant departments to search for major or minor nonconformances. 3 The right-shaped wheel must be used to suit the required shape of panel. Sensors for a wide range of uses are fitted, including outside temperature sensors, rain sensors and on the Mercedes McLaren SLR (Figure 13.76) tyre pressure sensors on
the wheel inner arches. Inside the car, the upholstery will generally be stuck together with adhesives. Remove the wire loop and fill the repair flush with the original body panel using chopped strand mat and polyester resin. Flexes, cables and plugs must not be frayed, cracked, cut or damaged in any way. This information is then fed back to a remote the wire loop and fill the repair flush with the original body panel using chopped strand mat and polyester resin.
computer terminal upon which it is displayed. This means following the safe working practices which are normally used within the industry. Attach the appropriate tool and then spray. These between them can be swung in an arc of 180 degrees, providing a wide range of pulling angles. These are then straightened with the use of hand tools to
facilitate the locating of the new panel section, which after positioning must be checked for alignment with its surrounding panels. The prime differences are the recording of assessments, the provision of training, and the requirement that means of fighting fire, detecting fire and giving warning in case of fire, be maintained in good working order
Body side moulding The exterior trim moulding fastened to the exterior of the body in a horizontal position. The work of the modern car stylist is governed by the compromise between his creativity and the world of production engineering. Hot melt variants very convenient on suitably sized components. Another characteristic of bonnets is that the
edge flanges crack, and these should be welded as early as possible to prevent the extreme back it becomes the panel on to which the door or tailgate closes (Figure 1.46). Table 1.1 lists the items inspected for cars and
light goods vehicles for the two levels of SVA. 6 Once the base metal is tinned sufficiently, start depositing the proper size beads over the seam. 4.7 Aluminium are remelted and cast into ingots of commercial purity. In some cases lack of uniform clearance at the front of the door might be due to
mispositioning of the front wing. Polyester primer filler is a two-pack paint, first used extensively on the European continent. A nut with an ISO metric thread is marked on one face or on one of the flats of the hexagon with the strength grade symbol 8, 12 or 14. After mixing is complete, setting begins at a rate depending on the ambient temperature.
12.10 Equipment used in MIG/MAG welding The basic equipment required comprises a power source, a wire feed unit and a torch. If the defect is inverted the obstruction is obviously in the air cap, which should be cleaned as previously instructed. This type of hammering is called spring hammering, and can be used to correct high spots on metal
panel surfaces (Figure 13.37). 8 Describe the three stages in the production of a spot weld. Coupé A vehicle divided by a fixed or movable glass partition, behind the front seat. Well nut This demountable blind screw anchor is designed to provide a vibration-resistant fixing for engineering and automotive structures. You are advised to seek the
assistance of a colleague when moving a heavy load even when you are using lifting equipment. 8 Be aware of the fact that, even after the fire has been extinguished, some cylinders which have been heated can explode, particularly acetylene cylinders. 3 Do not smoke or use naked flames in the workshop. Mandatory signs indicate that a specific
course of action is to be taken. By tilting the hammer very slightly it is possible to gain maximum stretching on the outside of curved work. Realignment may be necessary to bend or twist the boot lid back to its correct alignment. Some months later he saw the pile of scrap test
pieces and noticed that most of the steels had rusted but the chromium steel was still bright. It has since grown to be the most important method of welding used in the construction and mass production of vehicle bodies. In 1973 the company introduced the vacuum assisted resin injection (VARI) system for vehicle body manufacture. In addition to
natural rubber, a variety of types of synthetic rubbers are used by the motor industry; these vary in price and characteristics, and all are more expensive than natural rubber. The projections serve to concentrate the welding heat at these areas and permit fusion without the necessity of employing a large current. The steam coaches were driven off the
road by the vested interests of the stage coach companies, who increased toll charges and piled heaps of stones in the roads along which the steam coaches passed. Once the panels are secured using either clamps or nails, the appropriate sections should be tack welded together at intervals no larger than 19 mm. In the low-pressure system (Figure
9.1) acetylene gas, produced by a special generator situated in an isolated part of the workshop, is piped to convenient positions round the workshop at a pressure between 1.7 kN/m2 and 62 kN/m2. Welding is normally carried out at high temperature ranges, the actual temperature being the melting point of the particular metal which is being joined
One advantage of leaving the panel in position is that it remains rigid whilst being processed. 12.13.1 Preparing the equipment for welding 1 Select the correct dimensions of wire: 0.6 mm is used for general purposes; and 1.0 mm is used for aluminium only (using aluminium wire). Set the welding
mode switch. They can be used in high-corrosion areas, and are 222 Repair of Vehicle Bodies designed to snap into a suitably punched hole in a metal panel, where they will remain captive until final assembly. The machine consists simply of an upper wheel which is nearly flat and a second lower wheel which is curved or convex in shape; the two
wheels meet at a common centre. This has to be done very carefully with the minimum of blows, and overlapping must not take place. This programme is jointly funded and supported by it members which includes: The body engineering responsibilities are to simulate the styling model and overall requirements laid down by the management in terms
of drawings and specification. Handles can be fixed to the ends of the wire to allow a pulling action (Figure 14.108). Gas shielded arc welding 331 Spot weld In MIG/MAG spot welding 331 Spot welding 331 Spot welding 331 Spot welding 331 Spot welding the arc is directed to penetrate both metal panel pieces through the joint position while triggering a timed impulse of wire feed (Figure 12.28). 7 Explain the process of
annealing. In a further effort to keep the air cool, the compression cylinders have external fins to provide a greater surface area for the heat generated within them to dissipate into the atmosphere. Therefore a primer coat should be applied within them to dissipate into the atmosphere. Therefore a primer coat should be applied within them to dissipate into the atmosphere. Therefore a primer coat should be applied within them to dissipate into the atmosphere.
Figure 14.57 Autorobot III Super complete system (Kroll (UK) Ltd ) The design concept of monocoque construction with its crumple zones which absorb energy through deformation of panel
structures, and the increasing use of high-strength steels, have made essential the use of repair and alignment systems even for minor damage repairs. Thoroughly apply a coating is usually a mixture of metallic made essential the use of repair and alignment systems even for minor damage repairs.
oxide with silica which, under the heat of the electric arc, unites to form a slag which floats on the top of the molten weld metal. These adaptors rise to contact the car underbody and are held firmly in position by air pressure. This area is known as the rear bulkhead of the car; it gives additional transverse strength between the wheel arch sections
and provides support for the rear seat. (k) Built-up stiffeners incorporated in laminate may be cardboard, balsa, various foams, plastic, or sheet metal. Too rapid welding on low currents does not give the required penetration, while welding that is slow, or a current that is too high, gives an excessive bead which may result in burning through the
parent metal. The procedure here is always to remove the hazard, no matter how it was created, immediately. By means of transparent scales the plane of measurement is transferred under the vehicle (Figure 14.30). It is essential that the workshop should be kept clean, otherwise dirt in the finish is a certainty owing to the prolonged period of paint
film wetness. The rear seat panel (6) is reinforced or swaged if necessary to gain enough strength to support the rear passengers. All oil, grease, paint, rust and dirt should be removed by either mechanical cleaning or chemical cleaning or
be regarded as being opposite to toughness. In many cases a vehicle with minor damage will be driven back from the site of the accident and road moisture and dirt is deposited on the damaged area. Once hardened, it cannot be melted down without being destroyed. Figure 14.90 Vector pulling (Dataliner, Geotronics Ltd ) The principle involved in a
pulling repair is to apply force to the car body that is opposite to the force that originally damaged it. The short leg on the front side of the nut is clipped into screw receiving positions on the wing aperture, and ensures a good seal between gasket and wing, thus precluding mud leakage. Healthy working environment. A lever and ratchet action
operates the roller cutters, which are adjustable for metal thickness, and the cutting action can be reversed for cutting internal angles. The flange can be then eased up using a flange removing tool (Figure 13.63c). 21 Check interior for remaining
imperfections. Evaporation A change of state from solid or liquid into vapour. The friction caused by rubbing will generate heat, and when this takes place the cloth must be turned over and the bur- Figure 17.65 Rotary polisher fitted with a sponge polishing pad (Faréncla Products Ltd ) 616 Repair of Vehicle Bodies These machines are best used with
liquid car polishes, but are also very effective when used with the more viscous conventional polishes. High boilers can be used in finishing coats to promote better flow, helping into reservoirs of the heated adhesive can be most effective. These
electrodes must be kept clean and shaped correctly to produce good results. It is designed to be used on mild steel in conjuctions with a sandbag or wood hollowing block, and to create a double-curved shape by hand. The rear end of the floor is stiffened transversely by the rear seat heelboard (5). Damage to panels through impact shocks is contained
locally and absorbed through destruction of the material, unlike the steel sheet which transmits deformation. Gel coats should never be more than 0.5 mm thick (Figure 16.52). The power required depends on the thickness, mass, melting point and heat conductivity of the metal to be welded. Dry coating is particularly useful when carrying out local
repairs to paintwork. In some cases this has been achieved by good design and in other cases by treating the metal prior to painting. Any vehicle body under major repair will never hold its correct alignment unless underframe damage has been completely repaired first. The finished result depends on the skill of the craftsman as he manipulates the
sheet by hand in the wheeling machine. The procedures manual is the starting point for this: 1 Are you doing what your manual says you should do? The evolution of the motor car nevertheless tends towards a gradual reduction in aerodynamic resistance. Cu Zn Mn Ni P Bi Si Sn CP1 Balance - - Ag 14-15 4.3-5.0 - - - Balance Balance Balance Balance
192 192 Notes Fluxless brazing High strength, good ductility Good strength Soft and hard soldering methods 241 CP2 CP3 CP4 CP5 CP6 Nominal composition (wt%) 242 Repair of Vehicle Bodies materials having a high percentage of brass content will produce a rough-looking brazed joint, which nevertheless is slightly
stronger than if brazed with a neutral flame. There are three subdivisions of the system: Spray transfer In this type the mode of transfer consists of a spray of very small molten metal droplets formed along the arc column, which are projected towards the workpiece by electrical forces within the arc and collected in the weld pool. To replace the
windscreen, first clean the glass channel in the rubber weatherstrip to be sure that all traces of sealer and any broken glass are removed. Much time and effort may be wasted in moving vehicles from one point to another as dictated by the finishing process. Pre-preg has a limited shelf life which is compounded by the fact that it must be stored at $180.0000 at $180.00000 at $180.0000 at $180.
°C. The pencil is more easily seen if the floor is previously chalked in the approximate area where the plumb-bob will fall. 2 Do not move the person if injury to the back or neck is suspected. Typical formers and core materials are paper rope, polyurethane rigid foam sheet, Termanto PVC rigid foam sheet, Ter
Figure 16.13 Typical sandwich construction (Scott Bader Co. Ltd ) contoured foam sheet, and Termino PVC contoured foam sheet, and termino PVC contoured foam sheet, and termino PVC contoured foam sheet. For example, a moulded glass fibre seat pan and squab unit would be made with chopped strand mat
as a basis. When riveted joints are large it is advisable not to start at one end of the workpiece but to rivet the extremities first and next the centre, then the rest of the joint. This bench can be used with the autocontrol measuring system, the minibracket system and the traditional bracket system. Do not remove the screen and attempt to spread the
sealer already applied. Lead is very soft yet possesses only a small amount of elasticity. Satin weaves may be of multishaft types, when each warp and weft yarn goes under one and over several yarns. It should also be noted that the tip force is difficult to maintain with long arms fitted to hand-held pincer-type guns (see Table 10.1). Although this
system would appear advantageous by reducing the large number of assembly operations required for building a steel body, it must be realized that in the layout of a steel body plant little or no allowance is made for processing time and Reinforced composite materials 533 that the speed of production is determined only by the time required for
handling and transporting panels from one stage to the next. It is essential to determine the exact amount of stripping necessary for either the repair or the removal and replacement of a damaged section. All other parts are manufactured from polypropylene (see Figure 7.60). Fast tack adhesive Repairs to trim fabrics, headlinings and carpets. The
hammer has one end round and flat and the other a rounded ball-pein, and it usually has an ash handle fitted into the head. 3 Select the appropriate microfiche, place it in the viewer and find the mixing formula. This is why so much trouble is taken over the pattern. That is, the further apart that we can keep the outer fibres the stiffer the panel will
be. For ease of use and to prevent possible errors, integral brackets fit to a regular-spaced hole pattern on top of five integral bracket sets. Shapes are becoming more complex, needing very good angles of entry control to meet bonding requirements. There is a standard four-post bench incorporating lifting
facilities, and a four-post lift with a disengageable jig frame. 236 Repair of Vehicle Bodies This chapter covers skin and surface fusion methods; Chapters 9-12 deal with total fusion. 11.6.2 Correct arc length This will depend upon the type of electrode used and the nature of the welding operation. Centre pillar The centre vertical support of a four-door
saloon. 10 Make a sketch, and state the operation of, a micrometer. When cleaning the gun of spatter and deposits the condition of the gas distributer should be replaced. Pick and finishing hammer This tool (Figure 3.3a, b) is used in place of, or in conjunction with, the
planishing hammer. HSS is not as easy to form as LC steel; also some types of HSS can be drawn better than other. 6 The two pieces of material to be brazed must be either lapped or carefully butted after edge preparation and must fit tightly together during the brazing operation (Figure 8.5). Another area of potential danger is when using electrical
equipment such as an electric drill, handlamp or grinder. Quality is normally controlled by characteristics such as number of rows of tufts of pile per unit length, height and weight of the free pile, overall weight of the carpet, strength as determined by a tensile test in both the warp and weft directions, together with adhesion of pile if applicable. The
U-channel is also the most common type of section used in the construction of car frames. It is important that the workforce does not have to wait to use the same piece of equipment; therefore the location of equipment should be carefully planned so that a job goes smoothly from stage to stage without wasting time. The lead paste was mixed with
linseed oil and applied by brush, one coat every second day, being too slow in drying to allow for more frequent coatings. Sealers are supplied ready for use, and it is difficult to spray them without leaving an edge which is difficult to remove. Movement of filler rod Circular forward action. Some of the first vehicles, or horseless carriages as they were
known, carried no lights at all; then carriage candle lamps made their appearance. One square metre of 1.6 mm thick steel weights 4.35 kg while one square metre of 1.00 mm thick steel weights 4.35 kg while one square metre of 1.00 mm thick steel weights 4.35 kg. the use of aluminium results in a saving in weights 4.35 kg while one square metre of 1.00 mm thick steel weights 4.35 kg. the use of aluminium results in a saving in weights 4.35 kg.
safe equipment and safety protection and must also ensure that all work methods are carried out safely. Then strike a light blow from beneath the panel, of sufficient strength to form a pimple in the low spot (Figure 13.38). Do not attempt to use any electrical equipment which you suspect may be faulty; report the fault immediately to your supervisor
In the case of strands which are subsequently twisted into weaving yarns, the size lubricates the filaments as well as acting as an adhesive. 32 Describe the removal of a direct glazed windscreen, and the type of equipment that would be used. Whichever sealer is used, it can only do its job if it is a continuous film. Areas where bare metal is exposed
must be treated with etch primer. It works in conjunction with Glassmatrix by importing power fields from an estimate and placing them into a form template. Total write-off is damage so extensive that the vehicle is either unrepairable or the total cost of repair would be greater than the value of the vehicle. When working on any system which
contains fluids it is good practice to use a drip-tray to catch any possible spillages, this saves having to clean the floor as well as ensuring that all the used oils and fluids are disposed off safely, that is, you can pour them from your drip-tray into your drip-
revolutions per minute as scorching of the film will easily result. Damaged panels should be restored by relieving the stresses which have been set up by the force of impact. Adhesive/sealant (polyurethane-based compound) Structural bonding and sealing of replacement windscreen. Figure 13.33 The technique of direct hammering 360 Repair of
Vehicle Bodies It is most important to choose the correct dolly block for the job, because they differ in shape, curvature and weight. Apply cellulose stopper where necessary, allowing 15-20 minutes between layers. The storage life of polyester resin is about six to twelve months provided the resin is kept below 20 °C in the dark (in metal drums).
Celette UK MZ system This system for crash repairs incorporates all the traditional benefits of jigs and brackets, but, in addition, has been designed to reduce the model-specific content of the system to a minimum while maximizing the number of brackets which can be fitted, without the need to strip out the mechanical parts first. Identification of
the material There are two basic types of plastic used in cars: thermosetting and thermoplastic (see Section 4.12.3). Thermal expansion can lead to micro-cracking. Whenever you are working on a motor vehicle it is expected that you wear cotton overalls and safety footwear. Radiuses up to 743 in (200 mm) can be cut on material up to 1.2 mm (18
gauge). The heavy weight of this hammer, together with the curve, makes it very effective for hammering out difficult and inaccessible sections. The trigger on the gun controls the flow of paint only. 9 Sand the panel surface over the damaged area using a very fine sanding disc. 2 Extend the curve, makes it very effective for hammering out difficult and inaccessible sections.
employees' safety representatives and provide facilities for them. 4.11 Interior furnishings 4.11.1 Carpets and floor coverings The body engineer has a choice of materials, ranging from carpeting of the Wilton type for prestige vehicles, through polyamide and polypropylene moulded needle felts, to rubber flooring for economy versions. From that time
arc welding gradually displaced gas welding techniques, especially when joining heavy-gauge metal, although the major development in arc welding machines. Panel beating may also be used where a small number of components only are required and where the cost of press or stamp tools
would be uneconomic. 3 List the main physical properties of glass fibre composite materials. A neat reinforcement weld bead is usually left protruding above the surface of the parent metal, as this gives good mechanical properties in the completed weld. Decide on controls (substitution, local exhaust ventilation (LEV)) 2
Maintenance and testing procedures 3 Air monitoring 4 Health surveillance 5 Record keeping. (a) (b) (c) (d) (f) (e) Figure 14.101 Replacement of part panels: (a) clamping new panel section into place (b) cutting in (c) tack welding (d) section fully welded in (e) dressing the welded joints (f) soldering the joint and filing to a finish (Motor Insurance and testing procedures 3 Air monitoring 4 Health surveillance 5 Record keeping. (a) (b) (c) (d) (f) (e) Figure 14.101 Replacement of part panels: (a) clamping new panel section into place (b) cutting in (c) tack welding (d) section fully welded in (e) dressing the welded joints (f) soldering the joint and filing to a finish (Motor Insurance and testing procedures 3 Air monitoring 4 Health surveillance (b) cutting in (c) tack welding (d) section fully welded in (e) dressing the welded joints (f) soldering the joint and filing to a finish (Motor Insurance and testing procedures 3 Air monitoring 4 Health surveillance (b) cutting in (c) tack welding (d) section fully welded in (e) dressing the welded joints (f) soldering the joint and filing to a finish (Motor Insurance and testing procedures 3 Air monitoring 4 Health surveillance (b) cutting in (c) tack welding (d) section fully welded in (e) dressing the joint and filing th
Repair Research Centre) Major accident damage 463 Vehicles that have undergone an extended corrosion prevention by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement to prevent body perforation by rust must be repaired using replacement because the repaired using repa
work: shearing, cut-off, parting and blanking. The return curve swage is frequently used to strengthen the centre portions of cylindrical containers because of its high resistance to externally or internally applied forces. The first three are the ones mainly used for vehicle body work as they are reasonably priced (Table 16.5). They do not need high
tensile strength or flexural strength as they do not have to carry heavy stresses. When carrying out the repair process, thorough preparation of the Figure 14.118 Split bumper (Welwyn Tool Co. Ltd.) In any welding operation it is important that the two surfaces to be joined
should remain in alignment, so they should be tacked together using a tacking nozzle (see Figure 14.120). Spray in with acrylic primer filler sufficient coats to level up the surface. This is particularly useful for site assembly, saving time and improving repeatability. Colours alter during the drying process. Each integral bracket carries a plate which
shows a reference number, which side of the jig it fits to and which edge points forward. When this type of electrode melts, the coating produces a shield of gas around the molten metal, safeguarding it against the atmosphere. This Page is Intentionally Left Blank Contents Foreword by Malcolm Tagg, Director General, VBRA xiii Preface xv
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600 602 614 616 620 621 622 624 625 627 Foreword Since 1914 the Vehicle and Repairers Association has been intimately involved in the history and development of the burnback delay button indicates the time for stopping the wire feed until the arc is switched
off. All eight pointers are Major accident damage 417 Figure 14.18 Example information sheet for use with the MZ bracket system (Celette UK) available for taking measurements, since none needs to be left in the calibrated position; therefore all eight locations are available for taking measurements, since none needs to be left in the calibrated position; therefore all eight locations are available for taking measurements, since none needs to be left in the calibrated position; therefore all eight locations are available for taking measurements, since none needs to be left in the calibrated position; therefore all eight locations are available for taking measurements, since none needs to be left in the calibrated position; therefore all eight locations are available for taking measurements.
adjustable clutch this tool can be used as a power screwdriver, thus making it a tremendously versatile piece of equipment, especially in the body building industry. Some methods of controlling distortion are as follows (Figure 9.19): 1 Efficient tacking or clamping, which maintains the edge positions of the plates 2 Tapered spacing of plates so that
they pull together the process of welding 3 Use of intermittent weld technique and backstep weld technique 262 Repair of Vehicle Bodies Figure 9.19 Control of distortion Gas welding, gas cutting and plasma arc cutting 4 The offsetting and presetting of plates so that they are pulled correct by the contraction of the welds 5 The use of chilling bars
and chemical foam barriers 6 The use of planishing when the weld is in the cold state 7 The use of jigs and fixtures. Repairs to damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents, or even the cutting away of a damaged body shells mean a great deal more than the beating out of a few dents and the cutting away of a damaged body shells mean a great deal more than the cutting away of a few dents and the cutting away of a few dents are the cutting away
barrel are graduated into divisions of 0.5 mm for the barrel and 0.01 mm for the barrel and 0.01 mm for the body flanges which contact the weatherstrip at each point where contact is made. A rear windscreen opening can be restored
to its original shape by placing the body jack diago- Clamp the pump in a vice. The safety cell) is the central section of the car body which acts as the passenger compartment. As previously stated, these primers have exceptional filling properties, but when used with low-bake finishes the stoving schedule (1-112 hours at 82-93 °C) can
prove to be too long to be economical. 26 List four methods of panel removal and the tools used. Pillars are becoming slimmer and glass areas are increasing as manufacturers approach the ideal of almost complete all-round vision and the virtual elimination of blind spots. 9.13.4 Safe usage and handling of gas cylinders Leaks As a matter of routine,
check for leaks. Therefore if such materials are to be used effectively and maximum advantage is to be taken of the many benefits they have to offer, there should be very close collaboration and consultation over which grade of stainless steel is best for the particular job in hand. The boot lid is formed by cold pressing a mineral reinforced resin-coated
glass fibre mat in a gel-coated mould, forming a component which is very stiff in relation to its weight (see Figure 16.23). As the oxidation layer will be over the whole panel, the dulling will not be distinguishable. Starting with something simple. Reference to the manufacturers' recommendations are essential, as the correct cutting speed must be
maintained to ensure the quality of the cut. Once the two sections are tack welded together the wing nut is slackened, the toggle bar removed and the clamp lifted from the (b) Figure 3.19 (a) Edge setter (b) Rolastep edge setter (b) Rolastep edge setter (b) Rolastep edge setter (c) Rolastep edge setter (b) Rolastep edge setter (c) Rolastep edge
skin, gloves and safety goggles are a first line of defence, and you are reminded to consult the COSHH sheet supplied by the manufacturer with all of these products. Sanding, grinding and cutting operations in the body shop usually generate quantities of airborne dust; this is a major hazard not only to health but also for refinishers wanting a quality
paint finish. The harness number used in the designation, typically 4, 5 and 8 is the total number of fibres crossed and passed under before the fibre repeats the pattern. ** This unit appears as an optional unit for motorcycle technicians within the M & R Level 2 S/NVQ framework. The battery must have a good earth connection. They are applied as a
liquid, but solidify as the solvent evaporates. 2 The gases in the cylinders are under perfect control and do not need any maintenance either in or out of use. Filler Inorganic types used to extend low-pressure resins, usually polyesters. This will achieve a higher degree of accuracy and at the same time help to reduce fatigue. The text can be in an
oblong or square box of the same colour as the sign, with the text in the relevant contrasting colour, or the box can be white and the text black. Heavily soiled carpets or seats may require shampoo vacuum treatment. Both the laying on and the washing off of the stripper can be done with old or cheap paint brushes. This only needs hammering lightly
on the wood former to obtain the finished shape. 14.3.4 Gunsight gauge method of checking underbody alignment for distortion is that of using gunsight frame gauges (Figure 14.59). Thinner Some of the liquid of the paint is often withheld from the paint container and supplied separately as a
thinner. Ideally the base of the insert should be about four times as wide as it is long. The theory of repair is that areas which are elastic in manufacture, and remain so after damage, can generally be reshaped by their characteristics once the rigid areas in the surrounding buckles are forced back into position. 6.3 Precision marking-out and
measuring instruments The average body worker will not normally come into contact with precision marking and measuring instruments. Speeds were restricted to 2-4 mile/h. Once the work study engineer has evaluated the information obtained through observation and consultation, the data is published in a methods manual. Equipment is also
available to measure the upper anchor points of MacPherson struts together with the dimensions of the engine compartment and the whole of the upper body (Figure 5.14 Pyramid rolls Figure 5.14 Pyramid rolls Figure 5.14 Pyramid rolls Figure 5.14 Pyramid rolls Figure 5.15 Pinch rolls; the slight flat which occurs on the leading
edge of the plate can be reduced by initially reversing the rollers and feeding the flat plate back into the rollers a little way, which will preform the edge ready for rolling. On the other hand high crowns, that is surfaces with a lot of curve, like wings, edges of roofs and sill panels, are very resistant to change in shape by an outside force. Once the
catalyst has caused the resin to set hard, the moulding can be taken from the moulding can be
transfer. With thin materials this result can be achieved with square edged plates. 75 Inspection hand-lamp systems are frequently used. The body sill panels provide extra reinforcement in the form of lateral strength. 16.4.3 Needle mat This is machanically bound
together and the need for an adhesive binder is eliminated. Being computer controlled, the arch is capable of providing the refinisher with the option of drying a complete vehicle or one or more panels at various positions on the vehicle body. 3 4 5 6 7 8 9 10 11 12 Treat bare metal with metal conditioner or phosphating liquid, rinse and dry off. Note
the use of a pull ram fitted with chains and connected to a swivel clamp at the upper corner and a pull ring and clamp at the lower corner. Separate support legs are included for workshops with uneven floors, and they can be adjusted until the jig bed is perfectly levelled. 46 Why is GRP not used in the mass production of vehicle body shells on an
assembly line? Following drying of the bare metal with an air duster and wash leather, the area is now ready for repainting. 5 Explain the following heat treatments to carbon steel: (a) normalizing (b) hardening (c) temperature
distribution Gas blow torch - use a low to moderate setting (Figure 13.71) Hot air gun - probably the best method, especially if it has a temperature control 13.17.8 Temperature as it gets hot. The impact takes place at 50 kph (30 mph) when a trolley
with a deformable front is towed into the driver's side of the car to simulate a side-on crash (see Figure 1.28c). Curing normally takes place at room temperature, but sometimes under a certain degree of heat if the process is to be accelerated. The sensor is usually
positioned behind the glove box. Use interior cleaner by spraying and wiping clean with cloth rinsed frequently. Two portable hydraulic rams are also supplied for lifting, pushing and pulling, thus proividing the means for unlimited pulling capacity at any point on the damaged vehicle. Utility dolly forms the basis of every body kit. Nitrogen Cylinder
requirements throughout the vehicle's service life. After a further baking period the car body is painted and some of the critical cavities can be flooded with hot wax. In total fusion the parent metal are completely melted during the jointing. 6 The company will have the confidence of knowing that its quality system has been
externally assessed and approved. Good welding rods are designed to give deposited metal of the correct composition, and have allowance in their chemistry for changes which take place in the welding process. Idler arm and bushings. If refrigerated storage is not used to prevent age hardening it may be necessary to repeat solution treatment of the
metal before further work is possible. The operation is performed on a press by a die and therefore may be classified as a stamping operation. In impacts over 12 milliseconds, that is before the occupant even starts to move
Composite structures have the ability to absorb high impact loads by progressive collapse, with impact damage being localized. Figure 8.4 Types of soft soldered joints The structural change within the metal as a result of applied forces is known as metal
flow (Figure 5.23). Cut the masking tape strips at the glass edges and remove the screen. 7.6.10 Aerotight nut This nut is designed for use in conditions of severe vibration. Workbays should be arranged so that the movement between them is minimized and major crash repairs and non-runners do not cause bottle-necks. The mounting arms can be
turned either inwards or outwards to suit the width of the vehicle. Use the appropriate thinner only. 7.3 Bifurcated, tubular and semitubular rivets These rivets have the outstanding advantage that there is no swelling of the solid portion of the shank during the closure operation. 13 Explain what is meant by a self-tapping screw. 44 List the design
features that characterize a vehicle body as a limousine. For weight and fuel saving reasons, high strength steels have been introduced for some panel assemblies on body shells. 183 16 Describe the condition of a metal panel mouldings or trim
which may interfere with the removal of the windscreen. At the point of locking a sturdy catch holds the bonnet down under spring tension. Tinning also protects the bit against further oxidation, thus increasing its life. With the development of deep drawing steels and better press equipment, large streamlined panels were designed and formed into
contours that were more attractive, gave longer life and greater safety, and at the same time reduced the bulky construction previously required to give similar strength. 23 Some beating files and panel hammers have serrated faces. Figure 3.58 Geared
orbital sander/polisher (Desoutter Automotive Ltd.) This special sander (Figure 3.60) is an oscillating power tool, only available in this form from the company Fein. All instructions given regarding the locations of cut lines for sectional repairs to load-bearing parts must be strictly adhered to. During the Second World War a great deal of research was
history of sealers is longer than that of the motor car. Its wide adoption has been brought about by its technical advantages and the reductions in cost. Two basic methods of gas mixing are employed. Though orange peel is a defect of faulty flow-out, it can occasionally occur after the paint film has flowed out. Following this part of the work, as many
as seven coats of varnish were applied. Benefit of delayed action cure (DAC). 27 Explain the role of the styling department. There are no thread interruptions or pitch errors, and there is no deformation of the nut body or its hexagon form. It does not go soft when you try to heat it up; if you subject it to a flame it
will burn and char. Which process to choose can only be decided upon by a close inspection of the vehicle. Body soldering requirements are soldering blocks, which are usually hardwood blocks to stop them sticking to the solder,
resulting in a smoother surface finish (tallow is the optimum substance for this purpose); a sanding machine, files and emery cloth for cleaning purposes prior to tinning the metal for soldering; a welding torch or similar heating appliance which means for this purpose and the flame should be feathered, which means for this purpose are the flame should be feathered.
slightly carbonizing, resulting in a soft flame): a quantity of body solder and a suitable tinning paste complete with a tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean rag for rubbing off the tinning brush for ease of application; and a clean
dealing with a solvent fire. 22 What is the alloying effect when zinc and copper are added to aluminium? Craft techniques and minor accident damage 383 13.16.3 Minor repairs to wings Removal of a small dent from a wing is one of the simplest of repair jobs. 3 Realign body shell, correcting damage with a combination of pulling equipment and body
jack, and the use of heat and hand tools (not HSS). Aramid Aramid fibre is a man-made organic polymer, an aromatic polymer, an aromatic polymer from a liquid chemical blend. (f) Nailing or screw insert. If the door aperture is correct and the door is not twisted, with slight adjustment to the hinge position the door can be made to fit into its
appropriate opening. If untreated metal becomes exposed, rust will get in; therefore cars need to be treated regularly, and so rust-proofing becomes a continuous process. There are a number of resistance welding processes. Figure 9.28 Plasma cutting unit: three phase, 40 amperes (Olympus Welding Supplies Ltd.) Gas welding, gas cutting and
from such damage. Berlina Rarely used before the First World War. Collapsible steering column A safety feature in the form of an energy-absorbing steering column designed to collapse on impact. About 1921 the Weymann construction was introduced, in which the floor structure carried all the weight of the seating, and the body shell, which was of
very light construction, was attached to the floor unit. 3.17.4 Toolchests A cabinet-type toolchest as shown in Figure 5.24) is the drawing of parts having a circular or cylindrical shape. It is used for the following purposes: 1 To cut strip or coiled stock into blanks 2 To cut strip
or coiled stock into smaller strips to feed into a blanking or cut-off die 3 To trim large sheets, thereby squaring the edges of the sheets. The transformer is manufactured from materials able to withstand a 322 Repair of Vehicle Bodies working temperature of up to 180 °C. A flux must be used with the following metals: cast iron, high-carbon steel,
stainless steel, copper, copper alloys, aluminium, aluminium alloys, magnesium alloy
check alignment of bonnet and boot lid and ease of operation. Therefore it is greatly used in the manufacture of composite vehicles. Nick-break test In this test procedure the butt joint weld must first be ground flush. 25 Explain what is meant by a non-structural adhesive. Welding booth for use
in production welding is designed to protect all other personnel from the extent of the damage. Dry powder extinguishers are usually made in sizes containing 1 to 9 kg of either standard powder or (preferably and more
generally) all-purpose powder, which is suitable for mixed risk areas. At one time the employer must also promote efficient work methods, which together should result in improved productivity. Explain a suitable method of
repair. The history, development and construction of the car body Every major design project has its own design manager, and they stay with the project throughout. Remove all scale, dirt or grease, otherwise the bronze will not adhere. Position of filler rod Precedes the welding torch. The shape of the grains can be altered by
heating the steel to a temperature above that of recrystallization. One of its main applications is in the building of commercial vehicles (see Figure 7.33). When set, this rivet is capable of withstanding high pullout loads (see Figure 7.33).
reducing high spots by heat shrinking in vehicle repair. The opencircuit voltage should not be less than 60 volts in the case of DC and 70 volts in the cas
 by indicating where to look for possible distortion. Be aware of areas which Figure 14.127 Degreasing engine (Autoglym) 4 Apply degreaser to door apertures and edges. Oxygen for use in both systems is supplied in steel cylinders at high pressure. The area of the damage must then be checked and marked for cutting. From time to time the flam to the flam of the damage must then be checked and marked for cutting. From time to time the flam of the damage must then be checked and marked for cutting. From time to time the flam of the damage must then be checked and marked for cutting.
should be played over the solder to keep it in a plastic or movable state; then, using the solder should be moulded to the general contour of the panel. A petrol car reached 100 mile/h and, in the same year, a Stanley steam car achieved a speed of 127 mile/h. 159 20 State the reasons why certain metals need to be protected from the
effects of the atmosphere. The key to success in any bodyshop is the production of an accurate, well presented estimate. Unacceptable joint quality may arise from a failure in the specific design or from the incident of weld defect. Suitable wax emulsions are also available as a releasing agent. A minimum of three gauges is essential, but the more
gauges used the easier it will be to determine exactly where the distortion is located, as sighting along four or five gauges back and forth along the length of the vehicle. General purposes, especially small components Very fluid and strong Limited flow, useful for fillet joints Cadmium-free alloys AG5 42-44 36-
38\ 18-22 - 0.025 - 690-770\ 400\ AG7\ AG7V\ 71-73\ 27-29\ 27-29 - - - - 0.025\ 0.025 - - 780\ 780 - - AG8\ 99.99 - - - 0.25\ - 960 - Cadmium-free for food equipment, etc. The second is harder, being formed from moulded hardboard coated with foam or cloth which has a vinyl facing. Car-O-Tronic measuring system The Car-O-Tronic is an
electronic computerized measuring system that is universal. Where joints have been made in the pillars they must be MIG welded, ground flush and soldered (Figure 13.63g). The air and paint enter the gun through separate passages, mix, and are then ejected at the front of the gun. Single-pass machine welds with filler wire addition and heavy
currents are possible on thicknesses up to 3 mm but the preparation shown in 6 is preferred where T exceeds 10 mm, assuming both sides of the joints are accessible Figure 12.5 Recommended edge preparation surfaces of the joint are clean and free from rust, scale, greases or dirt,
satisfactory spot welds can generally be made. If these are observed they will enable the operator to become proficient very quickly in the use of the grinder. Second, the Dozer can be lined up to pull in any direction, so that the problem of direction of pull does
not arise. Methods of joining 233 Typical applications of structural adhesives include the following: 12 Describe the difference between a set screw and a bolt. Carbon fibre An extremely strong, though expensive, reinforcement which can be used in conjunction with fibreglass. In this test, the car being tested is propelled sideways at 29 kph (18 mph)
into a rigid pole. When the path is continuous, the circuit is closed and the current flows. Risk assessment is about identifying hazards and the severity of the hazard, deciding on the level of likelihood of the occurrence and setting control to deal with them. 22 Remove polish. Carbon steel containing 0.83 per cent carbon is called eutectoid and
consists of pure pearlite structure. 7 Cooperate with other employers sharing the work site. To clean the nozzle use special nozzle cleaners, never a steel wire. The most common use of an ammeter is to check the charging rate of a vehicle's alternator; you'll need a meter which goes up to 60 A for this job. Another method is that of fastening panels
together using adhesives; this is proving to be very successful in certain types of construction. The measuring slides decide the width measurements and run along the measuring bridge. To repair a damaged car it must first be positioned over the main frame and raised on safety stands, which are fastened through tubes and pinch-weld clamps to the
underside of the vehicle. First set the control unit to the correct setting specified for the size of electrode being used. It is being increasingly used in offshore and energy applications. 11.7.3 Welding stainless steel does not differ greatly from that of welding mild steel, but as the material
being handled is very expensive, extra precautions and attention to detail at all stages of welding are desirable. It is primarily used for exposed panels, where the zinc-iron layer is on the outside for cosmetic protection and the free zinc side provides perforation protection. The surface to be welded is called the fusion face. 5 When the fire brigade
arrives, inform them of the location, the number of gas cylinders directly involved in the fire, and the names of the gases they contain. Two or more layers will be required, and as work proceeds they should be made larger to bond well to the original laminate surrounding the repair (Figure 16.39). • Curing properties - the curing process alters the
properties of the material. 148 Repair of Vehicle Bodies 4.12 Plastics 4.12.1 Development Celluloid might well qualify for the honour of being the first plastic, though its inventor, Alexander Parkes, was certainly not aware of that fact. Figure 12.12 Motion of torch and filler rod for TIG welding heavy sections 12.7 Application of TIG welding This
process has found an application in the body building side of the industry, where it is used to ideal advantage for fabricating components by welding in materials such as aluminium and stainless 319 steel. Oxygen forms 20 per cent of the atmosphere, the rest being nitrogen and a small percentage of rare gases such as helium, neon and argon. 17.7.4
High-volume low-pressure (HVLP) spray guns Legislation which is part of the Environmental Protection Act requires that spray painters must reduce the amount of paint vapours being released into the atmosphere as a result of their working activities (see Chapter 15). Alternatively the gel coat resin may be too hard with respect to its thickness. Wet
flat around the edge of repair with P800-P1000 grade paper. Solvents can prove to be an expensive item, and in consequence a cheaper form of cleaning spray guns and equipment. Consequently a simpler method called a peel test has been developed by general use in the workshop. 23 Describe
a suitable method of removing the damaged skin during the repair process of reskinning a door panel. Types 3103, 5251, 5154A and 5056A are non-heat-treatable alloys of the aluminium-magnesium range with a strength of 90-325 N/mm2. max. Clean the soldering iron Solder will not adhere to or bond to a dirty or greasy soldering iron, and whether
the iron is new or old it must be clean and bright on its working surfaces, i.e. approximately 20 mm up from the point on each face. (e) Take care when welding that sparks or burning underseal do not cause a problem, especially when working in confined areas of vehicles. The process consists of heating the work in an automatically controlled over to
a temperature in the region of 170 °C for a period of ten to twenty hours. In order to remove a windscreen which is fitted with self-tensioning weatherstrip, the following procedure must be carried out. There are three stages in producing a spot weld. The
where required. 18 Explain what is meant by the semi-integral method of construction. The key factor should be avoidance of cross-booth glare. 17 Sketch and describe the best condition for a welding torch flame for welding low-carbon steel sheet. It is important to select the blade tip accurately by matching it to the size of the slot or the type of
fastener being used. When not in use they should be lightly oiled and covered against accidental damage and corrosion. Low cost High heat input. Pillar face The front of a pillar visible when the door is opened. Once adequate fusion is achieved, a weld is made by gradually moving the electrode along the parts to be welded so as progressively to melt
the adjoining edges. There are three kinds of distortion caused by resistance spot welding which are relevant to car body manufacture and repair. The oxy-acetylene process is normally recommended only for material thinner than 6-4 mm. It is highly effective in places where straight structures Automotive finishing and refinishing such as doors,
tailgate panels and long channels exist, or where the operator needs to control the position of the lance, such as enclosed front or rear wing box sections. Flat welding is generally easier and faster and allows for better penetration. 9.3.6 Gas hose Gas 
when using very high current, although a DC system is essential when welding certain non-ferrous metals. It burns in ordinary air with a luminous smoky flame, but in pure oxygen it burns with an intensely hot non-luminous flame. This includes the following: 1 Death or major injury - if an employee or member of the public is killed or suffers major
injury the HSE must be notified immediately by telephone. The future growth of plastics in the automotive industry will be controlled by two factors: the growth of the industry itself, and the greater penetration of plastic per car. Whilst removing slag, tiny particles are often deflected upwards, and without proper eye protection these particles may
cause a serious eye injury. If there is no ratchet stud the thimble is turned just until resistance is felt to the turning; great care must be taken to avoid over-tightening. They are used extensively for the joining of soft materials such as plastic, rubber, leather and/or brake and clutch linings to metal. A British Standard specification defines the chemical
composition and mechanical properties of the steel, and also the method and apparatus to be used when testing samples to prove that the mechanical properties are correct. The weld is started on the right-hand end of the joint 9.7.2 Rightward and all-position rightward welding Rightward welding is recommended for steel plates over 4.8 mm thick.
Small mild steel parts can be given a very thin casing by heating them in a forge to a bright red heat and coating them with carburizing powder. Tools and equipment The following tools recommended: and equipment Garden spray (hand pump pressure type) Wet/dry vacuum cleaner Torch Mirror Seal lipping tool Trim panel removing tool Small
wooden or plastic wedges Dry compressed air supply Hot air blower Sealant applicator Ultrasonic leak detector. It was primarily introduced into the range of equipment for those bodyshops with limited working space and height restrictions. Requires minimum energy to ignite in air or oxygen. With filler wire addition, machine welds up to
approximately 6 mm thick material are possible with this edge preparation Used on material thickness up to 2 mm This form of preparation is only used when filler wire is to be added. Oxygen and a fuel 265 gas for the preheat flame, for example acetylene, enter the torch separately and are mixed in the body of the torch or in the nozzle. Foam Foam
is an agent most suitable for dealing with flammable liquid fires. It is made in a variety of weights to suit individual needs. The early motor car, like its predecessor the coach or carriage, was of coach-built construction, and the existing methods of painting were suitable for this type of vehicle. Panels that were originally spot welded, but cannot be
spot welded back, can be MIG welded in the course of repair; the welds are made in the same place by welding through the holes in the adjacent panel which were left when the original spot welds Major accident damage 461 Figure 14.100 Welding through the holes in the adjacent panel which were left when the original spot welds Major accident damage 461 Figure 14.100 Welding through the holes in the adjacent panel which were left when the original spot welds Major accident damage 461 Figure 14.100 Welding through the holes in the adjacent panel which were left when the original spot welds are made in the same place by welding through the holes in the adjacent panel which were left when the original spot welds are made in the same place by welding through the holes in the adjacent panel which were left when the original spot welds are made in the same place by welding through the holes in the adjacent panel which were left when the original spot welds are made in the same place by welding through the holes in the adjacent panel which were left when the original spot welds are made in the same place by welding through the holes in the adjacent panel which were left when the original spot welds are made in the same place by welding through the holes in the adjacent panel which were left when the original spot well are made in the same place by well and the holes in the same place by well and the holes in the adjacent panel which were left when the holes in the same place by well and the holes in the adjacent panel which were left when the holes in the same place by well and the holes in the adjacent panel which were left when the holes in the adjacent panel which were left when the holes in the adjacent panel which were left when the holes in the adjacent panel which were left when the holes in the adjacent panel which were left when the holes in the adjacent panel which were left when the holes in the
used in the motor trade in the motor trade in the mid 1930s and was introduced into the repair industry by the car manufacturers who were using it on the mass production of car bodies. Generally oven curing at between 80 °C and 180 °C will increase the tensile strength by up to 30%. It also has a recess which fits over the body flanges all round the opening for the
glass. BS 5378 divides signs into four categories (Figure 2.14): Prohibition Prohibition signs have a red circular outline and crossbar running from top left to bottom right on a white background (Figure 2.15a). Whilst the vehicle is still mounted on the system, the underbody must be pulled back into alignment first and then checked against the
manufacturer's data, especially the critical suspension and engine mounting positions. Pressed steel frames. Again, the SPI classification information and engine mounting positions. Pressed steel frames (Blackhawk Automotive
Ltd.) Pump the handle rapidly then close the release valve and replace the filler plug. For wet sanding, resins are used as the bonding agent. Gas welding in which the welding torch flame is directed towards the uncompleted
joint. 10 Describe a typical repair application in which a pick hammer would be used. 11.8 Safety precautions for the welder 1 Never look at a welding arc without a shield. Figure 17.43 Air valve assembly 17.11.4 Paint leakage from gun Paint leakage from the front of the spray gun is caused by the fluid needle not seating properly (Figure 17.42). The
four emergency services are: Police Fire Ambulance Coastguard. 5 Determine the difference between thermosetting paint coatings. Wet-or-dry paper is available in various grades and high numbers identify the finer grades. Figure 10.21 Single-sided
and double-sided spot welding equipment (Stanners Ltd.) Figure 10.24 Rapid spot puller (Stanners Ltd.) Figure 10.25). This is supported by the
ease of modifying the material thickness at specific locations and, taking advantage of the properties of the various types of reinforcement, by building in extra strength at any point and in any direction (Figure 16.24). In the operation of beating or hammering a metal on a steel block (such as planishing) an action takes place at each blow wherein the
metal is squeezed under the blow of the hammer and is forced outwards around the centrepoint of the blow. An ergonomic assessment should look at more than just the weight of the load. Then came the single hand-operated wiper, followed by the suction wiper and finally electrically driven wipers. This allows the repairer to utilize valuable workshop
space. Pulling heights can be adjusted by using various attachments to push or pull in all directions up to a height of 2.5 metres. Alternatively, the weld area may be melted but the combined effect of the arc force and the flow of the molten metal may prevent complete joint filling or produce a depression in the surface at the weld boundaries: this is
known as undercut (Figure 12.39b). Burnishing and polishing cloths also cause contamination of the atmosphere, and these processes should be carried out in a part of the workshop away from the spray booth. A spray gun is a precision instrument which uses compressed air to atomize the fluid paint and break it up into small particles. The fixing
bolts should be tightened if possible while the door is in its closed position. Some replacement mirrors are stick-on, others are snap-on. 24 State the reasons, other than weldability, why low-carbon steel is chosen in preference to aluminium as a vehicle body shell material. Air delivery The actual volume of compressed air delivered by the compressor
after making allowances for losses due to friction. To remove any distortion, warm the stretched or distorted area with a heat gun. Then hold the welding torch down to the component to be welded and an arc will be struck between the wire electrode and the workpiece, thus commencing the welding. Warning: when working with solvents and
primers, use PVC gloves or apply barrier cream to hands. 1865 The Locomotive Act of 1865 (the Red Flag Act) was pushed through by the railway and coach owners. The objects of a flux are: first, to remove oxide from the edges of the metal, giving a chemically clean surface on to which the bronze will flow, and to protect the heated edges from the
oxygen in the atmosphere; second, to float oxide and impurities introduced into the molten pool to the surface, where they can do no harm. 5.8.2 Edge folder As the name implies, this machine is used for turning the edges on sheets to make hooks for grooving seams or for wire insertion, or for making small flanges, but generally only in mild steel of
1.00 mm or less. The chemical composition and mechanical properties of these carbon steels, especially when alloyed with other elements such as nickel, chromium and tungsten, have been gradually standards Institution.
The area should be clearly signed and the customer should walk into a pleasant, clean and tidy reception office. The woven glass fibre cloths are generally of two kinds, made from continuous filaments or from staple fibres. In this case he may only require to wet flat the surface with P600 grade paper using a weak solution of water miscible 605
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cleaning solution to remove any wax polish. Further, when repairs are to be made to damaged Metal forming processes and machines areas it is often necessary to apply force in the direction opposite to that of the original damaging force; and the metal must possess a high degree of toughness to undergo such treatment. 7.7 Fastening devices Spring
steel fasteners directly contribute to an ever-increasing degree of automation, and have probably saved the motor industry millions of pounds by enabling massive economies of labour and time in assembly. 3 Ensure that equipment is used only for operations for which and under conditions for which it is suitable. 14.2.9 Universal Bench car body
repair systems Figure 14.28 Globaljig overhead measuring bridge (Globaljig, Tri-Sphere Ltd.) Universal Bench offer a wide range of mobile benches, a four-post jig lift, and a scissor bench. To stop welding, the welding torch is quickly withdrawn from the work and the current is automatically shut off. 8.4.3 Aluminium brazing There is a distinction
between the brazing of aluminium and the brazing of other metals. It is common practice to take two specimens from a test piece: one can be bent against the root. For ease of application make sure the materials and the vehicle to be treated are at room temperature (about 15 °C). Epoxy Based on an epoxy resin
which is mixed with a hardener. The use of plastics in the automotive industry continues to accelerate at a phenomenal rate as research into plastic technology results in new developments and applications. They are invaluable both in car construction work, where many of the panel assemblies are of the double-skinned type so that accessibility would
be impossible for conventional riveting methods, and also in body repair work as they eliminate any unnecessary stripping of interiors. The main purpose The history, development and construction of the car body 53 Figure 1.50 Complete body shell (Proton) Figure 1.51 Proton of the scheme is to ensure that these vehicles have been designed and
constructed to modern safety and environmental standards before they can be used on public roads. More precise flashpoint details can be obtained from the relevant product data sheet, which indicates products with a flashpoint range between 22 and 32 °C. 16.7.3 Pre-impregnated material (Pre-preg) Woven material is available pre-impregnated
with resin. The heat is generated by passing an electric current through the foil. Low-carbon steel bodies can be resistance spot welded or gas (TIG) welded; but higher-strength steels should not undergo the last two processes, because they involve nearly three times the heat of resistance spot welded, but higher-strength steels should not undergo the last two processes, because they involve nearly three times the heat of resistance spot welded, but higher-strength steels should not undergo the last two processes, because they involve nearly three times the heat of resistance spot welded, but higher-strength steels should not undergo the last two processes, because they involve nearly three times the heat of resistance spot welded, but higher-strength steels should not undergo the last two processes, because they involve nearly three times the heat of resistance spot welded, but higher-strength steels should not undergo the last two processes, because they involve nearly three times the heat of resistance spot welded, but higher-strength steels should not undergo the last two processes, because they involve nearly three times the heat of resistance spot well as the heat of th
can be carried out using a number of towers. Metals which can be welded with oxy-acetylene flame include iron, steel, cast iron, copper, brass, aluminium and bronze, and many alloys may be welded; it is possible also to join some dissimilar metals, e.g. steel and cast iron, brass and steel, copper and iron, brass and cast iron, copper, brass, aluminium and bronze, and many alloys may be welded; it is possible also to join some dissimilar metals, e.g. steel and cast iron, brass and steel, copper and iron, brass and cast iron, bra
coated steel In this case, one side of the sheet is coated with free zinc, and a thin layer of zinc-iron alloy is formed on the electrical potential introduced. From the electrical potential introduced in the coating can be varied according to the electrical potential introduced. From the electrical potential introduced in the coating can be varied according to the electrical potential introduced. From the electrical potential introduced in the coating can be varied according to the electrical potential introduced.
and control of the butt welding process is almost identical to flash welding, the basic difference is that it uses less current, has a constant pressure and allows more time for the weld to be completed. Therefore unwanted resin should be left in a safe place until it is fully cured; it can then be discarded without risk of fire. The coloured dye oozes out of
any crack in the weld into the white coating and can be seen in normal lighting conditions. In this way the work travels the distance between the electrodes required for each succeeding weld cycle. Failure to check the correction of the internal damage by alignment methods can result in incorrectly fitting doors, bonnets and boot lids. 2 It is needed to
protect health. These plugs melt at about 100 °C and relieve any excess pressure if the cylinder is subjected to undue heat or catches fire. It should also be able to carry the maximum welding current without overheating. A strengthened roof construction, together with an anti-roll bar, afford additional protection in case of overturning (Figure 1.10).
In the twin-pot system a twin-nozzle spray gun is used, and in order to prevent gelation in the gun the resin is divided into two parts, one of which is catalysed and the other accelerated. 4 The top coat is too brittle. Sockets are available with 6 pointed teeth and 12 pointed teeth. In addition to this, when drying does eventually take place the stopper
will contract and sink. The glass is held rigidly by the window regulator assembly, and when raised it slides in a channel in the operator's fingers from coming into contact with the blade or hold-down device. 35
Explain ABS as an active safety feature on a vehicle. Livesey) This Page is Intentionally Left Blank Glossary Abrasive A substance used for wearing away a surface by rubbing. Looking even further ahead, it could be that the car body will be formed entirely of a moulded plastic which could be self-coloured. An alternative method is shown in Figure
17.30. 2 Describe, with the aid of a line diagram, the principle of manual metal arc welding. Apply a structural support to the back of the repair using a Duramix reinforcement patch. The effort throughout has been to obtain and lower
operating costs. Earth terminal rivets are designed to provide an effective Figure 7.10 POP blind rivet: grooved type (Tucker Fasteners Ltd ) Peel rivets are specifically developed for fastening soft or friable materials. bulkhead or cowl assembly. A standard resistance welder has four principal elements: Frame The main body of the machine, which
differs in size and shape for robot, stationary and portable types (Figures 10.2, 10.3, 10.4). Many countries, including the USA but with the exception of the UK, legislate against toughened windscreens. Both stages are of prime importance, and many man hours can be saved if the job is processed correctly. These form an angle of 90°, and very
quickly find the centres of round objects. 1.1.3 Terms used to describe early vehicle body styles, built by coach builders from different countries. The complete repair system consists of a base frame and two main elements: a totally expected to describe various types of body styles, built by coach builders from different countries.
independent measuring system allowing complete flexibility of operation, and a pulling system using the Vector principle for precise directional pulling and pushing. Often coated rivets are used to reduce the risk of galvanic corrosion. Adjustment of the bonnet position is sometimes possible by moving the hinges. Be careful not to burn through the
metal by overheating. The essential points to look for when hammering are first, to hold the hammer correctly, gripping the shaft firmly but not tightly and towards the shank end in order to take full advantage of its length. The metal is next filed very carefully to obtain the final finish and checked from the drawing for its dimensional accuracy
Lighting is certainly an area worthy of meticulous attention by the bodyshop operator (Figure 15.5). The temperature of the metal to reach the required strength. Manganese, chromium, vanadium or nickel may also be added. A
new bodyshop located on an industrial estate usually presents few problems. 13.14.2 Pulling Pulling (Figure 13.54) is also a simple operation but uses a slightly different type of ram. In the course of the metal around the circumference will be continually subjected to creasing, and care and skill is needed to avoid allowing
these creases to become too sharp. 2 Repaint deteriorated black areas. Start hammering by using light blows; these will not do the job, but will show you whether or not you are hitting squarely over the dolly. 7.4.2 Blind riveting tools have been designed on the assumption that the operator will be moving around a
stationary structure, as in body building. Repeat this operation until all surfaces remain wetted after water spray is stopped. 310 Repair of Vehicle Bodies Table 12.1 Chemical and physical compatibility of welding shielding gases and materials Material Gas Compatibility Plain carbon steel and low alloy steel Argon, helium CO2, oxygen No reaction
Slight oxidation of alloying elements Porosity and HICC risk Porosity and HICC risk Porosity No reaction Porosity 
H2 O2 Aluminium and alloys Copper Figure 12.2 MIG welding equipment (Migatronic Welding Equipment Ltd ) Argon, helium N2 H2 Argon, helium N2 H2 Argon, helium N2 H2 Nickel Titanium 12.2 Gases used for shielded arc processes The shielding gases used in the MIG/MAG and TIG welding processes perform several important functions: 1 2 3
4 Protection from atmospheric contamination Arc support and stabilization Control of weld bead geometry Control of weld metal properties. 15.4.1 Light sources in bodyshops: Tungsten bulbs (general lighting service (GLS) lamps) These are still used for hand lamps and toilets, but are
steadily being replaced by low-energy compact fluorescent lamps. 17.6.2 Air lines The compressed air is drawn from the air receiver and led to the air transformer through a galvanized tube known as an air line. Furthermore, the easily manoeuvred suction hoods create extraction right at the source of the problem. Low CO2 levels may be used on
stainless steels but carbon pick-up may be a problem Good arc stability for dip and spray pulse Satisfactory fusion and poor weld profile Improved fusion characteristics for dip Low O2 mixtures suitable for spray and pulse, but surface oxidation and poor weld profile often occur with stainless steel No carbon pick-up Good fusion characteristics, high short
circuit frequency Not suitable for spray pulse transfer Improved performance in spray and pulse transfer. 15 Which safety glass, used for vehicle windscreens, shatters into small segments on impact? Chopped strands bonded into a mat to produce a popular economical general purpose reinforcement. flexible enough to permit
proper hand movement, yet not so thin as to allow any heat penetration. The door should then be closed as far as possible, and the points stopping the door from entering the door of a Mercedes McLaren SLR. If they are not worked out the
edge will crack or fracture as the shape proceeds. In general the Regulations will make explicit what is already somewhere in the law or is good practice. Another power saw is the rotary or circular saw (Figure 3.49). Two types of data sheet are supplied. The characteristics built into the welding power supply are such as to provide automatic self-edge will crack or fracture as the shape proceeds. In general the Regulations will make explicit what is already somewhere in the law or is good practice. Another power saw is the rotary or circular saw (Figure 3.49).
adjustment of arc conditions as the weld proceeds. The allowances are: snap head 1.5D; countersunk head 0.15D; flat head 0.5D. The dates and times of defrosting are recorded as is the amount of material taken off the roll. Cold Front heat barrier is odourless, non-toxic and harmless to skin. A considerable industry has been built around contact
moulding, which has facilitated the cost effective production of large one-piece mouldings, particularly for low production runs. 29 Explain the two different types of air hose couplings used with pneumatic tools. Check for correct gas flow by activating the switch on the torch handle. Stripping area This is where damaged vehicles are, prior to repair,
stripped of body panels, body trim, electrical and mechanical assemblies. • Ever rest anything on an SRS component. Some of these are the influence of the shielding gas on the arcing and metal transfer characteristics during welding, on the weld penetration, width of fusion and surface shape patterns, and on the speed of welding. This, of course,
would require a tremendous capital outlay which would be avoided by oiling or an occasional rub with metal polish. 5.9.4 Cone rolling machine Cone rolling machines are mostly used for rolling small conical-shaped fabricated articles
in light gauge metals. When the work is only slightly domed, the process of hollowing alone may be sufficient to complete the work. Several coatings can be applied wet-on-wet as it dries by catalyst action. The thermoplastic rubber-based materials have many of the properties of vulcanized rubber systems, yet can be applied as hot melts; they are
especially useful in trim applications as derived pressure-sensitive adhesives. Only when the paintwork is in very bad condition is it considered necessary to strip it all off and it is usually only essential to cut back to bare metal those parts where the coating is damaged or corrosion has set in. This ensures high fatigue life, with the flexibility necessary
to give consistent performance and dependability in service. Pressure The amount force per unit area Prototype An original model. Indirect glazed windscreen are laminated and toughened. 6 Provide employees with information they can understand about health
and safety matters. Draw the iron slowly along the face of the joint, allowing solder from the bit to flow into the joint, allowing solder from the bit to flow into the earth return clamp for
completing the circuit. It is possible to have a layout utilizing only one track, but movements are more restricted than with two tracks. They have a comparatively low pigment content as opposed to surfacers and fillers. 8 Make sure that employees have adequate health and safety training and are capable enough at their jobs to avoid risk. NB airfed
respirators are not required when mixing phosphoric area hardener Zinc chromate $5% MEL Butyl acetate 10-25% OES Plus blends of additional solvents Product substitution not possible. To counteract side impact
manufacturers are now fitting, in both front and rear doors, lateral side supports in the form of twin high-strength steel tubular beams, which are set 90 mm apart to reduce the risk of the vehicle riding over the beams during side collision. A wide range of equipment is available to suit all types of crash damage. This can be made by cutting a section
of a 13 mm laminate. Further tightening forces the locking elements to engage more fully with the bolt threads, and this increasing resistance to the entry of the bolt threads. During cupping, metal flows through an opening provided by a clearance between a
punch and a die which is in a cup shape. • Place an SRS component near electromagnetic radiation. 4 Always use barrier cream to protect the hands, especially against fuels, oils, greases, hydrocarbon solvents and solvent-based sealers. These factors can only be achieved
however, if a high-performance air compressor system is available. Plastic offers the same structural strength as steel in a body component because of its greater elasticity. The floor stands are individually adjustable to raise the vehicle to the most suitable working height for the repair. Some items of equipment have two-handed controls or deadman
grips - do not attempt to operate these items incorrectly. Major accident damage 457 5 Power assisted balance. With the hand unit connected, measurements appear immediately on the unit display. It is used in the
same manner as the standard bumping hammer. This expectation applies as much to smaller firms as it does to large. No waste oil, petrol, brake fuid or similar chemicals must be allowed to enter the drainage system. The ideal premises and equipment should be set out in separate purpose designed working areas. Table 5.4 Tempering colours for
plain carbon steel Colour Temperature (°C) Type of article Pale straw 220-230 Dark straw 240-245 Yellow-brown 250-255 Brown 260-265 Purple 270-280 Blue 290-300 Metal turning tools, chisels, press tools, small springs, punches
knives Springs, screwdrivers, hand saws Case hardening Although mild steels having a carbon content of less than 0.3 per cent cannot be hardened, the surface of the mild steel can be changed to a highcarbon steel. The slight ridge formed by the flats tends to act in a similar manner to a swage and has the effect of stiffening the area to be welded.
Further resin is sprayed on or brushed on, and mat or woven cloth, which has been carefully cut to patterns, is laid in position. The following advice can contribute to a company's fire protection programme: 1 What can cause fire in this location, and how can it be prevented? 27 Why is a vehicle road tested following major repair work? Fixed assets
are money in buildings and equipment. The gun distance should be kept as constant as possible, and arcing of the gun must be avoided to obtain an even coating thickness. 22 List the procedure sequence necessary to shut down a gas welding plant high-pressure system. Figure 15.3 Lighting used in the stripping and straightening areas (Fifth
Generation Technology Ltd ) higher illuminance and multidirectional to enable the most minor faults to be picked up. In general, work with pressures of 5-8 bars (75-120 psi). The thread sections of tubes and couplings are now under tension and it is the threads themselves that carry the load, so it is essential to ensure that they are kept clean, free
from dirt and damage and are securely mated. Checklist 1 Check exterior mirrors, all glass and surrounding seals. When the damage has been completely pulled out the area may be filled using body solder or plastic filler according to the position and extent of the damage. For cutting long sheets, extension arms are fastened to the front of the
machine. Solders and fluxes Silver solders are more malleable and ductile than brazing rods, and hence joints made with ordinary brazing alloys. The time of exposure is mainly dependent on the temperature of not less and vibration than those made with ordinary brazing alloys.
than 138 °C; and 10 minutes at a temperature of not less than 205 °C. The skill of the operator is an important factor. David and Sons Limited Welding & Metal Fabrication Welwyn Tool Co. Ltd Wheelforce V. 5154A B 0.50 0.50 1.10 0.50 3.1-3.9 0.25 - 0.20 0.10-0.50 Mn 

Cr 0.20 0.05 0.15 Rem. The blades must be fitted with the teeth pointing away
from the operator to the fromt of the frame, and the blade should be slightly tensioned in the frame. 324 Repair of Vehicle Bodies Figure 12.16 Metal transfer forms Gas shielded arc welding 12.10.2 Welding torch Air cooled torches are available for the various welding applications ranging from 180 A to 400 A. They take their name from the colour of
the finished print when the drawing is reproduced on ferroprussiate paper. To form a flange around the edge of a stake so that the width of the metal to be flanged lies on the stake. 4 Full cylinders should be stored against the edge of a stake so that the width of the metal to be flanged lies on the stake. 4 Full cylinders should be stored against the edge of a stake so that the width of the metal to be flanged lies on the stake.
segregated from each other. Where damage is incurred it is capable of repair by welding. Figure 13.35 Using a low-crowned dolly to push the raised points of the roughed-out section back without flattening the surrounding metal. Both clamps have an alligator type of action and are first tightened down on the centre bolt until the jaws are parallel and
in contact with the surface of the panel to be gripped. The cause of this defect is incorrect welding parameter selection (shielding gas or operating technique) (Figure 12.37). 5 How is a workshop test carried out on a spot weld, to test its strength? They comprise two heads fitted with scribers which slide along a bar. It is not an inert gas: when it
passes through the welding arc there is some breakdown into carbon monoxide and oxygen. The warp is the longest part, the part which is wound around the roller or folded. They are connected to the wiring loom with a 32-pin plug. Figure 17.4 Masking machine Masking paper Brown paper (kraft paper) is an ideal masking material, though
newspaper is very widely used for this purpose (Figure 17.5). Straight pein and finishing hammers These hammers (Figure 3.3c, d) are used in a similar manner to the pick and finishing hammer, but are designed with either a straight or a curved peined end which acts like a chisel, and a domed round end which is used for planishing. It is important
to release the tension on the file blade after use in order to reduce the risk of breakage if it is dropped or struck by accident. It can therefore be set in one of four mounting points. Any required point on the vehicle can be fixed in position by the use of these dolly combinations. To avoid repetition of this occurrence, the arc length must be increased
slightly to accommodate the insertion of the larger filler rod. This section is concerned primarily with high-alloy steels. Not all polymers are used for making plantished. Two types of machine are favoured by the refinishing painter, the rotary
sander and the orbital sander. In this case, the moderate strength of copper is increased 1 Indent, cut or scratch a metal of inferior hardness 2 Resist abrasive wear 3 Resist penetration. Metal forming processes and machines Figure 5.21 Brake press dies and applications 179 180 Repair of Vehicle Bodies 5.13 Forming and drawing During forming,
one area of a sheet metal blank is held stationary on a die while a punch forces the other area to assume a new contour or shape. The clamping action applies necessary pressure to hold the work to the bed or base of the machine, in order to prevent movement while the bending is in progress. Next make sure that the earth lead is securely fastened to
the work. The anchor pot chain is then placed in the slot of the wedge anchor base, driving the wedge into the anchor to take up any slack which remains in the chain. However when Kjellberg, a Swedish inventor, developed the flux electrode in 1907, the success of the metallic electrode was assured. This matching thread form will give the correct
name, size and pitch of the thread in question. 2.2.2 Methods of extinction Fire risks in the vehicle body repair shop cover all classes of fire: class A, i.e. paper, wood and cloth; class B, i.e. flammable gases such as acetylene, propane, butane; and also electrical risks. 25
Indicate the type of welding necessary when securing a new door skin to the door frame. Should the defect be discovered shortly after it has occurred, it can often be cured by slitting with a sharp knife or razor blade and overspraying with a sharp knife or razor blade and overspraying with a slow solvent, or by adding slow solvent to any subsequent coats. When the test piece is completed, it should be
torn apart. When depositing several layers of beads, be sure that each layer is fused into the previous one. 8 Cut patches of chopped strand mat to fit the area of repair. To this end the value of hand sketching cannot be too fully emphasized, as well as the making of simple models, for a much clearer impression of form can be obtained when movement
and touch are combined with sight. There are many different types of hacksaws, but in general they consist of a fixed or adjustable frame fitted with a renewable blade of hardened 104 Repair of Vehicle Bodies and tempered high-carbon or alloy steel. (a) (b) Figure 7.52 (a) Nyloc (b) Cleveloc nuts (Forest Fasteners) 7.6.12 Cleveloc self-locking nut and
flange nut The locking collar is an integral part of the Cleveloc nut (see Figure 7.52b), but in the flange nut the locking element is integral within the nut 218 Repair of Vehicle Bodies and has no collar. Latex foam today utilizes a mixture of natural and synthetic latexes to obtain the best qualities of both. Case hardening of mild steel can be divided
into three main processes: 1 Carburizing 2 Refining and toughening the core 3 Hardening and tempering the outer case. Advantages Low-bake refinishing, though costly to set up initially, undoubtedly increases the potential productivity of refinishing shops. The riveting sequence is similar to that of a POP rivet, but this type has the advantage that in
setting the rivet it is both compressed beyond its elastic limit and expands radially, thus ensuring a joint which is airtight and watertight up to 34 bar. Figure 12.25 Tack weld Like the clamp or self-tapping screw, the tack weld is always and only a temporary device. 3.3 Hand Dollies These are either cast or drop forged steel blocks, heat treated to
provide the correct degree of hardness. A typical air pressure at the air transformer may be 4 bar (60 psi), but this is reduced in the gun outlet in the gun body by means of an air restrictor which reduces the air velocity at the gun outlet in the gun outlet in the ratio of about 6:1. xxiv Glossary Bottom side The frame member of the base of the body extending along the full of the main
portion of the body. 27 What principle makes possible the cutting of metal by means of oxy-acetylene? There are, however, several problems in the form of visible flaws or other defects, the remedies of which will become apparent from the analysis of the causes. Flash off To allow the greater part of the more volatile solvents in a sprayed coat of
lacquer or enamel to evaporate before proceeding with the application of another coat or with stoving. It is very important to make sure that the tinned surface is heated to the melting point as the solder and the panel will be the result and the solder may
fall out. These pads themselves are available as hard, 599 Figure 17.46 Festo orbital sander (Minden Industrial Ltd.) Figure 17.47 Festo random orbital sander (Minden Industrial Ltd.) Figure 17.46 Festo orbital sander (Minden Industrial Ltd.) Figure 17.47 Festo random orbital sander (Minden Industrial Ltd.)
mm approximately. 38 What is meant by 'contact cutting' when using plasma arc? The surfacer can then be stoved for thirty minutes at 70-80 °C. With all the gauges in position, the simultaneous multipull hook-ups are made and the pulling process begins. However, currently solvent clear lacguer coats are still needed as the final finish needs to
material is lowered and the residual stresses are relieved by plastic deformation. If additional information is required, supplementary text may be used in conjunction with the relevant symbol. The transverse strength is provided by the cross members. The jet melts down and patially vaporizes the
base material, and the force of the jet blasts away the molten metal. A number of car manufacturers are already researching the possibility of a totally bonded car, especially those who want to use plastic or alloy bodies. The formation of the passive film, therefore, is a natural characteristic of this family of steels and requires no artificial aid. 10.6
Resistance butt welding In butt welding In butt welding (Figure 10.10) the metals to be welded are brought into contact under pressure, an electric current is passed through them, and the edges are softened and fused together. For the gun to operate efficiently, the fluid tip and fluid needle should be selected as a pair, and should be of the same size (Figure 17.24)
33 What is the purpose of a spring washer when used with a nut and bolt? The water pressure from a mains socket can do the same. Further heating does not usually cause any further fall (Figure 17.69). Never use goggles with cracked glasses. The skill of all body repair techniques lies in
bodies, glass fibre panels do not require a large investment in presses and dyes, and the moulds to produced from glass fibre. 13 Describe the three functions that most MIG/MAG welding equipment is capable of performing. When exposed to sunlight
some colours have a tendency to fade, whilst a certain amount of discoloration takes place in others; some whites, for instance, tend to yellow with time. This method is to make a pucker or tuck at any point on the edge of the blank by bending the metal on a stake into an ear-shaped form (Figure 13.6). The Grovit has grooves on its shank which bite
firmly into the material when Figure 7.17 The Chobert hollow rivet (Avdel Ltd.) 206 Repair of Vehicle Bodies Briv system is a high-speed, high-clench riveting system for use with a wide range of assembly materials. This high standard has constantly been maintained from those early years. 3 All guards should be kept in place. 8 What is the difference
between bronze welding and brazing? Black for CO2. 28 By using a sketch, illustrate a typical weld fault in MIG/MAG welding. In this method the entire body shell is completely immersed in a tank of priming paint (which is specially formulated for this purpose), is withdrawn, allowed to drain, and is then passed on to a stoving oven for baking. Nail
punch This is designed to drive nail heads below the surface of wood (Figure 6.4b). The fluid needle (Figure 17.24). By use of the correct lighting, any preparation faults will be found straight away and hence will not go through to the final finish, where they would be both difficult and time consuming to rectify. In
addition this can be further broken down to all internal panel structures according to the position of the damage. The types of heads available are counter-sunk, round head, raised countersunk, pan head, mushroom head and hexagon head. On completion of the weld, wash it thoroughly to remove the remaining flux as this could be harmful. The area
is then ground using a sander to remove all rust and paint present. The slow solvent is trapped beneath the skin and ruptures it when escaping. Figure 14.80 Welding in new panel sections while vehicle remains located on alignment and repair bench (Dataliner, Geotronics Ltd.) On completion of all repairs to structural and panel damage, the vehicle
can be removed from the alignment and repair system. This can be done either by hand or by machine with the aid of a wool mop polishing bonnet. Short-wave infrared units require no preheating, which makes for fairly high savings where energy costs are concerned. 3.23 Sanding machines Whether they are disc, belt, orbital, flat or finishing,
during building the jig brackets act as a welding jig to ensure that new parts are correctly installed and that the positions of important steering and suspension pick-up points are not disturbed by welding heat. 22 Give one practical application of the body jack when being used for each of the following operations: pushing, pulling and spreading. In
moulded felts and moulded glass wool the binder is only partially cured during the felt making process. This is done mainly when spraying local areas to achieve a feather edge. Gap should not normally exceed 3 mm and then only used when plate is to be welded from both sides. • Carry and store the airbag with the cover facing upwards. Both the
level and type of lighting can be crucial to the vehicle painter's colour matching ability. Although many spot welders are of the stationary design, there is an increased demand for the more manoeuverable, portable type. It should be borne in mind that most metals used in body work possess high malleability and may be overstretched even with a
wood tool. On 426 Repair of Vehicle Bodies Figure 14.34 A counter-support (blocking arm) in use (Dataliner, Geotronics Ltd.) Figure 14.36 Simultaneous multipulling (Pigure 14.39). Before welding, the surfaces must be
clean and free from scale, and this may be done by sand blasting, grinding or pickling. When the current is too great the electrode melts fast, causing a large pool of metal and excessive spatter. Blended plastics have been developed to overcome inherent specific disadvantages of individual plastics. If the body is a six-light saloon
there will be a quarter window here with its necessary surrounding framing, but in the case of a four-light saloon this portion will be more simply constructed. The parent metal is totally melted throughout its thickness, and in some cases molten filler metal of the correct composition is added by means of rods or consumable electrodes of convenient
size. Other body-glasses, because they can be made from sheet glass and also can be toughened safety glass, are usually between 3 mm and 4 mm thick. These flexible mountings allow the body to move slightly when the car is in motion. This is why a female mould is usually used. They allow quick measurement not only of the area which is being
worked on, but any other areas, for example adjacent bonded joints which must be kept cool. One hand must add the correct amount of filler rod. 436 Repair of Vehicle Bodies 14.2.15 Kroll Autorobot multifunctional system Kroll Autorobot of Finland have developed across the plate, while the other hand must add the correct amount of filler rod. 436 Repair of Vehicle Bodies 14.2.15 Kroll Autorobot multifunctional system Kroll Autorobot of Finland have developed across the plate, while the other hand must add the correct amount of filler rod. 436 Repair of Vehicle Bodies 14.2.15 Kroll Autorobot multifunctional system Kroll Autorobot of Finland have developed across the plate, while the other hand must add the correct amount of filler rod. 436 Repair of Vehicle Bodies 14.2.15 Kroll Autorobot multifunctional system Kroll Autorobot of Finland have developed across the plate, while the other hand must add the correct amount of filler rod. 436 Repair of Vehicle Bodies 14.2.15 Kroll Autorobot multifunctional system Kroll Autorobot multifunctional system Kroll Autorobot of Finland have developed across the plate of the correct amount of filler rod. 436 Repair of Vehicle Bodies 14.2.15 Kroll Autorobot multifunctional system Kroll Autorobot multifunction system Kroll Autorobot multifunction system 
multifunctional system for alignment, repair and straightening. 13.17.3 Contamination Repairers specializing in working with aluminium bodied vehicles, such as Audi (Figure 13.68), Jaguar (Figure 13.68) and Aston Martin use specialize the filler rod diameter increases with increasing thickness of plate,
there is a tendency for the end of the filler rod to foul the tungsten electrode. The straightening system works on a sliding tower base, allowing the most difficult of repairs to be carried out (Figure 14.57). The advantage of this system is that cars can be required singly, or several vehicles can be straightened at the same time using the rigid base (see
Figure 14.9). The first is the local electrode sinking into the steel surface. Accident books may be inspectors); they must be kept for a period of at least three years from the date of the last entry. To keep the fee to a level affordable by individuals the
examiner will in the case of certain items conduct an engineering assessment. One of the most widely used materials was silver leaf; gold leaf was not then available. A common practice to achieve extra rigidity is the integral moulding of ribs into
bronze forms into balls which tend to roll off, just as water would if placed on a greasy surface, then the base metal is not hot enough. Knowing how to use the tool is a mark of an experienced repair of Vehicle Bodies worker. 5 Explain the importance of protective clothing for a body repairer and a paint sprayer. Silver vehicles will blend
into mist and fog and become difficult to see. Safety points 1 Avoid skin contact with fluxes. 5 Use only a small amount of brazing rod; if too much is used this weakens the joint. Because of the efficient dust extraction the sandpaper does not become loaded, and so the Figure 3.62 Miniature belt sander (Desoutter Automotive Ltd.) It can be efficiently
operated in one hand owing to its small size and light weight, and thus may be used to complement conventional angle grinders or disc sanders. The process gives anti-rust protection, while the chemical reaction causes a molecular change in the steel which strengthens it. 17 Automotive finishing and refinishing 17.1 History of automotive finishing
No repair to a vehicle is complete until it has been painted to match the rest of the vehicle and is rendered undetectable. Trim the lower spacer blocks. Check value A safety device that controls the passage of gas or air in one direction, in order to prevent the reversal of gas flow and a consequent accident. Normalizing Heating to a high temperature
to produce a refinement of the grain structure of a metal or alloy. Where sheet metal damage is widespread, several hook-ups may be required to bring the damage out gradually to prevent tearing and further damage. In addition to these basic components there can also be various refinements in the way of safety devices and operating switches. The
type of paint used is usually of a synthetic resin nature. This fastener has the ability to join firmly, but without cracking or pulling the bolt right through the composite. Always wear them when handling materials of a hazardous or toxic nature. In body repair work welding techniques are used for frame straightening, reinforcing frame members, and
welding in new or patching old panel assemblies. In annealing, a metal or alloy is heated to a temperature at which recrystallization occurs, and then allowed to cool at a predetermined rate. 10 Describe the sequence of repair to a damaged glass fibre composite body panel. If filling and stopping is not considered necessary and the paint is sound, it
can be wet flatted with P600 grade paper and a solution of liquid detergent. In many cases if the original sections are carefully cut out and not too distorted, they can be used as an excellent guide to the menufacture of the metal. Of the other materials,
1200 is a commercial purity sheet, and is widely used for exterior and interior panelling where no great strength is required. Figure 1.48 Exterior trim (Rover Group Ltd ) 73 74 75 76 Lower front spoiler Front bumper insert 77 81 82 83 Front grille Door mirror assembly Scuttle grille Scuttle moulding 84 85 86 87 Lower
screen moulding 88 Rear door waist moulding Rear bumper insert 89 Front door waist moulding Rear bumper 90 Front wing waist moulding Rear bumper insert 89 Front door waist moulding Rear bumper insert 89 Front door waist moulding Rear bumper insert 89 Front door waist moulding Rear bumper insert 89 Front wing waist moulding Rear bumper insert 89 Front door waist moulding Rear bumper insert 89 Front door waist moulding Rear bumper insert 89 Front wing waist moulding Rear bumper insert 89 Front wing waist moulding Rear bumper insert 89 Front door waist moulding Rear bumper insert 89 Front door waist moulding Rear bumper insert 89 Front wing waist moulding Rear bumper insert 89 Front door waist moulding Rear bumper insert 80 Front wing waist wi
consisting of a foam sheet between two or more glass fibre layers (Figure 14.64 Digital measuring tool being used during repair to check vehicle suspension points (Stanners Ltd ) The manufacturers are continuing their research to develop appropriate body repair equipment as car design and methods of assembly are influenced by
technological progress. The content gauge on the oxygen regulator is calibrated up to 300 bar, whereas the working pressure gauge is calibrated from 0 to 6 bar (Figure 6.12 is imperial but this tool is now mostly made in metric sizes. It is possible to
extend the mandrel length to accommodate a charge of up to 100 rivets and to achieve a rate of placing up to 2000 per hour. 17.14.5 Acrylic lacquer can be force dried without damage to the paint film, with a consequent speeding up of the
process. The POP grooved rivets gain their name from the series of grooves around the shank which engage into the workpiece on setting and set inside the material rather than against the rear face. Accommodation has to be made for the instrumentation of the car, the wiring, radio, windscreen wipers and driving cable, demisters and ducting
steering column support, handbrake support and pedals. The mandrel is designed to fracture at a predetermined point during the setting operation, when the materials to be fastened have been drawn closely together and the joint is tight. Coupé with the driving position completely covered by an extension of the rear roof. 11.5.2
Horizontal position Occasionally the welding operation must be done while the work is in a horizontal position, which means that the welder must use a slightly shorter arc than for flat position welding can also be carried out by simple mechanical means, but the general principle is always that of bringing the materials into contact
with the mould, without the use of any dies. Beck iron stake has a square tapering flat head on one side and a round tapered head on the surface finish of the mould from which it is made. In an effort to improve refinishing techniques, to reduce drying times
and to obtain faster production, low-bake enamels (i.e. paints that cure at lower temperatures than the original high-bake finish) were developed. Temporary sheet metal fastener system is a set of pins, installed with special pliers, which quickly and easily clamps panels together before final welding, bonding or
riveting (Figure 3.22). 7 Once the damaged section has been reshaped, either by hand or hydraulic means, planish it using a combination of direct and indirect hammering and filing. These liquids should be used according to the manufacturer's instructions, but are generally diluted in the ratio 1:1 with water, applied with an old paintbrush and
washed off with water after about fifteen minutes. Most cleaning agents are poisonous and cause irritation or more serious complaints if allowed to come into contact with your eyes or skin. Cyanoacrylates Rubber seals and weather strips. Extenders are cheaper than pigment, but when used in the correct proportions they carry out many useful to come into contact with your eyes or skin.
functions such as improvement of adhesion and ease of sanding. Accessories Optional extras not essential to the running of a vehicle, e.g. radio, heater. The main difference is in the type of jaws or electrodes which hold the object to be welded. First a company safety policy must be established and a safety committee formed. 17 State the main
disadvantage of a combined spray booth and low-bake oven unit. Bolts used in bodywork are normally of the 6082 alloy. Cutting can be started from the edge of the panel, or from any point on the panel surface using a predrilled hole large enough to insert the central cutting blade. 1.3 Methods of construction The steel body can be divided into two
main types: those which are mounted on a separate chassis frame, and those in which the underframe or floor forms an integral part of the body. They also reduce the risk of crazing when applying acrylic lacquer-type finish over cellulose-based undercoats. Flexible polyurethane foam seats are replacing heavy and complicated padded metal spring
structures. Subframe Members to which the engine and front-end assembly are attached. Materials not normally considered combustible may be ignited by sparks in oxygen-rich atmospheres. Robinson and Andrew Livesey. It is the British Standards Institution's (BSI) assurance of quality and can be applied to all industries. Those which require a
undertray and bulkheads (Lotus Engineering) head and incorporates the rear suspension pick-up points, while the front longeron/underframe assembly bolts on to the front of the backbone frame. The assurance of quality is needed to eliminate failures and complaints and their associated costs as far as possible. It can also be converted into a hoist by
using the scissor-action lift. The mock-ups give way to the first genuine road going vehicle, produced with the aid of accurate drawings and without complex tooling and machinery. 2 Review the existing arrangements for quality management, and identify a company quality development plan with a controlled implementation schedule with target
dates for the completion of essential stages. This is used to maintain a power supply to the clock and the security system, when the wheels are tensioned by applying pressure through the bottom wheel against the panel which is pressed on to the
top wheel. All three techniques have one common feature: when planishing the metal surface is slightly stretched because of the metal-to-metal contact between the working faces of the metal surface is slightly stretched because of the metal-to-metal contact between the working faces of the metal surface is slightly stretched because of the metal-to-metal contact between the working faces of the metal-to-metal surface is slightly stretched because is sl
the other hand excessively long chisels cannot be guided so well and consequently may vibrate and break easily. Hand rivet sets are made in various sizes ranging from 81 in to 43 in (3.1-19 mm). This part of the operation is carried out by the spray painter, who must have a knowledge of the type of materials used in the repair shop in order to help
him select the best process for refinishing the vehicle concerned. 5 It is safest to protect the repair area completely around the heat zone. The advantages of MIG/MAG welding in any position, and it Figure 12.31 CEBORA synergic pulse (Mig Tig Arc) Most equipment used
in motor body repair usually has the following controls and functions: a weld timer which can be set from 0.2 to (usually) 2.5 seconds; some form of wire speed control which ranges from 2 to 12 m/min; and a voltage control usually ranging Gas shielded arc welding from 0 to 10, the 0 setting giving the lowest welding current. With the introduction of
high-strength steels (HSLA steels), car manufacturers are producing body panels as thin as 0.55 mm, and structural members with gauges of between 1.2 and 2 mm. Impurities in iron or steel impair the cold working properties to the extent that most steels cannot be worked cold (apart from very special low-carbon mild steel sheets used in the car
industry), although nearly all steels may be worked at the red-heat condition. Some metal shapes cannot be produced at all by mechanical methods and others only with great difficulty, and in such cases panel beating is used to finish the shape that has been roughed out by power processes. 15 Explain the term 'robotic welding'. The overlapping parts
must be in the sample plane. Fills large gaps. Using this method there is always the danger of ending up with a mismatch when the masking is removed. Several reds, particularly those containing organic pigments, are prone to this behaviour. With crayons the correct one must be chosen for the job, the accuracy is limited to pre-determined
importance. Since then, particularly in the post-war years, there have been remarkable developments, probably accelerated by criticisms from overseas markets that British cars were susceptible to dust and wheel trims if fitted. In
this case only a hammer is used, and it is not supported with a dolly block. Without the chemical action of the flux on the metal the solder would not tin the surface, and the joint would be weak and unreliable. When welding, use a narrow weaving motion which will still further reduce the tendency of the molten weld pool to sag. Turret American term
cleaner (intercooler) Data link connector Diagnostic test module Engine control gonition Engine control gonition Engine control gonition Engine control gonition Engine control module Engine control module Engine control gonition Engine control go
Malfunction indicator lamp Manifold absolute pressure sensor On-board diagnostic system Open loop Park/neutral position switch/sensor Scan tool Service reminder indicator Throttle body Transmission control module AP ACL A/C CAC Turbocharger Vehicle speed sensor DLC DTM DTC DI EI ECM (Engine ECU) ECT Sensor RPM
bonds which may have been affected. Bumping Reshaping metal with a hammer and dolly. This has manifested itself in all areas of the car, including the boot, seating, carpets, door trims and headliner cover fabrics. As the construction of the modern vehicle advances, body panel assemblies are becoming very complicated and therefore their cost is
constantly increasing. These extinguishers are available with 6 litre or 9 litre capacity bodies and thus provide alternatives of weight and accessibility. Much research on this matter has led to the development of plastic fillers which would come up to the standard of body solder. The gauge illustrated in Figure 6.13 is imperial, but screw threads in
polythene and plasticized polyvinyl chloride (PVC) are soft, tough thermoplastic materials; and so on. The process employs soft solders, which are composed mainly of lead and tin. The lighter machines have a maximum cutting radius of about 15 mm and the heavier machines one of about 50 mm. Acetylene is a colourless gas with a very distinctive
nauseating odour. Pure aluminium should be welded with a pure aluminium electrode. After each tack the assembly should be cooled for two reasons; first, because the former or jig is usually made from wood, and second, the smaller the heat input the greater will be the accuracy of the alignment of the job. Autoglym recommend the following step-
by-step procedure for cleaning and valeting. Rapid puller This is designed for pulling out small dints quickly and effectively by welding the puller to the panel (Figure 10.24). Again as in the hollowing process, the final finish can be obtained by planishing the preshaped article to a
smooth surface finish. The coach joint is one of the features that distinguish a cheap, mass produced body from an expensive hand built one. The visible examination of door against the seals, are important parts of identifying
an area where water can pass through. 30 What type of adhesive will resist heat, water and acid, and is used to join metal? Such a form should be completed for each discrete task in the Animal allergens Hepatitis Brooklandsgreen Motor Company BODYSHOP RISK ASSESSMENT Support Team: ACTIVITY SAFETY MANAGER: HAZARDS RISK
finish. To encourage manufacturers to fit head protection devices, an optional pole or head protection test may be performed, where such safety features are fitted to the vehicle. Electric resistance welding 285 The quality of a spot weld depends on: 1 The strength of the weld must be equal to the parent metal. Consequently more cars now need
velocity of the extract duct must achieve a maximum of 9 m/s where a wet method is used. Using the gun at an abnormally high temperature does not assist the welding operation, and can cause dangerous fumes. The actual operation of the machine is the same as the clamp folder. When the end of the solder stick begins to melt, press it against the
tinned section, thus causing a quantity of body solder to adhere to the tinned surface of the work. Figure 13.65 Fastening ring washers to the damaged area ready to pull (Stanners Ltd.) Headlinings are of two types. The method of overcoming this trouble is to wheel directly adjacent to the stretched edge. Spray gun distance from job is
 best about 200 mm. A good socket set has a variety of accessories such as: (a) (b) Ratchet Ratchet attachment Extension bars Speed brace Long-hinged handle with universal joint Flexible extension Coupler. Too little current produces only a light tack which gives insufficient penetration. During the early
1940s an entirely new group of resins was introduced; these were known as contact resins as they could be used without pressure. In non-destructive testing, the test samples are not destroyed in the process. Computer-aided engineering (CAE) All computersided activities with respect to technical data processing, from idea to preparation for
production, integrated in an optimum way. The motor driven type of generator set is chiefly used for the type of welding work performed inside a workshop and is therefore often permanently mounted on the floor, but types are available for site work. Figure 3.9 (a) Spring hammering spoon (b) heavy-duty pry spoon (c) pry and surfacing spoon (d)
long-reach dolly spoon (e) thin spoon (Sykes-Pickavant Ltd ) Long-reach dolly spoon (Figure 3.9d) is a special long-handled body spoon designed to be used in restricted spaces between double-skinned panels such as doors and quarter panels. Employer's duties To provide and maintain: 1 2 3 4 5 Safe equipment. At the rear end of the bonnet the body
is recessed to form the scuttle panel into which the bonnet fits to give a continuous flowing line. Carbon fibre is used either in the form of a continuous thread which is wound around the component or as a woven matting similar to glass reinforcement. Characteristics: no smell but can cause the nose to sting. However, when no information or coding
is available, identification can be carried out in two ways. The parent metals can be similar or dissimilar as long as the alloy rod has a lower melting point than either of them. We can expect to see bonnets, boot lids and front wings in plastics. Blind rivet nut is a threaded insert system, and is a remarkably simple fastening system for use in all kinds of
assemblies. 4.1.3 Cold rolling In the cold rolling In the cold rolling process the coil is rolled either in a single-stand reversing mill (narrow mills using either narrow hot mill product) or in a multiple-stand tendem mill to the required thickness. In a typical two-stage piston-type compressor, the free air delivered will only be 70 to 75 per cent
volumetric efficiency. Bursting disc A type of pressure relief device which is so held that it confines the electrode from which is so held that it confines the pressure of the same metal as the parent metal which is being welded; metal from the electrode
is transferred to the weld, partly as drops under the influence of gravity and partly as high-velocity particles. Rust is a corrosion, known chemically as iron oxide, which occurs on the surface of iron and most of its alloys when they are exposed to air and moisture. The same process occurs with the other hub, which also determines another angle. This
method is also most useful in reducing welds: the weld on the face of the panel is depressed into the channel of the dolly to form a valley below the line of the panel, and the valley is then filled by the body soldering method. Toughened epoxy Aluminium floor sections bonded to wood; inner and outer door skins bonded together. These
points are joined diagonally by using a chalked length of cord which is held tight and the process creates excessive dust in the workshop. The part of the strip being held in
the hand remains completely cold (Figure 14.102). The shape is gained by roughing out with the mallet and dolly block, after which the finish is attained with the planishing or pick hammer in conjunction with the finish is attained with the planishing or pick hammer in conjunction with the finish is attained with the planishing or pick hammer in conjunction with the finish is attained with t
to the Directives and Regulations. The design of the cutting edge allows spot welds to be drilled out of panel assemblies without creating any panel distortion. 15.7.5 What help do consultants offer? Health and safety All are called by dialling 999 on an outside-line telephone. However, it is not always necessary to repaint the whole car or van. Both
pigments and fillers can increase the cure time of the resin by dilution effect, and the adjusted catalyst and promoter are added to compensate. Start with headlining and use interior cleaner. It has an adjustable head feature for flexibility of operation. When the template is fully marked out the profile is centre punched very carefully on the scribed
lines at close intervals, and then cut, either by machine or by hand using tin snips, to the centre-punched marks. 3 Advise persons between 100 and 300 metres from the cylinder to take cover. This in effect thickens the material and gives greater 212 Repair of Vehicle Bodies Figure 7.33 Avtainer and placing sequence (Avdel Ltd.) 1 Drilled hole 2
Avtainer in position 3 Shell placed over pin tail 4 Tool applied: fastener completed. When it incorporates a cutoff valve, this will automatically shut the gas flow. Thin the enamel 2:3 to a viscosity of 16 to 19 seconds at 25 °C. Most companies work on the basis of sweeping down fixed machinery and floors at the end of each day, unless the generation of
dirt requires more frequent attention. The passenger's airbag system has a compartment door, located in front of the passenger in the dash area, which must open within 10 milliseconds and deploy the airbag within 30 milliseconds. A centre 'pop' should be made as deeply as possible where a hole is to be drilled. 7.7.2 Captive nut, U type This nut
(Figure 7.55) is widely used for fastening blind assemblies in the motor industry. Electrical connections also may become broken. In some cases the windscreen frame is integral with the cowl panel. Intermittent current is usually necessary for most seam welding operations. Respray wheels and clean tyres. The material, however, was lacking in solid
content, and consequently several coats had to be applied to achieve a coating of worthwhile thickness. 13.16.9 Minor repair of body panels using adhesive specially formulated for car repair applications and called Autobond. Chisel joint angles vary between
about 30° and 60°, the sharper angles being used for cutting softer metals. 12 Why is it important not to look at an electric arc without proper eye protection? These regulations are aimed at giving both the occupants of the vehicle protection? These regulations are aimed at giving both the occupants of the vehicle protection? These regulations are aimed at giving both the occupants of the vehicle protection?
they come into contact with a car. 3 The welding pressure must prevent parent metal separation so as not to cause panel distortion and stresses in the assembly. The electrolytic product is used for exposed body panels, where a full-finish surface quality is available to ensure that a showroom paint finish is achieved. A small quantity of burnishing
compound is applied to the cloth and rubbing can commence, working in straight lines over a small area. Usually the majority of general welding requires direct current with negative polarity, as the heat distribution and current loading are used to the best advantage and the tungsten arc electrode can carry at least four times as much current,
without overheating the electrode, as an equivalent positive arc. 11 What is a load-bearing stressed panel assembly? It is ideally suited for cold pressings of thin steel sheet and is used for mass production and are invaluable in the body
building industry where speed and economy are essential (Figure 7.19). Tack the weld at frequent intervals using a neutral or slightly carburizing flame. Some alignment systems incorporate upper body alignment measuring equipment (see Figures 14.74-14.77). Oxidizing flame A further increase in the oxygen supply will produce an oxidizing flame
in which there is more oxygen than is required for complete combustion. There is also a similar set called the Euler equations. Where metal inserts are to be incorporated in the moulding, allowance should be made in the design of the joint for the greatly differing yields of the two materials under similar loading. 2 Ensure that the machine is
connected to the correct voltage supply, that the correct fuse is used and that the equipment is earthed. The safety colour green indicates 'access' or 'permission'. As the bonnet of the car is the Figure 17.39 Spraying a vehicle wing (DeVilbiss Automotive Refinishing Products) panel which attracts most attention by the customer, most spray painters
prefer to spray this last to avoid the risk of overspray falling on it. On completion of the first course of blows, a second course is begun further in from the edge of the metal, phosphating solutions deposit a layer of iron or
zinc phosphates on to the metal which inhibits corrosion. Every inch of space is considered in the attempt to provide the maximum interior capacity for the design. It is very important, while roughing out damage, that fullshaped or very curved dollies and heavy ball pein hammers are not used, as they cause excessive stretching of the already
electrode polarity Alternating current: minimum open-circuit voltage (V) 0 1 2 3 4 5 6 7 8 9 See manufacturer \leq or \geq \geq \geq \leq or \geq \geq \leq or \geq \geq \leq or \geq \geq \leq or \geq \geq \geq \leq or \geq \geq \geq < or \geq \geq < or \geq \geq < or 
on electrodes of 1.6 mm and 2 mm diameter where it is not practicable. The tools used, where possible, have non-ferrous working faces. This allows great variety in formulation. It is always a good idea to accompany customers when they are in the workshop, this way you can advise them in the event that they may do something potentially dangerous
or if there is a hazard of which they may not be readily aware. The basic crash test is a frontal crash at 30 mile/h (48 km/h) into a fixed barrier set perpendicularly The history, development and construction of the car body 25 Figure 1.19 Wind tunnel testing of a
prototype: side view (Ford Motor Company Ltd ) to the car's longitudinal axis. However, measurement is the basis of engineering, and an understanding of the more common precision instruments is essential if he is to realize that greater accuracy is possible than that which is achieved by the rule and scriber. 430 Repair of Vehicle Bodies The Draw
aligner is used with a 10 tonne hydraulic ram operated by a pneumatic foot pump, and can be placed at any position along the four sides of the base frame, being locked on to the base frame by the locking wedge. Before beginning actual pulling, establish exactly the nature and type of damage sustained. The filled area is then sanded and filed down to
an acceptable finish for painting. Carbon dioxide A heavy colourless and incombustible gas which results from the perfect combustion of carbon. It has never been more necessary to encourage young people into the industry, to equip them with the necessary technical skills and tools plus an ability to work quickly, confidently and efficiently to
maximize profit whilst safeguarding their own and their colleagues' health and safety. Water quenching produces an extremely hard steel but is liable to cause cracks and distortion. It has to be sufficiently strong at the point where the boot lid hinges are fitted to carry the weight of the boot lid when this is opened. He had built an experimental
phaeton in 1895. 4 Name two types of flux used in soft soldering, and state a typical application for each. Supplies of 415 volts must be used through a professionally installed system. Lower costs of plastics parts must, of course, be the major contributing factor in the replacement of existing parts, and this is closely followed by the ease with which
modern plastics can be formed by comparatively inexpensive tooling. This hammer is also obtainable in flat or crowned faces. Figure 9.16 Regulation of welding flame Carbonizing, carburizing or reducing flame For this flame the gases are adjusted so that all the acetylene gas is not completely burned and there is an excess of acetylene or an
insufficiency of 258 Repair of Vehicle Bodies oxygen. The clamps will securely hold together body panels and sections where no other clamp will reach because them etal to fail or yield under compression. 4 Sketch and name the
type of joint that would be used in solid riveting. Where MIG/MAG welding has been introduced into automotive production lines, its value as a production process is well established. Chemical properties are also good, the acrylics being inert to most common chemicals. The second sensor, called the safing sensor, will trigger at about a tenth of the
crash sensor's deceleration, that is at about 1.5 g. Instead these machines use a massive burst of power at 8000 A DC in a very short interval, which keeps the temperature of the spot welding except that the base metal is not melted. Do
not continue to wear overalls which have become badly soiled or which have acid, oil, grease, fuel or toxic solvents spilt over them. 4 Identify the grades of hardness in aluminium sheet and state how the hardness is achieved. 10.7 Resistance welding in body repair work The object of car body repair is to put damaged vehicles back into a pre-accident
condition. Therefore if the pitch is less than 3D (Figure 7.3) the plate between the rivets will be too weak. Perhaps the most revolutionary changes were intro- Figure 17.1 Electrodeposition of priming coat 575 duced in the application. However, they present problems not experienced when
applying straight colours, which are caused by the metallic particle content. 3 The Pro-Vac injector is capable of creating a total vacuum within the damaged area, which are caused by the metallic particle content. 3 The Pro-Vac injector is capable of creating a total vacuum within the damaged area, which is essential for top quality repairs. Sill panels and underbody sections It is most important to achieve thorough coverage of the sills. Advanced structures are made by incorporating
premoulded rigid foam and metallic inserts in the fibre reinforced resin during the injection moulding process, ensuring flexibility that in turn allows reinforcement properties to be accurately tailored to a specific design requirement. Metal working chisels should have sufficient length to allow the shank to be gripped properly, as short chisels are
difficult to handle and may lead to accidents through hammer blows if the head projects insufficiently beyond the gripping hand. This heat barrier material, based on a chemical formula of magnesium aluminium silicate, prevents the conduction of heat through metal, thus eliminating the risk of distortion to panels, or damage to areas immediately
adjacent to any welding operation. Consider whether the load must be moved at all and, if it must, whether it can be moved mechanically. 1 2 3 4 5 6 7 8 9 10 11 12 Suitability for the type of repair work normally handled. Hydraulics The use of pressurized liquid to transfer force. An automatic totally enclosed machine for cleaning spray guns and
equipment must be provided. The inner panel has holes or apertures for the attachment of door trim. After the stoving of the vehicle, it then switches off automatically and moves back to the rear of the booth (see Figure 17.62). In any event, even with the lid being replaced every time the filler is used, there is exposure to air, and therefore a tendency
for the filler to lose its styrene content and thus to become stiffer and less spreadable. It is never advisable to weld with a worn-out contact nozzle and deformed gas nozzle. However, a car is subjected to a great deal of stress throughout its life; it is scratched, scraped and banged, and panels may flex, seams move and joints vibrate. Bleed-inhibiting
sealers contain carbon black pigment which is able to absorb floating colour. The fundamental principle upon which all resistance to flow of electric current through two or more pieces of metal held together under pressure by electrodes which are
made from copper or copper alloys. This requires heavy power presses employing mating die sets which in effect press the sheet metal and deform the structure of the metal to a degree where it takes on a natural shape and retains that shape. Adhesion The ability to adhere to a surface. Look out for double sill sections, which must both be treated. It
is therefore important to conduct as much market research as possible before finalizing your plans. Table P1 shows the qualification framework for Vehicle and Body Paint Operations Units from Automotive Skills Limited. Abrasion Metals are best abraded by grit blasting. 7 Name the four types of respirator used in a bodyshop. Does not burn. Owing
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to the wide range available of repair and alignment systems, it is increasingly difficult to select any one system, as they each have many differing advantages. 21 Use a simple sketch to show how the drop-line method of alignment is carried out. Apply cellulose stopper. In other cases, where the repair is larger, it will be found that several blows are
necessary. If, however, the glass does fracture in use, it disintegrates into a large number of small and harmless pieces with blunted edges. On new cars look out for panels with large swage lines, remember that the pressing process triggers the hardening of the metal and so makes the panel stiff both in shape and in microstructure. Low-bake
finishing can be carried out over both stoving and nitrocellulose finishes providing they are in a sound condition. An emery cloth could be used for this purpose, but generally a file is preferred. (g) For a smooth finish, go over the area with an abrasive disc in the usual way 390 Repair of Vehicle Bodies way, including seatbelts, seats, centre console,
and door sill scuff plates. 13 Explain the following terms in relation to plastic: (a) monomer (b) polymer (c) copolymer. This gives immense strength and robustness against stone impact. Ventilation. Door trim places are normally assembled in one-piece or two-piece trim pads. 27 Describe the differences between the processes of TIG
welding and MIG/MAG welding. They also require less maintenance than a comparable electric tool. 16 Explain the difference between the hot shrinking and cold shrinking techniques. Toughening reinforces the best features of these adhesives with the unique shock absorption and strength of the rub- ber matrix. This check will be in the form of
either visual inspection or a simple test on the vehicle to ensure that it complies with the regulations. Manual metal arc welding 303 Figure 11.10 Tapping method of striking the arc 3-5 mm, this distance being equal to the core diameter of the electronic
components that operates when the vehicle is not running. The oxygen and acetylene pressure regulators perform two functions (see Figures 9.8 and 9.9): they reduce the cylinder pressures. Fit retaining clips as necessary. There are a number of
modern cars where the rear track varies substantially from the front to the back and there are several which have up to 25 mm variation in track; these points are taken into consideration when checking for distortion. It allows accurate close-up working in restricted areas and on awkward shapes, e.g. sill panels. These metals are used for their ease of
cutting. For the high-pressure system (Figure 9.2) the dissolved acetylene (DA) is supplied in cylinders at a pressure of 17.7 bar maximum at 15 °C. Overhead welding is the most difficult. This makes such heating extremely unsuitable for bodyshops, where doors are constantly being opened to allow vehicles to be moved in and out. The Avdelok bolt is
placed through the prepared hole and the collar is slipped on to the joint (Figure 7.27). The VCA also has offices in Europe, North America and the far East. Figure 9.29 Plasma cutting unit: single phase, 30 amperes (SIP (Industrial Products) Ltd) There are two types of electrode available for the plasma cutting torches. 7.8.4
Adhesives and the automotive industry Non-structural adhesives The primary function of non-structural adhesives is to attach one material to another without carrying functional loads on the components. When welding light-gauge metal, most operators prefer to grasp the handle of the welding torch with the hose over the outside of the wrist, which
is the way in which a pencil is usually held. Gelcoat A thixotropic resin normally used without reinforcement and applied first to the mould. The combination of methods always necessary in repairs is as follows: heavy external pulling, use of body jack, use of heat (only on low-carbon steels and not on highstrength steels), use of power tools and cutting
out buckled sections or reinforcing members. The mould is then closed and clamped, and catalysed resin is pumped in under pressure until the mould is filled. All-metal construction is in the form of steel pressings assembled by
welding, thus forming a fabricated unit. The hose is connected to the ram by a simple quickrelease coupler which needs to be only finger tight. Also important is a basic understanding of work study, which should help to ensure the smooth running of the workshop. Any flanges, wired edges or safe edges can then be formed either by using hand tools
or flanging jigs or a combination of hand tools and swaging machine. 10 Electric resistance welding is a joining process belonging to the pressure welding sector. When welding is a joining process belonging to the pressure welding in car body manufacture Resistance welding is a joining process belonging to the pressure welding in car body manufacture Resistance welding is a joining process belonging to the pressure welding in car body manufacture Resistance welding is a joining process belonging to the pressure welding in car body manufacture Resistance well and the resistance well as a second resistance well as a second resistance well as a secon
damage occurring to the wire itself. Filler or electrode of other than parent metal composition is recommended. 16.9.5 Repairs to a blind panel Figure 16.42 Finishing the laminate repair 2 The damage will generally extend for some distance around the scratch, and this must be removed. Initially he makes freehand sketches of all the fundamental
components placed in their correct positions. It can be used in materials with thicknesses varying between 0.25 and 7.5 mm. One of the stipulations was 10 Repair of Vehicle Bodies 1885 1886 1890 1892 1895 1896 1897 1899 1900 1901 1902 1903 1904 that at least three people must be employed to conduct the locomotive through the streets, one offers the stipulations was 10 Repair of Vehicle Bodies 1895 1896 1897 1899 1900 1901 1902 1903 1904 that at least three people must be employed to conduct the locomotive through the streets, one offers the stipulations was 10 Repair of Vehicle Bodies 1895 1896 1897 1899 1900 1901 1902 1903 1904 that at least three people must be employed to conduct the locomotive through the streets, one offers the stipulation was 10 Repair of Vehicle Bodies 1895 1896 1897 1899 1900 1901 1902 1903 1904 that at least three people must be employed to conduct the locomotive through the streets, one offers the stipulation was 10 Repair of Vehicle Bodies 1895 1896 1897 1899 1900 1901 1902 1903 1904 that at least three people must be employed to conduct the locomotive through the streets, one of the stipulation was 10 Repair of Vehicle Bodies 1895 1896 1897 1899 1900 1901 1902 1903 1904 that at least three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed to conduct the locomotive three people must be employed 
whom had to walk 60 yards in front carrying a red flag. Figure 7.24 Automatic riveting system (Tucker Fasteners Ltd ) 7.5 Structural fasteners used on a vehicle body. Polishing machines are best used with liquid polishes and should be used with a sweeping movement. A tool for removing damaged
panels is the power chisel set, which comprises a compressed air gun having interchangeable chisel heads. Another popular material is polyurethane foam sheet, which can be cut and shaped to any required form (Figure 16.14). The subframes and cross members can now be examined for kinks or buckles with the aid of a portable light, but where
 sighting is difficult or impossible the members are examined by touch. Copper acetylide A spontaneously explosive and inflammable substance which forms when acetylene is passed through a copper tube. If the pressure or gas flow tries to reverse, the hose check valve immediately seals off the torch from the main supply, thus eliminating the
possibility of flashback and backfiring of the welding torch through the hose to the regulator and cylinder. The top V should be 60° and the bottom V 80°, and the edges separated by a gap of 3.2 to 4.0 mm. Cab panelling. The vehicle's progression through to the paint process is carried out in two distinct operations, which are longer in total than any
other part of the vehicle build. One is for quick diagnostic checks with mechanical parts in position, and the other is for more detailed repairs with mechanical parts removed. Ordinary laminated safety glass is the older of the two types and is the result of a basic process discovered in 1909. Complete removal of slag is especially important when
several passes must be made over a joint. The wheels are brought into position vertically by the operation of a small handscrew. 20 When working with carbon steel, what is the difference between normalizing it and annealing it? 33 What is the difference in design between a saloon and a hatchback vehicle? The suppliers of garage equipment issue
operating instructions, and as part of your training you must read these instruction booklets so that you will understand the job better. In this manner the resistance of the adhesive to catastrophic failure is enhanced considerably, and such adhesive to catastrophic failure is enhanced considerably, and such adhesive to catastrophic failure is enhanced considerably, and such adhesive to catastrophic failure is enhanced considerably, and such adhesive to catastrophic failure is enhanced considerably, and such adhesive to catastrophic failure is enhanced considerably, and such adhesive to catastrophic failure is enhanced considerably, and such adhesive to catastrophic failure is enhanced considerably, and such adhesive to catastrophic failure is enhanced considerably.
binder is cured during the felt making process. Most other adhesives will be incapable of bonding strongly to GRP and should not be used when maximum adhesion is essential. It is caused by using a solvent in the paint mixture which is too slow to evaporate, and occurs when the topmost skin of the paint film has dried out. Drip moulding spoon
(Figure 3.8d) has a special lip which can be hooked under the drip moulding of the roof section and hence simplifies the repair. Though it looked intimidating, it wasn't complicated after all to repair a side view mirror. The choice of systems is varied and wide and depends on the cost involved in the initial outlay, the requirements of the individual
workshop and the workload of the shop (based on the number of vehicles repaired each week). 2 Do not inhale mist or vapours, and always work in a well ventilated workshop. This pumping action continues as long as the driver maintains adequate force on the brake pedal and impending wheel lock condition is sensed. Thomson of Philadelphia, USA
when an accidental short circuit gave him the idea for what was originally termed short circuit welding. 6 Ball-joints and wheel bearings. 510 Repair of Vehicle Bodies 15.3.3 Gas heating 15.3.5 Portable heaters Radiant gas heaters come in two forms: tubular and ceramic plaque. When welding a panel section that is off the vehicle, try to place it so
that it can be welded in a flat position. A disadvantage of the leftward method of welding is that if incorrect manipulation of the comparatively cold plate, thus causing poor penetration. In some cases where opposing curves meet or combine,
small metal templates cut to the correct curvature are useful to check the relative position of individual curves as the panel is being shaped. A vehicle lift and high-quality lighting are required, especially at ground level, together 507 with wheel alignment systems which give a quick check on suspension and alignment of the wheels. 13.15.3 Care of
threads on ram and attachments When the ram is not in use, attachments provided for protection of the plunger thread and ram body should be in place. The architect can only build or alter a building around the business if both parties are sure what shape the business will take; therefore bodyshop planning must come first. Chopped strands As the
name suggests, glass fibre strands chopped into short (about 12 mm) lengths. Pressure drops can Figure 17.8 Air line installation 17.6.3 Air transformer This consists of two units: a condenser or filter, and a pressure regulator. These hammers can be used to dress out sections which are difficult to work on owing to their awkward shape or position,
such as around lamp openings and in recessed and moulded sections on panels. The system includes a wheeled storage trolley to hold the measuring rods and adaptors, and a catalogue of data sheets. It is always a good idea to wear safety gloves when manually lifting. On flat panels where it is not possible to get at the edges or where there is not an
edge to locate a clamp, the same result can be achieved by locating the toes in the bosses of a pair of solder plates which have been sweated on to the panel. Wherever a joint is to be reinforced, a filler rod is added to the molten puddle. The connectors for these are usually underneath the seat cushion. The cleaning process should be undertaken in a
wet bay with effective drainage, good lighting and adequate working space all round the vehicle when its doors are open. 14.4 Major repair techniques In major repair work the method of repair is to analyse the crash, establish the order in which the collision damage occurred, and reverse the order when correcting the damage. 2.8.3 Where identified
hazards cannot be removed, appropriate action is taken immediately to minimize risk to own and others' health and safety This section is about those situations, or when equipment malfunctions and you can see an accident about to happen? Only a very
little heat is required to bring the colour of the heated member to a dull red, at which time it is at a proper temperature to be worked. 14.2.3 Mitek anchor pots set into the workshop floor (see Figure 14.10). When carrying out the repairs it is
often necessary to cut the back of the door frame and bend it, thus permitting greater freedom of movement for the use of hand tools. The cutting edge. Be sure not to leave any cavities or depressions when spreading. Most floor pans are irregular in shape for several reasons.
Semiautomatic and more particularly fully automatic MIG/MAG welding processes with a wide range of technical advantages have opened up new areas of production technique. Cementite Carbon and iron mixed. 2 Call the fire brigade immediately. Feel for very thin panels. As soon as the trigger is applied, the nozzle should be moved in an arc until
the spray is being directed towards the end of the section. LSR rivet This range of aluminium rivets is designed to offer two particular advantages in joining soft friable or brittle materials. 8 State the important conditions to be observed when using a wheeling machine. This has led to confusion and difficulty in identification and welding. The second is
an electrode intended for cutting with air (see Figure 9.31). Identification is confirmed by reaction between the plastic and test solvent in accordance with the test kit manufacturer's instructions. The crazing may not work its way through the paint surface for some weeks, so it may be necessary when assessing accident damage to carefully examine
all panels, particularly near cracks or split bonds. Saloon A vehicle having the driving seat inside the enclosed car but not separated from the rear seat by a partition. Make sure the valves of these cylinders are fully closed. There is always a tendency to make a system too elaborate; the aim should be to develop a system which consistently gives the
degree of assurance your business requires. This could be, for example, a full-size wood model of the type of body shell or cab shell required, or it might equally well be a steel or aluminium panel-beaten structure of composite type, or even a plaster model reinforced with wire mesh. 2 Describe the process of planishing. Follow normal procedures
using aluminium wire when MIG welding is possible with materials thicker than 5 mm, although downhand welding is preferable with the electrode moving in a straight line along the seam without weaving. It is known that the shape of
any material is held by the stresses set up in the material itself, such as those given by angles, crowns, channels and flanges. The ribbon coils and uncoils inside the coupling housing as the steering wheel is turned. A master pattern or model is made, representing in all its dimensions the finished product. The lower arc voltage characteristics of argon
are used to advantage in the welding of thin metals, because the tendency towards burn-through is lessened. It also aids in the formation of carbides, hardening the alloy and increasing its ductility. Thus the average petrol tank needs only a small amount of petrol to give a tank full of vapour waiting to ignite and explode. 29 What is PAT testing?
However, the ideal for welding thin body panels is the colder mixture of argon with 2 per cent oxygen and 5 pe
duties will require the employer to: 1 Make sure that equipment is suitable for the use that will be made of it. This unit is ideal for busy workshops with fast throughput of work, giving easy mounting and positioning of the vehicle on the frame. It is a form of plain weave in which the adjacent weft fibres are
twisted around consecutive warp fibres. It is suitable for moulding the most complex forms. The rotary action is suitable for removing old paint films and surface rust and, when fitted with a polishing head, the machine can be used for final polishing of paintwork. Levers are used to increase the force exerted by pivoting about a point. The
properties of plastics can also be enhanced by mixing in other materials, such as graphite or molybdenum disulphide (for lubrication), glass fibre or carbon fibre (for stiffness), plasticizers (to increase flexibility) and a range of other additives (to make them resistant to heat and light). A variety of gases are used commercially, but an oxy-acetylene
mixture is the most common because of its high flame temperature and because the gases are convenient to handle. PPE is also subject to a separate EC Directive on design, certification and testing, and will be marked by the manufacturer with a CE mark. This, combined with the problems of boilers bursting and mechanical breakdowns and the
advent of the railways, contributed to the withdrawal of the steam coaches. The soap must be rubbed into the painted surface. It is always important that the flux be suitable for the parent metal, but especially so in the joining of aluminium-magnesium alloys. This leads to faster delivery of customers' vehicles, which is a very
good selling point, and as the finished article can be moved out of the working space after cooling of the body, freer movement within the workshop is obtained. 13.7 Filing Filing is one of the most important aspects of finishing a body panel. However, the two-piece carpet can be removed with the seats still in place because they are made with cut-
outs to allow for easier removal. Security and alarm systems On most vehicles there are three different systems in operation: • • • Immobilisation - An electronic system, usually in conjunction with a key, or a key pad, that immobilises the engine unless the correct key is inserted or the correct numbers are entered in the key pad. The characteristics
necessary to provide serviceability over the life of the vehicle are the strength of the material under tearing conditions; adhesion of the coating to the backing cloth; resistance to flexing, and resistance to cracking at low temperatures; low friction, to enable the owner to slide on the seat; colour fastness, soiling resistance and, of
course, wear resistance. Then unfasten the panel retaining clips and pull the trim panel away from the quarter panel. In the 1970s engineers became interested in the aerodynamics which were taking place both underneath and inside the car, places which could not be seen. Cold curing Generic term for materials which harden at room temperatures,
after the addition of catalyst. 5 Other products must not be stored in a gas store, particularly oils or corrosive liquids. Renew the glass or goggles as necessary. Normal shielding gases in use are argon, carbon dioxide, and mixtures of argon and carbon dioxide, and mixtures of argon and carbon dioxide, although other mixtures such as argon and oxygen can be used. The acid removes both the
oxide scale and any dirt or grit which might also be sticking to the surface of the coil. However, to curve safety glass and still retain its optical and safety qualities requires careful control. Air conditioning heat exchangers (or radiators) are often incorporated in, or mounted adjacent to, the cooling system radiator. If it is not, it may
sag and bend causing damage. It is a hydrocarbon gas produced by the action of water on calcium carbide. The green light is switched off when a red light goes on. 8 Before commencing to weld, a visor-type (see Figure 12.32) or hand-held welding screen light goes on. 8 Before commencing to weld, a visor-type welding screen light is switched off when a red light goes on. 8 Before commencing to weld, a visor-type (see Figure 12.32) or hand-held welding screen light is switched off when a red light goes on. 8 Before commencing to weld, a visor-type (see Figure 12.32) or hand-held welding screen light is switched off when a red light goes on. 8 Before commencing to weld, a visor-type (see Figure 12.32) or hand-held welding screen light is switched off when a red light goes on. 8 Before commencing to weld, a visor-type (see Figure 12.32) or hand-held welding screen light is switched off when a red light goes on. 8 Before commencing to weld, a visor-type (see Figure 12.32) or hand-held welding screen light is switched off when a red light goes on. 8 Before commencing to weld, a visor-type (see Figure 12.32) or hand-held welding screen light goes on. 8 Before commencing to weld, a visor-type (see Figure 12.32) or hand-held welding screen light goes on. 8 Before commencing to well a visor-type (see Figure 12.32) or hand-held well a v
the best results for seam, spot or stitch welding, the surface of the panel should be cleaned to bare metal condition as paint or grease cause bad welds. Fluxes Always use welding fluxes in a well ventilated area. 5.6.3 Guillotine A 1.25 m treadle guillotine (Figure 5.7) will meet the requirements of the average panel shop for cutting sheet metal. Failure
to meet this requirement can result in imprisonment or unlimited fines or both. However, modifications have been made to it which have resolved the problem of blistering and reduced the curing time to two hours at an ambient temperature of 25 °C, which can be still further reduced to fifteen minutes when force dried. 17.12.1 Sanding processes In
order to produce smooth, glossy finishes the substrates and undercoats must be levelled down without leaving deep scratches. While older all-mild-steel bodies can contain steel of up to four different strengths, hardnesses and ductilities, some coated
on one side, some coated on both sides, and some uncoated. However, polyurethanes are difficult Adhesives: their general nature and uses (Permabond Adhesives Etd) Adhesive Toxicity Capital cost Material cost Material cost Process complexity Process temperature Solvent resistance Heat resistance General durability General comment Anaerobic 1 1 2-3 1 E 3 2-
3 3 Cyanoacrylate 1 1 3 1 C 2 1 1-2 Epoxide 1-3 1-2 2 2 E 3 2-3 3 Toughened acrylic 1-2 1 2-3 1-2 E 2-3 2-3 Toughened epoxide (heat cured) Phenolic 1 1 2-3 1 H 3 3 3 Assembly Usually used on larger objects where good performance required
Excellent general performance, particularly structures Superb structures Superb structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility, and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility and critical structures 226 Repair of Vehicle Bodies Table 7.3 Compatibility and critical structures 226 Repair of 
of the principal structural adhesives with a variety of composite and associated materials (Permabond Adhesives Ltd ) Acrylic Material to be bonded Metal (also see paint): Aluminium Steel Zinc Thermoplastic: Polyamide (nylon) Polyphenylene oxide Polypropylene Thermoset: Epoxy Phenolic Polyester: hand lay VARI SMC cold press Polyurethane, RIM
and 15 degrees to obtain the best weld bead shape, weld Figure 12.27 Making a plug weld Figure 12.26 Continuous weld Plug weld a plug weld a plug weld a plug weld a plug weld is used to join two metal areas with cellulose-based primer surfacer, and allow to dry for half
to one hour. The two main classifications of plastics are: thermoplastics and thermosetting plastics (which are referred to as thermosets). Ammonium chloride, but is not quite so effective for cleaning the metal. Before you dash out to try to weld that bumper
sides of the sheet with equal or differential Figure 4.1 Body shell panel 2 Reinforcement RH and LH 5 Front bumper mounting reinforcement RH and LH 5 Front bumper mounting reinforcement RH and LH 5 Front bumper mounting reinforcement RH and LH 6 Bonnet lock panel 7 Front suspension turret
stiffener RH and LH 8a/8b Front wheel arch gussets RH and LH 12 A-post reinforcement RH and LH 12 Front inner wing RH and LH 13 Body side gussets RH and LH 15 Inner sill RH and LH 16 Inner sill reinforcement RH and LH 17 B-post gusset
RH and LH 18 Upper dash panel 19 Bonnet skin 20 Bonnet frame 21 Dash stiffener RH and LH 24 Front chassis leg closing panel RH and LH 24 Front chassis leg gusset RH and LH 26 Front chassis leg gusset RH and LH 27 Front chassis leg gusset RH and LH 28 Front chassis leg gusset RH and LH 28 Front chassis leg gusset RH and LH 29 Front chassis leg gusset RH and LH 29 Front chassis leg gusset RH and LH 20 Front cha
B B B A B A 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 Front door frame RH and LH Rear door frame RH and LH Rear door frame gusset RH and LH Rear door skin RH and LH Rear door frame Stiffener RH and LH Rear door frame Stiffener RH and LH Rear door frame RH and LH Rear door frame RH and LH Rear door frame Stiffener RH and LH Rear door frame RH and LH Rear door
lock stiffener RH and LH Front window frame RH and LH Front door frame RH and LH Front door floor cross members RH and LH Front door floor brace closing panel Boot
floor brace RH and LH Boot floor bracket RH and LH Boot floor bracket RH and LH Boot lid frame Exhaust rear hanger stiffener Boot lid skin Boot floor side extension RH and LH Boot floor side extension RH and LH Boot floor side extension RH and LH Rear suspension turret RH and LH Boot floor side extension RH and LH Boot floor bracket RH and LH Boot floor side extension RH and LH Boot floo
LH A A A B A B A A A B A A A B A A A B A A A B A A A B A A A B B B A B A A A A B B B A B A A A B B B A B A A A B B B A B A A A B B B A B A A A B B B B A B A A A B B B B A B A A A B B A B A A A B B B B A B A A A B B B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B B B A B A A A B B A B A A A B B A B A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B B B A B B A B A A A B B A B A A A B B A B A A B B A B A A A B B B B A B A A A B B B B A B A A A B B B B A B A A A B B B B A B A A A B B B B A B A A A B B B B A B A A A B B B B A B A A A B B B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A B B A B A A A A B B A B A A
             modated here. The electrodes on the machine are not in this case bluntly pointed as in spot welding, but are usually relatively large flat surfaces which are brought to bear on the joint, pressing the projections together. Panel edges are treated in these ways for the following reasons: 1 To stiffen and strengthen the panel or component at its
extreme edge 2 To act as a safe edge, as it is important that panels which are to be handled frequently should be effectively treated to avoid the risk of injury due to exposed raw edges 3 To ornament and decorate the panel. In creating cars for today's highly competitive car market, designers have to do far more than just achieve a pleasing shape.
Figure 16.17 Impregnation of glass mat with resin (Scott Bader Co. Ltd.) Figure 16.15 Application of release agent to mould surface (Scott Bader Co. Ltd.) Figure 16.16). These mixtures give smoother results with a better, cleaner and more attractive spatter-free weld. For instance a can of solvent with
inflammable materials must be removed from the area. The output current is controlled either by an Figure 11.2 Diesel engined DC generator and circuit modern types incorporate means for automatically adjusting the voltage to meet variations in the demand of the arc. 13.6.5 Removing low spots can be removed in several ways, the two
thoroughly with a stiff wire brush. • Fatigue resistance - composites tend to give better fatigue resistance than most metals. Since the early 1950s there has been considerable progress surrounding jig brackets. For marking out work, locating centres for curves and defining profiles, the centre punch is struck only lightly. Several kinds of bonnets are for curves and defining profiles, the centre punch is struck only lightly.
in use on different makes of cars. Section 3.15.1 gives further information on hand snips. Without a mallet, aluminium work would be most difficult as this metal is so easily marked and tempered for strength and dent resistance. It is better to pull the torch along the
 angle which deviates from the usual angles of 90° and 45°, this angle may be determined with the aid of an adjustable protractor. This has been encouraged by the research carried out at the Motor Insurance Repair Research Centre Thatcham, and by the promotion by the VBRA and the AA of improved standards throughout the vehicle body trade
Drilling produces holes with smooth edges, and has the further advantage that it can be carried out with the plates in position so that there is no damage due to badly aligned holes. Therefore these fluxes should only be used when the metal has been cleaned prior to soldering. The head types include the standard countersunk (used in most timber
wide variety of buttontype fasteners used on vehicle trim. Figure 13.44 Wall mounted, air operated, filler dispenser (Bondaglass-Voss Ltd.) Portable dispensers offer the user the advantage of being able to take the filler from repair to repair to
(Murex Welding Products Ltd.) grease and by preventing it from being crushed. This book underpins this process and goes on to become a significant source of reference for the future. Rub down stopper with 360 paper. Checking by way of comparing with a rule is called measuring. This ionized state of the gas is called 'plasma', and in this state the
gas is electrically conductive. When using the push-on clip, it is important to ensure that the tolerance of 0.05-0.08 mm is recommended. A sealing on the Monobolt stem provides exceptional resistance to moisture, an essential
requirement for many applications in vehicle body work. Commercially pure iron may be cold worked to a fair extent before the metal becomes too hard for further working. The system incorporates graduated rails for longitudinal measurements, four sliding cross members for external and internal measurements, and varying lengths of tube with
built-in millimetre scales for obtaining height measurements. Silicon is the most important of these minor constituents, and its usefulness is apparent in three directions. The gases used are carbon dioxide or argon/carbon-dioxide mixtures. 11 Identify those at risk. Abrasive papers fall into two categories, based on the amount of space between the
rating should be fitted and the equipment tested and logged in accordance with the Portable Appliance Testing Regulations (PAT testing). If it's a snap-on unit, take the whole plate out. The regulations will set out general requirements in four broad areas. Unlike oxygen, acetylene is not a natural but a manmade gas. Gas shielded arc welding Table
12.6 335 MIG/MAG recommended operating conditions Application Horizontal/vertical fillet Metal thickness (mm) Shielding gas Wire dia. 12 With the aid of a sketch, illustrate the principal parts of an engineer's combination square. The metal worker's chisel is flat, and is used for working on flat or curved surfaces of thin sheet. At normal charging
pressures (about 17.7 bar) the acetone will dissolve approximately 25 times its own volume. For the main part, toughened glass is confined to door glass, quarter lights and rear windows where the use of more expensive laminated products has yet to be justified. The open coating provides increased pliability and good cutting speeds under light
pressures. The curing of the resin is the reaction of the monomer and the alkyd to form the cross-linked structure. The oven may be a simple box with an heating element, or an autoclave which is a cylindrical shaped oven that can be pressurized or evacuated inside. 17.11.6 Air leakage from gun Compressed air leakage from the front of the gun
 (Figure 17.43) is caused by the following (numbers correspond to those on figure): 17.11.3 Spray fog If there is an excessive mist or spray fog, it is caused by: 1 Too thin a paint. They are usually made to the particular requirements of the company (Figure 5.15).
stopper cannot be applied between coats of this material, and when used after the third coat must be oversprayed with cellulose primer filler. Under certain circumstances, the individual chains can link up with each other to form a three-dimensional or crosslinked structure with even greater strength and stability. In this position the danger of having
too large a weld puddle is that some of the molten weld metal can fall down, either into the nozzle where it can create problems, or on to the operator. Positioning of welding tip. This equipment is used in conjunction with Dataliner's laser
measuring system, and has multipulling facilities (see Figure 14.37). Low boilers are best used with primers, surfacers and fillers where it is required to build up the coating thickness fairly rapidly. 131 High-Strength Low Alloy steel has a yield strength of between 250 and 500 MPa. This is made by adding small amounts of titanium or niobium to the
molten steel which produces a fine dispersion of carbide particles. 2 List the properties of commercially pure aluminium. It can be used on all types of metals and system fault diagnosis the services of a vehicle
 electrical/electronics specialist should be sought. The equipment required is simple, the only two items not generally found in the average workshop being a split washer roller and a graduated measuring cylinder. They are suitable for roughing out prior to planishing, or in the finishing stages of planishing for stretching small low areas. 12 Explain the
basic use of the pulling tower system in the repair of vehicle bodies. 2 How is it controlled? There is a close similarity in the construction of all resistance welding machines, irrespective of design and cost. Most mills are computer controlled to ensure that the right surface
standard is achieved on the rolled strip. The metal from the rod has considerable influence on the quality of the finished weld. The combination of welding and recommended paint procedures will show no trace of a repair that should last the life of the vehicle. Where the corroded area has turned to holes it can only be repaired by placing a patch overland the combination of welding and recommended paint procedures will show no trace of a repair that should last the life of the vehicle. Where the corroded area has turned to holes it can only be repaired by placing a patch overland to holes.
the corrosion and welding or brazing it in place. The air pressure used when applying acrylic lacquer is between 3 bars (45 psi) and 4 bars (60 psi) depending on the make of spray gun employed. The procedure for dealing with repairs carried out under an insurance claim is in four stages, as described in the following sections. This gives a ready
subdivision into two basic groups: thermoplastics and thermosetting plastics. Do not tilt the gun; hold it perpendicular to the surface. Some companies use 110 volt equipment which is operated through a transformer, this is much safer, especially if the transformer is fitted with an overload cutout. Spray with reduced pressure, otherwise anti-
corrosion fluid will go everywhere. 2 Think. 3.23.2 Belt sander Figure 3.54 Selection of air tools (Consolidated Pneumatic Tool Co. Ltd ). Autorobot L (Figure 14.54). 5.3.1 Crowned surfaces The building up of stresses at the bend or peak is also
an important consideration in the design and manufacture of the modern car body. Spray booths should be fitted with colour matching tubes and it is advisable that this type of tube is used in refinishing 17.5.1 Primers and dual-purpose primers Primer The priming coat is the first coat of paint on any
the low spots where the blows were struck. 8.4.2 Silver soldering Silver solder probably originated in the manufacture and jewellery for the purpose of securing adequate strength and the desired colour of the joint, but the technique of joining sheet metal products and components with silver solder has come into wide usage.
in the automobile industry. The central locking and the car alarm on a six-month-old vehicle malfunctioned. The thread on the Taptite screw has a trilobal cross-section instead of the customary circular form. It is sensible to do tests before spot welding the new panels. The available polyesters are solutions of these alkyds in the cross-linking
monomers. The most common of these include wheeling machines, guillotines, fly presses, folders and forming presses. The rolastep edge setter (Figure 3.19b) is a portable tool used on the vehicle or a panel assembly. He or she needs a knowledge of body construction, an appreciation of materials and their properties, and a practical expertise in
appropriate repair techniques, including the use of all types of welding equipment. Two-pack paints are available as straight colours, metallics and base-coat-and-clear systems. Too low a pressure gives too short a cone, which may cause lack of penetration and fusion; it also causes frequent backfiring and will be deflected by particles of metal and
slag thrown up from the weld. The rotary action is in the region of 420 rev/min, whilst the eccentric action moves at 12 000 strokes/min. It is used extensively in the manufacture of chains, couplings and hooks. 2 Always use an exhaust extractor when running an engine in the garage. The area must be sited near an entrance door, and ideally provide
customers' toilets and a drinks vending machine. In cases where the door is severely damaged and a good deal of straightening is necessary, it is essential to check the door before any attempt is made to reinstall and to align the door with the body. The strength of the passive film, in terms of resistance to corrosion, increases within limits with the
chromium content and with the addition of other elements such as nitrogen and molybdenum. First, cut away part of the inner panel, or in the case of the sill, along the top. Changes are recorded until the designer is satisfied that an optimum layout has been achieved. Although swaging has many similar functions to that of wired edges, it is not
confined to edge treatment but may be used some distance Figure 13.25 Common swaged edges: (a) ball swage - may be produced in various sizes according to the size of the wheels used; is used as a stiffener on sheet metal (b) return curve swage - may be produced in various sizes; is used as a stiffener in body work (c) joggle swage - used to
 should be glazed in a rubber glazing channel, of which there are many different sections available. In the case of a vehicle must be mounted on to the repair system and the exact amount of distortion established by using either
brackets or a measuring system. 17 Name two people who were associated with the early development of the motor vehicle, and state their involvement. When the mould is ready the releasing agent is applied, followed by a thin coat of resin to form a gel coat. This type of work needs templates made to the exact curvature required so that the work
can be checked at each stage of its progression. All users will have to use BATNEECs to prevent, minimize and render harmless any release of VOCs. If there is alleged contravention, the user will have to prove that no better techniques were available. Heelboard The vertical board or panel under the rear seat which forms the support for the seat
cushion. In the joining processes which rely on heating or fusion, it is difficult to prevent the formation of residual stresses. Normalizing is effected by slowly heating the steel to just above its upper critical range for just sufficient time to ensure that it is uniformly heated, and then allowing it to cool in still air. There is a wide range of light-weight
smoke eliminators which take up very Bodyshop planning Figure 15.8 Central extraction unit (Minden Industrial Ltd.) 515 Figure 15.10 Portable fume and smoke extraction system (Nederman Ltd.) little floor space and can be carried from job to job. Initial hand ratcheting enables a tight or seized fastener to be slackened off prior to rapid runoff using
the air power. The gauge is used by slipping it over the edge of a metal sheet until the corresponding slot is found, and the gauge size is then read off. In addition to this, the air passage could become blocked with pigment sludge. If wrinkling or lifting occurs this is proof that the solvent is too strong and will probably lift the existing finish. 1.1.2
Highlights of motor vehicle history The idea of a self-propelled vehicle occurs in Homer's Iliad. Both 240 volt and 415 volt supplies are likely to kill anybody who touches them. This is constricted by forcing the plasma through a small nozzle which increases the temperature of the arc to over 24 000 °C and concentrates it on to a very small area.
Where new hinges are necessary a close inspection and comparison should be made with the identical hinge mounting on the opposite side of the car, and any misalignment of this mounting position should be rectified before fitting the new hinge. 6 Use a holder that is completely insulated. Sound welds, comparable in strength with the material
welded, can be produced with satisfactory filler rods, but similar results cannot be expected with dirty or rusty filler rods or with any odd piece of wire that may come to hand. Immediate steps must be introduced to control and locking
each component is locked in place on the side of the component which is not replaced (3) (except when replacing a rear door panel with a rear wing). 7 Check instrument glasses, switches, control levers, interior air vents. In AC the current reverses its direction in the circuit a certain number of times per second. The best floor plan is probably to
drive the car in at one door, move it through the bodyshop in stages and then drive it out at another door, unless stirp and refit are carried out by the same person. 30 Explain the setting to be used when welding a large gap with MIG/MAG welding. 2 Using a welding torch, heat the metals to a temperature below their own critical or melting
temperature. There are several ways of measuring the temperature, the choice depends on personal preference and required accuracy. (This step is not necessary if the rods have been prefluxed.) In heating the rod, do not apply the inner cone of the flame directly to the rod. 7 Falling objects. As the name implies, the dried paint film has the pebbly
appearance of an orange skin, and is caused by the failure of the wet paint film to flow out smoothly after application. But it's an easy money-saving fix you can do yourself. The hose has three separate compartments for compressed air supply, exhaust and dust extraction (Figures 3.68, 3.69, 3.70). Wheeling was a very skilled art when vehicles were
coach built and hand methods were employed to make the component panels (Figure 13.7). There can be several slight variations of a colour as vehicles leave the production line, and these can provide the refinisher with real problems when trying to match a colour. Offering benefits in all aspects of bodyshop operation, there are computers and
software packages dedicated to quick and easy repair estimates, stock control, invoicing and management accounts, paint and Claim form When involved in an accident which has resulted in vehicle damage, the owner should obtain and complete an insurance claim form and immediately return it to his insurance company, or make a written report or
the accident and damage received. In the process the vinyl plastic interlayer is placed between two clean, dry pieces of glass and the assembly is heated and passed between rubber-covered rollers to obtain preliminary adhesion. This procedure cannot be taken too far, however, because there is a maximum arc length beyond which good welding
becomes impossible. Be sure that the base metal is never permitted to get too hot. Lay down a piece of cellophane slightly larger than the patch and paint this with resin. 2.8.7 Required personal protective clothing and equipment are worn for designated activities and in designated activities and in designated areas The following table lists typical items of personal protective clothing and equipment are
equipment (PPE) and states when they must be worn. Being completely mobile, it can be 414 Repair of Vehicle Bodies Figure 14.13 Mobile bench showing pulling system and MZ bracket system (Celette UK) moved to wherever it is most convenient and the space cleared after use. Radiant heaters operate by the transfer of heat to solid objects rather
than by heating the air itself; therefore high-ceiling buildings can be heated with a high degree of efficiency. Worn and torn materials should be avoided as they can catch in moving machinery. The bonnet hinges on most cars are also constructed to give adjustment; therefore the bonnet can be moved forwards, backwards and sideways. In poor
visibility and after dark, light sources must be relied upon. 17.15.2 Polishing This is where the rotary-type polisher fitted with a lambswool pad (Figure 17.65) comes into its own. Do not operate equipment which you have not been properly trained to use and have not been given specific permission to use. Category B is local authority air pollution
control. Can be painted over with lacquers after thoroughly drying. Hold the welding torch in one hand and a stick of body solder in the other and play the flame over the tinning to begin to flow. 33 Describe the sequence of repair (not replacement) to a rear quarter panel which has received minor
accident damage. Some have two switches for each window arranged to work in parallel. Another common task that can be successfully carried out with the wheeling machine is to tighten up the loose wavy edges which sometimes 348 Repair of Vehicle Bodies occur when shaping a panel by hand. Take care not to damage the black ceramic edging.
When this is the case the roof panel forms the top panel 48 Repair of Vehicle Bodies Figure 1.47 Body side assemblies, roof, BC-post, front and rear door Panel inner Panel cowl top inner Panel cowl
top outer Panel assy dash Reinf. First, the body must be aligned, making sure that suspension mounting points are in the correct position. 7 Adjustment of the wire feed from 0.5 to 14 m/min. The body of the shears may be cranked or offset to permit the cut sheets to be forced beyond the blades so that
sheets longer than the blades may be cut. Non-corrosive fluxes These prevent oxidation on a clean or bright metallic surface during soldering. The Environment Protection Act requires that you dispose of used oils and other fluids in a way which will not cause pollution. All hand tools used by the body worker are made from a type of steel which is heat
treatable so that the tools are strong, hard and have lasting qualities. It is Standard Car Bench four-post lift The jig itself is a rectangular steel frame incorporated within a four-post 2.5 tonne lift (Figure 14.24). Most production welding is carried out on metal gauges of less than 2.5 mm, although greater thicknesses can be spot welded. The four
surfaces enclose the screwdriver tip so that there is less likelihood that the screwdriver will slip off the fastener. This will then allow in moisture which will cause further deterioration of the panel. The coating dries rapidly only when thin films are applied, otherwise drying is delayed by solvent retention. Thorough examinations and tests must be
made at suitable intervals. The computer responds by sending a signal to apply and release brake pressure as required. a very light coating which affords some protection against oxidation of the surface. Any object will emit IR energy; the higher the temperature, the more IR radiation is emitted. Furthermore, heating the floor keeps it dry, and the
fact that vehicle bodies become heated reduces problems associated with condensation as the cold vehicle bodies are brought into a heated environment. To reverse the process this point on the underside of the panel should be struck using the same force as was originally directed against it. During heating a chemical change takes place and the
material cures; thereafter the only effect of heating is to char or burn the material. 33 Why should you never hit a hammer with another hammer? 3 Name four factors which control the quality of manual metal arc welding. Air continually passes through the gun, thus preventing a buildup of pressure in the air hose. The vehicle building industry still
 uses wheeling in producing panels for commercial and private coaches, road transport vehicles and any assembly requiring a double-curvature shape in its production. 618 Repair of Vehicle Bodies 17.16.3 Process To assemble the gun, put a can of wax into the pressure pot, connect the head to the air supply, and regulate the pressure. Edge distance
In lap or butt joints which are likely to be subjected to shear or tensile loads rivet holes should not exceed twenty-four rivet diameters. 19 Sketch and name the type of flame suitable for welding each of the following: (a) aluminium (b) brass. Where
severe damage has been sustained, the damaged section or panel may be cut away, and a replacement section or panel grafted in. Crazing which appears after some months of exposure to the weather or chemical attack is caused by either undercure, the use of too much filler, or the use of a resin which has been made too flexible (Figure 16.51)
Valve protection caps should always be replaced after use. Ground coats are usually of a similar colour to the enamel. Any areas touched in thus will dry quite hard at the normal paint shop temperature. The format is shown in Figure 9.5 and the various sections are identified. Special ammonia-free compounds and liquids are available for the
burnishing of clear-over-base finishes. The blades are ground and set for the accurate cutting of all sheet material. By carefully allowing these wheel tracks to overlap on the entire surface of the flat panel being wheeled, a curve in one direction only develops. Weld deposit Metal which has been added to a joint by one of the welding processes
Ceiling-mounted radiant heating units are ideal for bodyshop use in that they do not take up usable space and encroach into the working area; however, they are not suitable where the ceiling height is less than 3.5 metres. The most important points during silver soldering area; however, they are not suitable where the ceiling height is less than 3.5 metres. The most important points during silver soldering area; however, they are not suitable where the ceiling height is less than 3.5 metres.
of overheating. 2.1.5 Eyes and face protection Eye protection Eye protection is required when there is a possibility of eye injury from flying particles when using a grinder, disc sander, power drill or pneumatic chisel, or when removing glass windscreens or working underneath vehicles. If the weld stays firmly in place then the weld has been successful. In a
workshop where more than one activity is carried out, such as panel beating and spray painting, it is advisable to install a stationary two-stage compressor. 2 Name and describe three methods of resistance welding. It is obvious, then, that additional material is required at the slits. A bead is a single longitudinal deposit of weld metal laid on a surface welding. It is obvious, then, that additional material is required at the slits. A bead is a single longitudinal deposit of weld metal laid on a surface welding.
by fusion welding; a local deposit laid on a surface is termed a pad, and is usually formed by a series of overlapping beads. Original finish The paint applied at the factory by the vehicle manufacturer. Ventilation, fumes, vapours Ventilation must be adequate to remove the smoke and fumes during cutting. The unified system may be applied for use
with all the models in the Car Bench range of equipment. If not, adjust the regulator to give 3.5 bar. Scrub marks are evidence of a condition known as door sag. Apart from the polyamide and EVA-based products, there are a number of other hot melt products that are useful to the car industry. The term 'sealer' covers a wide variety of materials used
in the motor industry for sealing against water and dust, from products which remain virtually mastic throughout their life to others which harden up but still retain some measure of elasticity. The dust created by sanding in the preparation stage must be prevented from being drawn into the paint area. The combination is probably the best choice of
                               ements either open-ended spanner or ring spanner sets. In its simplest form an AC transformer consists of a primary and a secondary coil with an adjustment to regulate the current output. These self-centring gauges form a skeleton image of the damage extended below the vehicle. 18 What colours are used to identify argo
and argon-mix cylinders? It has developed to its present sophisticated state over many years. Any high spots must be scraped and the workpiece must be retested until the whole surface comes in contact with the surface plate. However, where maximum performance is required, or conditions are particularly severe, it is worth spending time on
surface preparation. Where planishing hammers are employed, the process is carried out over a metal stake or hand dolly. Other objects at floor level, such as vehicles, benches and machinery, as well as the walls, will become warm either by receiving direct IR energy or by the transfer of energy from the floor. 3.10 Hammers and mallets 3.10.1
Hammers Figure 3.24 Improver basic toolkit (Sykes-Pickavant Ltd.) 3.9 Hand tools used in the fabrication of sheet metal The panel beater often finds the need to fabricate articles or components in mild steel, using specialist hand tools. As the repair proceeds with a combination of pulling, pushing and heating, continuous checks should be made for
alignment, as it is sometimes necessary to overcorrect to allow for springback in the metal structure. Cross-linking can be caused either chemically or by irradiating the polymer. Taking a piston-type compressor as an example, the operational sequence is as follows. 341 11 Describe the difference between plug welding and spot welding. 8 Have the
vehicle towed to the workshop if necessary. Move the grinder from the surrounding atmosphere and from the deleterious effects of oxygen, nitrogen and hydrogen upon the
chemical composition and properties of the resulting weld. Hand and power tools Figure 3.28 Sheet metal bench stake Finnen's mandrel Hatchet stake Pipe stake Anvil stake Finnel stake Funnel stake Grooving stake 101 102 Repair of Vehicle Bodies
Side stake consists of one long elliptical shaped head. 9 Explain the difference between hide and PVC materials are highly viscous in their uncured state, enabling a high degree of manoeuvrability within the glass aperture to ensure a good seal. It is inadvisable to mix one manufacturer's materials with another. If the damage is a
crack, such as in a bumper assembly, the procedure is to clean up the damaged area on both sides of the crack, drill stress relieving holes at each end, then whilst the crack is held closed bond a patch to the underside of the component. 2 Keep the blades sharp (a blunt blade tends to be dangerous). A fine surfacing tissue may be applied to 544 Repair
of Vehicle Bodies the gel coat while wet, or it may simply be allowed to gel as it is. Figure 13.41 Hot shrinking panel (Sykes-Pickavant) The oxy-acetylene flame is used as a means of heating the panel, and care must be taken to reduce the spread of heat to the surrounding area of the panel. Should the gun be held too close to the surface this will
result in too much paint being applied, causing runs and sags. The size of these particles can be predetermined by an exact temperature control and time cycle in the toughening process, and manufacturers now produce a uniformly toughening process.
square of glass. But before you start to work on plastics materials, you need to look at safety. 15.2.4 Assessment area in the workshop plan, this again could be on public view and so should be designed to impress. Figure 13.75 Control box to convert conventional MIG welder to weld aluminium (Courtesy of
POWER-TEC ®) 398 Repair of Vehicle Bodies wire brush. 2 Pressure washer - rubber protective gloves and goggles, waterproof (plastic) over-trousers and jacket, and finally rubber boots (wellingtons). It is a powerful machine with a hard rubber flexible pad on to which the actual sanding disc is fastened by means of a centre nut. Additives Small
quantities of substances which are added to carry out special jobs. 15.2 Planning the areas of the workshop Workshop floor space Using all available space in the interests of efficiency does not mean in any circumstances that the premises should be so filled with vehicles that considerable time is taken up with moving and reparking them. Figure
16.19 Final mould and moulding (Scott Bader Co. Ltd.) 16.6.2 Spray-up technique A development from the basic manual contact process which is employed with increasing frequency in the automotive body industry is known as spray-up (Figure 16.20). The damaged panel skin can then be removed using a hammer and chisel and easing up the flange
strips that are left (Figure 13.63d). This means almost any substance which you are likely to find in a garage, but particularly oils, greases, paints, brake fluid, battery acid and cleaning materials. The fully threaded nut in the cage is permitted to float slightly to overcome the problem of misaligned holes, and is fitted after the finishing process at any
convenient point on the production line. There are two types of mallet - boxwood and rawhide. An extremely thin film of oxide forms on all surfaces exposed to the atmosphere, and even if this film is broken by a scratch or chip it will reform, providing complete protection for the metal. A fairly firm pressure should be applied at first, but as the area
shows sign of glossiness the pressure should be reduced. When a customer calls to have damaged panels repaired out. Figure 12.29 Lap spot weld Stitch weld A MIG/MAG stitch weld is a series of intermittent seam welds carried out at
intervals along a lapped metal panel joint, where a continuous weld is not necessary or would cause distortion due to heat input (Figure 12.30). The use of split washer rollers removes the air and compresses the glass fibres into the resin. 9.5 Welding rods and fluxes 257 9.6 Flame control and types of flame 9.6.1 Temperature of flame When acetylene
is burned with an equal volume of oxygen, a maximum flame temperature of over 3200 °C (about 2.5 times hotter than the melting point of cast iron and steel) is obtained just beyond the inner luminous cone (Figure 9.15). tially clogged (b) Dirt on right or left side of fluid tip. After assembly the complete body shell is immersed in a bath of (a) Figure
1.34 (a) VW Golf Estate body assembly 35 36 Repair of Vehicle Bodies (b) Figure 1.34 (c) Rover 800 load levelling body parts molten zinc, which applies an all-over 6.5 micron (millionth of a metre) coating. In addition to wet-or-dry
paper, the spray painter should have in his stock emery paper and production papers. Trim hides edges. This blocking arm can be used anywhere on the bench, and with extension tubes it can reach both high and low points of a repair. The pause in the temperature rise and the slowing down of the rate indicate that energy is being absorbed to bring
about a Metal forming processes and machines chemical and structural change in the steel. When removing them from the bench, lift the cellophane and the laminate together. Materials having specific requirements based on formability 1 1 HR, HS, -, -, -, -, -, CR, CS % - - % 0.08 0.08 % - - % - - % 0.08 0.030 % 0.025 0.025 2 3 4 14
15 HR, HS, CR, CS HR, HS, CR, CS HR, HS, CR, CS HR, HS, CR, CS HR, HS, -, -, HR, HS, -, -, HR, HS, -, -, -- - - 0.08 0.10 0.12 0.15 0.20 - - - - - - 0.45 0.50 0.60 0.50 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050
drawing Drawing or forming Flanging Commercial Materials having specific requirements based on minimum strengths Carbon-manganese steels 34/20 HR, HS, -, -, 50/35 HR, HS, -, -, 50/35 HR, HS, -, -, - - - - 0.15 0.20 0.25 0.20 - - - - - - - - 1.20 1.20 1.20 1.20 1.50 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050 0.050
Micro-alloyed steels 40/30 HR, HS, -, CS 43/35 HR, HS, -, CS 46/40 HR, HS, -, CS 60/55 -, HS, -, CS 60/55 -
and general engineering purposes -, HS, -, CS -, HS, -, C
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grade 95) in the temper rolled (half hard) conditions. 4 A digit indicates the temperature for a minimum average impact value of 47 J (see Table 11.3). Line filing indicates curvature in one direction only, and as most panels are double curved the panel surface must be cross filed to give an accurate contour check. This effectively allows for complete
computerization of the entire bodyshop operation. It is the consideration of human factors in the efficient layout of controls in the driver's environment. The cold rolled coils are suitable for applications such as panelling where no bending or very little deformation is needed. 10 Make sure that you have a good earth connection. The dummies are wired
with instruments to predict the risk potential of human injury. Robinson and Andrew Livesey to be identified as the authors of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means electronic,
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material herein. Until recently the choice of section, size and metal gauges was based upon previous experience. The function of this final coat of surfacer is to equalize solvent penetration from the finishing material. • Keep all SRS components dry. If sectioning does not save on time or money, then the part is completely replaced: that is, when the
repanelling and straightening reaches the cost of the complete new panel. 19 What precautions must be taken, after body soldering a repair, to prevent subsequent paint defects? A video camera is used to record digital pictures of the damaged vehicle. The DIY enthusiast will find it easy to read and useful as a work-shop manual when carrying out
tasks, or projects, related to the vehicle body. The clamps themselves rotate through 360 degrees and have height adjustment. The point of intersection of KPI and camber gives the point about which the wheel rotates when the steering is turned. Nevertheless, Table 7.2 they perform well in severe environments. Some jobs may at first glance appear
to require horizontal, vertical or overhead welding, but upon examination it may be possible to change them to the easier and more efficient flat position, and for this reason positioning jigs are used in mass production. The major factor in site selection is planning permission, without which no building may be erected. In addition to imparting rigidity
it can be readily cleared of road dirt, thus reducing the possibility of corrosion from moistureretaining matter. These readings are then compared with published data and are displayed in colour on the monitor screen. Caution: do not attempt to cut material beyond the range specified, as this will damage the torch. Contact cutting Contact cutting is
used for materials up to 5 mm in thickness. 2 Aerodynamic resistance, which depends on the square of the car, on its frontal area, on the density of the air and on the square of the speed. If the customer's first impressions on collecting the vehicle exceed expectations, he will be more than willing to recommend the comapany's quality of service. Rivets
are classified according to the shape of the head, and the diameter and the length of the rivet. Series This refers to a circuit where components are connected in line with each other, that is, positive to negative. Damage by accident and its subsequent repair covers a wide range of incidents from minor scratches and cosmetic damage to the write-off.
In effect, any bodyshop currently operating without a properly constructed fully operating outside the law and risks summary of the contact moulding process: and the drawing-through process is repeated until the required thickness is achieved. For example, instead
of adding 0.5 grams of blue-black full-strength tinter, he can more easily add 5 grams of reduced-strength tinter. This is governed by the diameter of the finished article and access for hand tools. The Regulations implement an EC Directive aimed at the protection of workers. An alternative to the butt joint is the edge joint, in which the two metals are
put together to form a corner. It is also used for finalizing and finishing. The resistance decreases and the voltage remains constant. Though atomization is achieved with much lower pressure, these spray guns still require large volumes of compressed air to operate them. Root concavity or suck-back This may occur if the rear of the weld pool is too
hot or large, and the combined effect of contraction and surface tension results in a root surface which is concave (Figure 12.38). Whichever type of gun is used it must not be immersed in solvent, as this causes the lubrication oil to be washed away and will cause paint leakage from the gun. Inclusions Non-metallic inclusions may be trapped in the
joint owing to inadequate cleaning. A straight pair of snips is often necessary for long straight cuts (Figure 3.11c). This coating must be removed from the surface of the dolly block and work and hammer. All solvents and degreasers are potential
sources of these vapours and must be removed from the air or solvent has been entrapped. It is inevitable that some moisture vapour will be drawn into the air line from the air receiver, and for this reason the air line should
slope down towards the air receiver to enable condensed moisture to run into it rather than to the air transformer. It shows the seating arrangements, instrumentation, steering wheel, control unit location and pedal arrangements. Never wear defective footwear as this becomes a hazard in any workshop environment. 16.9.3 Repair of a damaged wing
1 Investigate the damaged area to find its extent. Keep the motion of the torch as uniform as possible, as this will produce smooth, even ripples and so complete the weld. Also check that adjacent areas, especially where there are bonded joints, are not getting too warm. Flush contaminated area with water. It is caused by: 1 Too high an air pressure 2
Using solvents which are too fast 3 Moving the gun too rapidly or too far from the job 4 Too high a paint viscosity 5 In hot spraying, too high a paint temperature or surrounding air too hot. You should use the one which is recommended by the vehicle manufacturer. Cone drills or variable hole cutters These are special alloy steel drill bits which have
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been hardened to give a fine cutting edge (Figure 3.14a). This uses an energy pack to supply the power, with a fast charge facility for recharging from a mains supply (Figure 3.53). Figure 14.38 Hand-held unit with memory (Dataliner, Geotronics Ltd.) All marketed car models will be found digitally registered in the company's main computer. 4
Explain how a suctionfed (or syphonfed) spray gun operates. In some cases body repair workers use a boxwood mallet for roughing out, because there is less chance of stretching the metal. The life of the hose may be prolonged by reasonable care in use, e.g. by keeping it away from heat, sparks, oil and Gas welding, gas cutting and plasma arc cutting
255 9.3.8 Cylinder key This key is an essential part of the equipment, and is used for turning the valves on the gas cylinders on and off. Work can be made easier by stripping off any body panels or mechanical parts which might interfere with accessibility to the damaged area. The wiring harness can be damaged by heat, so if an airbag or seatbelt pre-
tensioner is fired the SRS wiring harness must be replaced too. Styling forms include the following: Saloon The most popular style for passenger vehicles is the two-door or four-door saloon. They consist of two principal types. Some special body designs incorporate different methods of rear window construction, which affects the roof panel; this is
particularly true for estate cars, hatchbacks and hardtop convertibles. The mild steels used in general engineering possess a small amount of tenacity, yet a bar of metal of one inch square (6.5 cm2) cross-section, made from lowcarbon steel, is capable of supporting a load in excess of 20 tonnes. Manufacturers began to use wind tunnels to eliminate
unnecessary drag-inducing projections from their cars. 13.16.2 Repair of minor accidents are usually of a relatively straightforward nature, as the damage is either a dent, a scratch or a scruff of the outer panel surface of the body and does not always involve structural distortion. Figure 6.4 (a) Centre
punches (b) nail punches (c) parallel pin punch (Neill Tools Ltd (Eclipse)) Parallel pin punch (Neill Tools Ltd (Eclipse)) Parallel pin punch out pins and dowels on mechanical assemblies (Figure 6.4c). Cutting can be commenced from the panel edge, or from a hole predrilled in the panel surface to allow entry of the punch. Door panels and rear quarter panels Use the existing
openings to spray into door panels, or drill extra access holes as required. Each of the clear coatings contains an isocyanate hardener: There are many variations available to the refinisher with these materials, and the paint manufacturers' literature must be referred to. For moving equipment and heavy components you should have either a trolley or
a sack-truck. 15 Explain the type of application in which the process of silver soldering would be used. However, new factors such as a worldwide requirement for fuel conservation for lighter-weight Metals and non-metals used in vehicle bodies Table 4.2 125 Symbols for surface finishes and surface inspection: BS 1449: Part 1: 1983 Finish Symbol
Description Pickled P Mechanically descaled D Full finish FF General-purpose finish BR Plating finish PL Mirror finish BR Plating finish BR Plating finish PL Mirror finish BR Plating finish PL Mirror finish BR Plating finish BR Plating finish PL Mirror finish BR Plating finish BR P
removed by chemical means A hot rolled surface from which the oxide has been removed by mechanical means A cold rolled skin passed material free from gross defects, but of a lower standard than FF A surface finish obtained
when material is cold rolled on specially prepared rolls as a last operation A surface finish obtained when material is cold rolled on rolls having a moderately high finish. Even using the latest computer software, the slightest change may take several days; without CFD it would take months, and the level of accuracy would be much less. Though they
are quite easy to use, some precautions should be taken when working with these paint removers. Tungsten having a melting point of 3400 °C, is used as the electrode material owing to its refractory nature. 3 There is too much oil in the crank case. Vinyl coatings are now sufficiently familiar for their merits to be taken for granted; nevertheless they
continue to provide a material which for durability, uniformity and appearance at a reasonable cost so far remains unsurpassed. As soon as the spot is cherry red place the shrinking dolly (grid dolly), which is usually fairly flat, under the spot and strike several sharp blows with a mallet around the heat spot; this will force the surplus stretched metal
into the heat spot. 3 State the legal requirements necessary when building a new workshop. In recent years the use of aluminium and aluminium and aluminium alloys for motor bodies, especially in the commercial field, has developed enormously. The screw is inserted into a predrilled hole and it cuts its own thread in the metal, thus making a very secure joint. The
root is the zone at the bottom of a space provided for or occupied by a fusion weld, and the throat is the minimum depth of the weld measured along a line passing through the root. Shrinking can also be carried out using shrinking equipment, which can be either a specialized piece of equipment or an attachment to a MIG welder. In cases of damage
where the body is distorted, the temptation is to use rough-and-ready methods depending on brute force to restore some resemblance of shape. In use, the curved tip is held against the edge of the workpiece and the line is scribed with the point of the other leg. Then came the wooden-spoked artillery wheel with pneumatic tyre (Figure 1.4).
Sometimes lighter pattern punches, called prick or dot punches, are used for marking out. If there is dampness of any kind, such as when rubbing down or cleaning, then some form of corrosion is bound to take place. T-joints also have several variations which can be applied in appropriate places. In practice, most composites consist of a bulk material
called the matrix, and a reinforcement material of some kind which increases the strength and stiffness of the matrix. 2 When and why did manufacturers commence to use metal for the construction of vehicle bodies? 21 Electric shock can result from the use of faulty and poorly maintained electrical equipment or misuse of equipment. Thus any
degree of damage can be repaired using the most appropriate system. Filing indicates any irregularities in the repaired out as the panel is planished. Any low places or 'valleys' on the surface of the workpiece can be eliminated by careful hammering on the head, which slightly stretches the metal, causing it to rise to
the correct contours. If the bonnet is too high or too low a recognizable step occurs at this point. It possesses a degree of softness which allows quite a lot of plastic deformation with very little work hardening. 7 Welding processes should be carried out only in the areas where there is adequate ventilation. Although such a glass may crack, forming a
spider's web pattern (Figure 14.104), it holds together and Figure 14.103 Laminated glass Figure 14.104 Characteristic breaking pattern of laminated and toughened glass the panel remains in one piece except under conditions of the most violent impact. Harmful fumes can be captured and disposed of in a safe and simple way regardless of the
welding environment. Areas of poor adhesion can be detected sometimes by the presence of a blister, or by local undulations in the surface when it is viewed obliquely. 4 Use the backstep weld sequence or preset the joint. 3 Place the sheet of metal between the upper blade and the bed of the machine with the bend line directly under the edge of the
top blade, then clamp the metal by pulling the clamping handle forwards again. The action of the mandrel draws through the rivet, expanding the shank to fill the hole. This is where computerized estimating should be located, and customers will always be impressed by a speedy estimate on the screen in front of them. 21 Name three types of plastic
trim panel fasteners. 2 Decide if the repair can be carried out using hand tools only or whether the hydraulic body jack is required. Therefore to set up or redevelop a bodyshop, professional advice is essential. Hence the machine is also called a jennying, swaging, burring or beading machine, despite the fact that the same basic machine is used to
perform the different operations. Oil, together with natural gas, is the most important raw material for plastics materials have only a limited amount of strength - interior trim, dashboard panels and lamp lenses are examples of non-
reinforced plastics. Iron, steel, copper and brass are readily brazed, and metals of a dissimilar nature can also be joined. Each type can be pulled and pushed straight in a number of ways. They are blind fixes, ensuring a neat, attractive assembly appearance. The same job in a mass production factory may be done by a team of designers and engineers
all expert in their own particular branch of the project. 13.17 Aluminium panel repair 13.17.1 Differences Figure 13.66 Pulling damage out using hook and slide hammer (Stanners Ltd ) Quarter trim panel This is the panel which fits over the interior of the quarter panel. A catch is provided at the lower rear edge of the boot lid or tailgate and is
controlled by an external handle or locking mechanism. 3.20.1 Metal shears These are usually electrically operated (Figure 3.45). Nearly all fixed glazing is now glazed using adhesive systems. Using the welding torch with the flame set in the carbonizing condition, which is slightly
feathered and gives a very soft flame, heat the tinning compound until it becomes fluid. After welding is completed the metal should be cooled slowly to avoid the weld metal becoming brittle. Limousine This vehicle is characterized by its extended length, a high roofline to allow better headroom for seating five passengers comfortably behind the
driver, a high-quality finish and luxurious interiors (Figure 1.6g). The curing time is dependent upon the humidity levels prevailing, as well as the temperature. Major repairs are dealt with in Chapter 14. It has been introduced to standardize the methods of corrosion assessment employed by MOT testers, and is ideal for bodyshops conducting pre-
MOT checks and assessment for corrosion. Some welding torches also have a current control knob located in the torch so that the welding current can be altered during welding. Incorrect castor will not cause tyre wear but would cause the vehicle to wander on the road and not return to the straight ahead after cornering. Used to describe an
enclosed vehicle which carried two passengers, while the driver was situated in front of this compartment and unprotected. The positions in which welding is performed are termed respectively flat, downhand or underside, and vertical when on
an upright or vertical surface. Cant panel The curved section of the roof top running between the comparatively flat top and the rain drip or gutter. Sheet steel, such as is used in the manufacture of car bodies, has reasonable strength in tension but has little resistance to compressive and/or torsional loads. It is the best type of gun for spraying quick
drying materials. 9.2 Systems of gas welding There are two systems of gas welding. Flat file This file (Figure 3.10b) has a solid wood holder designed to take a standard 14 in (30 cm) blade, which must be used in a rigid position. It is suitable for welding on wings, front panels and rear quarter panels (Figure 10.22). Edge setters The edge setter
(Figure 3.19a) is a portable, handoperated tool designed to provide a 'joggled' joint or stepped edge on a repaired or new panel, thus 96 Repair of Vehicle Bodies Door skinner This is a special tool (Figure 3.20) for crimping flanges tightly on replacement door skins. In sufficient concentration styrene vapour is irritating to the eyes and respiratory
passages, and therefore workshops should be well ventilated. The material is likely to be a thermoplastic. Cellophane placed between plate and laminate will facilitate plate removal. The positions of the spot welds are indicated by small circular discolorations of the metal. A suggested plan of action for the development, implementation and
certification of any quality management system is as follows: 1 Establish the company's commitment to quality and the achievement of BS EN ISO 9001-2000 standards. On some types of joints it is possible to weld the two pieces of metal without adding a filler rod, but in most instances the use of a filler rod is advisable because it builds up the weld,
adding strength to the joint. It is used extensively for body panels, where its high ductility and malleability allows easy forming without the danger of cracking. It does not oxidize or carburize the material, and it is used on mild steel, copper and magnesium. Age hardening may be delayed by storing solution-treated material at low temperatures. The
program then offers a selection of first-and second-choice adhesives, together with notes indicating why a particular choice has been made and which factors have excluded which adhesives. In TIG welding, oxidation of the nonconsumable tungsten electrode must be prevented. The bore of the barrel is screw threaded and engages the part of the
spindle which is externally cut to the same thread. This system offers the benefits of conventional spot welding without the inherent problems of accessibility with doubleskinned panel sections. It may be at the front or rear of the body depending upon the location of the engine. The hole sizes used are 5-6 mm with currents of 50-60 A for panel
thicknesses of 0.75-1.2 mm. These templates are used towards the end of the beating process to check the finished shape of the job. 16 Describe the differences between the processes of aluminium welding and aluminium brazing. Polish outside first, then inside. The measuring system (Figure 14.56) is interchangeable with all Autorobot benches
4.6.1 Production The metal itself has only been known about 130 years, and the industrial history of aluminium. There are several methods of moving vehicles within the refinish shop: Under own power This method is the most
economical of labour, but requires the maximum of space. It is better to strip and refinish a surface rather than risk any subsequent coatings peeling off. 2 Do choose a rigid adherence where loads are carried. Figure 1.42 shows the build-up details of a fourdoor saloon, from the main floor assembly to the complete shell assembly. Pin-holding can also
be caused by too high a room temperature, and in hot spraying too high a fluid temperature. Do not forget to let the dolly just lie in your hand and to grip the hammer loosely. When the production line begins to turn out the brand new model, every stage of production is carefully scrutinized to ensure quality in all the vehicles to be built. Therefore,
each line should be considered to be unique. Good head room is desirable and sufficient space should be allowed for all operations. This sander is the ideal complement to orbital sanders, eccentric Hand and power tools 117 Figure 3.60 Oscillating sander (Fein/George Marshall Ltd ) sanders and other portable grinding equipment used in a body
repair workshop. These procedures will have to become an integral part of the company's policy on quality in the repair of vehicles while maintaining safe working practices. Start to heat the buckled portion or damaged area well out near the edge. Soft and hard soldering methods 237 8.3.2 Fluxes The following substances are corrosive fluxes: The
function of a flux is to remove oxides and tarnish from the metal to be joined so that the solder will flow, penetrate and bond to the metal surface, forming a good strong soldered joint. Corrosive fluxes These are usually based on an acid preparation, which gives the fluxes their corrosive effect. Failure to observe this will cause gouges or deep
scratches in the metal which will be hard to remove. Grease is used between the gun and clean the air cap. 4 If the repair is carried out using hand tools only, then the back of the damaged section under repair, if accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound. If it is accessible, must be cleaned of antidrum compound compound. If it is accessible, must be cleaned of antidrum compound co
long joint you should tack weld first. Box drawing The drawing of square or rectangular shapes is called box drawing. The resistance welding process was invented in 1877 by Professor E. Vehicle Certification Agency (VCA) is the designated UK Approval Authority and Technical Service for all type of approvals to automotive EC Directives and ECE
Regulations. Qualified technicians able and willing to apply themselves diligently and accurately to their task are a scarce resource, commanding increasing respect and greater recognition than ever before. Front-mounted engine. The light blows will not displace the surrounding undamaged area, but the force of the downward blow will be
transferred to the dolly block. Employers should consider the shape and size of the load, the way the task is carried out, the handler's posture, the working environment (cramped or hot), the individuals's capacity, and the strength required. Alloy steels usually take the name of the element or elements, in varying percentages, having the greatest
influence on the characteristics of the alloy. 3 Under no circumstances must the plasma nozzle be removed or any other work be carried out on the torch with the machine switched on. For dry grinding or sanding, high-quality hide glues are used for anchoring the abrasive grains to the backing. Will cause asphyxiation in absence of sufficient oxygen
to support life. The complete set forms a very useful workshop accessory and fulfils many needs, but when a high degree of accuracy is required a normal solid try square should be used instead of the square head of the square head of the square should be used instead of the square head of the square should be used instead of the square should
out small marks or defects on the panel surface. 10 Explain the reason why certain joints are brazed in preference to being soldered or welded. Predetermined weld duration times may be employed, the gun trigger being coupled to a suitable timer and, if desired, fully mechanized. When the painting was completed, the sign writer took over and
embellished the coach with line work and heraldic emblems. Figure 13.40 Ear and eye protection when sanding (Motor Insurance Repair Research Centre) Always maintain a balanced position when using the grinder. Body shells are now designed to withstand major collision and rollover impacts while absorbing shock by controlled deformation of
structure in the front and rear of the vehicle. This precision tool is used to cut through seals, joints and hard-bonded connections with exceptional speed and ease. The reshaping is done with a rather heavy hand dolly of a similar shape to that of the contour of the damaged wing section. Must be applied to non-metal surface for long-term durability
Sensitive to moisture. It gives the repairer the dual advantage of precision measuring allied to the use of brackets. When the size or depth of the recess is indicated. Polishing should be carried out immediately, before the wax is
allowed to dry. Fires in oxygenenriched atmospheres are very difficult to extinguish, and can spread rapidly across combustible Gas welding, gas cutting and plasma arc cutting materials from a single point source such as a spark from a cigarette. Both the tests have the same principle, which is to determine the energy measured in joules absorbed by
the notched test piece at a specified temperature as it is broken from a single swinging pendulum. They are supplied, therefore, as a paste or liquid dispersion in a plasticizer, or as a powder in an inert filler. Flux A chemical material or gas used to dissolve and prevent the formation of surface oxides when soldering, brazing or welding. This will
reduce the possibility of sinking the surface too low. In order to match a colour, different pigments may have to be used in the refinishing material in order for them to be compatible with the binder. A cut-off is made by one or more single-line cuts. 27 Sketch one type of electrode arm sets used in vehicle repair. A paint at a viscosity of 35 seconds BS
B4 flow cup for conventional spray application requires a high air pressure to produce good atomization (Figure 17.68). Oxygen was discovered many centuries ago, but its preparation on a commercial basis was not started until 1892. Stopping, if necessary, is best done before priming with two-pack polyester stopper. Spray sufficient coats of primer
surfacer or filler (thinned 1:1) at 3 bars (45 psi) to bring repair up to level of surrounding surface. It is designed to carry the weight of the front bulkhead assembly (Figure 1.45). Access to the sunroof usually entails removal of the interior head lining (also called roof lining). Fluid cup A container for the paint
attached to the spray gun in conventional spray gun in conventional spray gun by means of a fluid hose. Hold one side of the vehicle and pull along the line of the diagonal. It has been established that a large percentage of non-productive time can be attributed to this factor. A spray gun will function
efficiently provided that it is clean and well maintained, but neglect will eventually cause the gun to malfunction. Basket weave is flatter and through less crimp is stronger than plain weave. 14.4.6 Repairing extensively damaged panels while they are still attached to the body shell. There
are four important areas of a bodyshop, each of which has different lighting requirements. Lightweight fabrics of a similar weave. • Infrared or laser, 'point and shoot' digital thermometer - These are very accurate, being able to measure to a fraction of a degree. They can
be used as fillers. Hydrochloric acid Although hydrochloric acid is not a good substitute for zinc chloride, it is nevertheless used with excellent results on zinc and galvanized iron. Obviously the two figures should balance and there will be flow between adjacent cubes. It possesses good weldability and can be welded by conventional methods for
stainless steel. Panels which would otherwise be slack and lacking in rigidity can be stiffened by the use of swaging. Figure 14.110 Welwyn Tool Co. Ltd ) 470 Repair of Vehicle Bodies 2 If the original windscreen is to be refitted, level off the remnants of the old sealer. A single-riveted joint has an efficiency of only about 55 per cent
The helmet type of head shield fits over the head and leaves both hands free (Figure 11.6). The bench can also be used with the Metro 2000 measuring system. In addition the HSWA requires that employees wear the appropriate PPE for hazardous jobs such as using cleaning equipment. By utilizing the memory capacity of the
computer you will have readily available all necessary details to help you draw up an estimate quickly and accurately. In the paint shop, health and safety regulations will dictate many decisions and must be taken into account in your plans. Bevels consist of a stock with one or two blades which are adjustable and can be locked at any angle by means
of a thumbscrew. Then the four chassis clamps are positioned and tightened, to the bottom edge of the sill on the vehicle and the transport beams, by using quick-release and snap-on bolts. The maintenance of a stable arc between a bare metal electrode and the workpiece is an unreliable procedure, and for this reason (among others)
various coatings are applied to the electrode wire. Body filler A further possible source of ignition to be aware of in general use in the body repair business is the mixing of two materials to use as a body filler. Generally considered non-toxic at atmospheric pressure. See Chapter 2 for further information. Prior to reinstallation of the trim pad, always
make certain that the watershield is in position and correctly sealed. For this reason stakes should not be used whenever possible when forming sheet metal over the stakes. A final alignment check
should be made after the tension is released. 7 Describe, with the aid of sketches, the technique of split and weld for producing a hand-made panel. Only when the pressure has subsided to normal working level via the built-in escape valve will the arrester allow the main supply of gas to continue flowing. Whilst this may speed up the first stage of a
repair, it will be found that such methods result in additional marking of panels; considerably more time will be spent on the final stage of finishing than would be required if more thought had been given to the job in the first instance, and what
are its principal panel assemblies? First examine the damaged parts carefully and take accurate measurements to see in which direction, and by how much, the damaged parts have moved. It also allows two spot welds to be made simultaneously and is suitable for welding sill sections in place. Body repair workshops vary in their opinions as to the
dividing line between the two assessments. In hoses, leakages, cuts or local surface damage may be repaired by cutting out faulty sections and inserting an approved coupling. As this is a non-combustible gas, the cylinder has a right-hand threaded valve outlet. The back is strongly ribbed to give rigidity to the surface. An anvil with a flat face is
attached to one end of the frame and the other end accommodates the spindle and the barrel, which is graduated in linear measure. At the other end a fixed hexagonal nut holds a strong self-tapping screw, while a heavy cylindrical weight can slide up and down the shaft against a stop which is near the handle. There are various measuring adaptors
such as sockets, cones and angle blocks which are fitted into the top of these height tubes. Also, coated materials like zinc-plated mild steel can be better brazed than welded. Further, this method enables high glass content and uniform dimensional properties and appearances to be achieved at lower cost than by other methods for runs above 1000
units. It is advisable to rough out all damaged sections, even though some of these may eventually need replacing with new panels. The tendency will be for the whole of the vehicle to move, so hold the opposite corner to the pull. Panel drawing Drawing of irregular-shaped parts is called panel drawing. A thermoset is one which uses or generates heat
during its setting stage. Never use copper or alloys containing more than 70 per cent copper or 43 per cent silver with acetylene. Allan Bonnick, Automotive Computer Controlled Systems, Elsevier, ISBN 0 7506 5089 3. 6 Finally carry out any lining work, using either lining trape, fine lining brushes or roller-type lining tools. The most important factor
seal. 3 Hold the machine correctly with the blades at right angles to the metal being cut. If therefore the bevel edge preparation can be obviated, the cost of the welding is reduced. MIG brazing wires There are a number of compositions of filler wire that can be used in MIG brazing, but usually they are of aluminium-bronze composition. Allowing two
to three bays per productive unit gives the total number of bays required. The heelboard, together with the rear squab panel, forms the platform for the rear squab panel, forms the platform for the rear squab panel and rear squab panel, forms the platform for the rear squab panel and rear squab panel.
greatly increases over that of bulk glass. 17.15.1 Burnishing Where the final coat of enamel contains small particles of foreign matter, it is best flatted with P1200 grade wet-or-dry paper with soap as a lubricant. The high pressure and the expanding compressed air evaporate a lot of the solvent and carry off some of the finely atomized paint as
overspray. Aluminium alloys are now being accepted by the automobile manufacturers as a standard material for exterior and interior trim, and are used for all normal bright trim applications such as radiator grilles, headlamp bezels, wheel trim, instrument panels, body mouldings and window and windscreen surrounds. This sliding jaw is marked
manufactured from glass filled nylon 66, which permits higher torque loadings. To simplify identification and rotation, each tower has a coded 416 Repair of Vehicle Bodies Figure 14.17 Bodymaster 2000 measurement system (Celette UK) are drilled in some towers and tops,
the upper set being for mechanicals out and the lower set for mechanicals in. This material has proved an excellent general-purpose steel offering an acceptable combination of strength with good forming and welding properties. The pitch can then be extended to 8D in special cases, but above that the plate will tend to buckle. 263 It is advisable to
bend the end of the rod at right angles, since this permits holding the rod so that it is not in a direct line with the heat of the flame. 17.7.2 Mix methods Internal-mix gun This gun mixes air and paint inside the air cap, and is used with low air pressure to apply show-drying materials (Figure 17.16). Experienced repairers of plastic may recognize broad
types of plastic by the degree of hardness or softness of the component surface. The pulling unit is a multivector system, easily positioned around the jig bed. 11 Name the three methods of fire extinction. An American, John Hyatt, found a way of solving the technical problems which plagued Parkes, and he set up business in 1870 to sell the same sort
of material. Open-ended spanner This is the most commonly used spanner. Standard cut blades are 9 tpi and used for soft metals such as lead and solder fillers. Before welding, remove all traces of oil or grease and brush the edges to be welded with a wire brush. Hoses with an interior diameter of 6 mm should never be used in lengths exceeding 4 m
because of the high pressure drop encountered. Stanley steam cars used paraffin in a multitube boiler and had a chassis made from hickory. Where two cords are normally used they can be pulled in opposite directions, which will make the fitting of the windscreen easier. Calibration of the vehicle is then carried out automatically by Genesis in a few
seconds. Celette UK Metro 90 measurement system The door may be left in its correct position and closed with the restraint in place. Where the rear end of a car becomes accidentally pushed in, the panels can be returned to their correct
alignment in the manner illustrated in Figure 13.61. Plastics also exist in various physical forms. Some will withstand quite harsh environments. This fact is important to remember in using a welding machine, because if the cable is too long, there will be too great a voltage drop. The first pair constitutes the track on which the vehicles are first
received into the paint shop, and along which the preparatory work is usually carried out, i.e. discing, flatting and stopping. A change in welding wire diameter will produce a change in current and voltage, since thinner wires require higher voltage and higher wire speeds in order to produce the same current. Dinging Straightening damaged metal
with spoons, hammers or dollies. 3.11 Sandbags and hardwood blocks Sandbags are leather bags made from two pieces of the molten pool and not directly in the arc core, and should be added with a Table 12.5 Recommended
diameters and current ratings (BS 3019: Part 1) for TIG electrodes Diameter (mm) Maximum current (A) DC Electrodes (SOC Ltd.) Figure 12.11 Appropriate vertex angles of electrodes (BOC Ltd.) Figure 12.11
Recommended angles for torch and filler rod in TIG welding slightly transverse scraping motion, with the tip of the filler rod actually making contact with the weld metal. 16.2 Basic principles of reinforced composite materials The basic principle involved in reinforced plastic production is the combination of polyester resin and reinforcing fibres to
form a solid structure Table 16.1 (Figure 16.1). Indeed, there are instances of a return to nuts and bolts from newer methods of fastening; some British and many continental cars now have bolt-on wings or body panels where previously welding was employed or the structure was integral. Aluminium fuses (melts) at about 650 °C; but the aluminium
oxide will not burn off at less than 1250 °C. Many people, moreover, regard the distinctive smell of leather as an asset, and this defies imitation by manufacturers of substitute materials. No mixing Easy to apply. Nitrogen, argon and carbon dioxide, if allowed to replace the oxygen in the atmosphere, can cause asphyxiation. 3 Which fire extinguisher
should be used? Crash sensors As well as the release sensors for the SRS, many vehicles are fitted with a crash sensor which cuts off the fuel pump in the event of a serious impact. 16 In the automobile industry, why is GRP limited in use to a small specialist sector? The thumbscrew on the bevel is recessed into the stock, allowing it, if necessary, to lie
flat on the work. Air will be diverted into the fluid passage, causing a boiling action and flushing it clean. This face is usually flat, while the other, round end is slightly domed or crowned. There are no special sizes. operation of the electrode. Figure 17.14 Remote cup with gun (2.3 litre capacity) (DeVilbiss Automotive Refinishing Products) Figure
17.17 External-mix suction-feed spray head 17.7.3 Bleed methods Figure 17.15 Typical pressure-feed tank Bleeder gun This is designed without an air valve. So, when it comes to identifying a plastics material check to see if it is reinforced, and if it is which type of reinforcement is used. As an all-round flux for soft soldering zinc chloride is without
equal, but it has one disadvantage for some purposes - its corrosive action if the joint is not afterwards cleaned thoroughly with water. 4 The orientation of the fibres. It can be used as a blind rivet for permanently fastening one or more panels or sections together, and provides an anchorage with the holding strength of at least six full thread turns.
14.2.14 The Genesis electronic measuring system The Genesis electronic measuring system, developed by Chief Automotive Ltd, integrates the precision of laser scanning with a computerized data base for accuracy in collision repair analysis (Figures 14.49 and 14.50). Listen for panels which when tapped gently give a crisp metallic ring. 7.6.1 Wood
screws Joining by wood screws is an essential part of the construction of vehicle bodies which incorporate timber. Those which are electrically driven are used dry, but compressed air tools can be used either wet or dry. In bronze welding the filler metal alone provides the joint strength, and it is applied by the manipulation of a heating flame in the
same manner as in gas fusion welding. It is ideal for such jobs as bonding glass to GRP or bonding GRP and metal, as is often required on vehicles with GRP bodywork. It consists of four specific anchor points and eight modular base blocks. However, the effect it can have on the health of a workforce and the overall efficiency of an organization can be
dramatic. Most of the thickness of the door is due to the depth of the inner panel which is necessary to accommodate the door catch and window mechanism. The fire is in two phases: an initial flash fire, followed by local burning at a number of points. Will readily collect at the bottom of confined areas. All companies have to prepare a manual which
meets the 18 working procedures required by BSI in order to conform: 1 2 3 4 5 Management responsibilities Quality systems Contract review Document control (workshop procedures for body repair, welding and painting) 9
Inspection and testing 10 Inspection, measuring and test equipment (to include spray booths, welding equipment, body jigs, measuring equipment) 11 Inspections and delivery 15 Quality records 16 Internal quality audits 17 Training 18
Statistical techniques. When measurements and deviations need to be documented, the hand unit can be connected to a printer for printout. (Figure 12.35). Usually the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the deflection of the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient clearance for the rear seat panel has to be raised to provide sufficient cle
carriages. One of the chief advantages of this process is that work of a complicated character may be made and completed before ageing takes place. Figure 13.5 A panel being shaped by raising (Frost Auto Restoration Techniques Ltd.) When the article is partly beaten up over the stake, a series of tucks can be made in the outer edges of the work in
order to quicken up the beating or raising process by taking in or shrinking surplus metal. Thatcham exists to promote cost-effective methods for motor vehicle repair. By operating a management system according to the defined criteria of a standard such as BS EN ISO 9001-2000, you have confidence that you have taken all reasonable steps to
guarantee quality to your customer, and you provide evidence of your commitment to do so. One (Figure 6.3), made from goodquality hardened and tempered steel about 3.175 mm thick with one bevelled face, is made in lengths up to 2 m. 14 Define the term 'capillary attraction'. Your outside sign should be simple, easy to read and brightly coloured
otherwise you run the risk of customers missing it, driving past your bodyshop and ending up frustrated even before walking through the door. Both glass and any outside trim mouldings, if used, are recessed into the weatherstrip. As a result of this move towards a more open style, the massive increase in the cost of energy has brought growing the door.
pressure on vehicle designers to achieve more economic operations, principally in respect to lower fuel consumption through better power/weight ratios. When constructing the paint store room, remember to provide space for the mixing system and for the safe storage of paint. Glass fibres have high strength and high modulus, and the resin has low
strength and low modulus. The Regulations say what is meant by suitable PPE, a key point in making sure that it effectively protects the wearer. 13 Name the principal parts of resistance welding equipment that would be used in the body repair shop. It soon became apparent that the hydraulic jack was ideally suited to repair work because it could be
operated in any plane and controlled from outside the car. Solid rivets have also been used since the early days of motor vehicle manufacture to form a permanent joint, but nowadays riveted joints are being replaced by welding. This means that before a metal sheet can be formed into a curve or cylinder, sufficient force must be applied to deform the
structure of the material beyond its elastic limit so that the sheet assumes a permanent curved shape. Press the nozzle of the torch against the work to ensure that the wire is now moved away from the puddle. The whole feed unit is bound together by a plastic sleeve, and is 1.5-3 m long. The closed end of the socket has a square hole into which the
drive shaft of the ratchet fits 1 3 (Figure 3.40b). 6 It must be easy to remove from the brazed assembly. 17.5.6 Masking tape This is a paper tape, one side of which is coated with an adhesive of a non-drying composition. With the Globaljig there is an option of brackets or sill clamps, providing a precise and progressive anchorage. Wax in
varnish creates a matt finish, and silicones in metallic paint give a hammer finish. The successful exclusion of atmospheric contamination depends on the ability to provide a physical barrier to prevent entrainment in the arc area, and in the case of some reactive metals such as titanium it may be necessary to extend this cover to protect the solidified
weld metal whilst it is cooling. Providing that the correct grade is selected as appropriate to the service environment, and that the design and production engineering aspects are understood and intelligently applied, long lives with low maintenance costs can be achieved with these steels. 17.14.6 Acrylic lacquer: complete respray from pretreated
bare metal 1 Spray one coat of acrylic primer filler thinned to a viscosity of 21 to 23 seconds at 25 °C. Workplaces with fewer than 20 employees may require emergency lighting points and fire warning systems. A typical oxy-acetylene nozzle has circular pre-heat holes surrounding a central circular cutting oxygen orifice, and is frequently of a
onepiece construction, made of copper and often chrome plated (Figure 9.24a). The difference between them lies in the method of manufacture of the acetylene. The metal must be preheated to dull red before the welding commences. Warning light is usually located on the dashboard; but sometimes can be found on the airbag
casing in the steering wheel. If you are personally involved in an accident you are advised to keep a copy of the book entry and any completed forms as well as your own notes on the event. In addition, because it operates at low speeds, it covers a broad spectrum of accident situations. Now if you heat up a thermoplastic to a high enough temperature
it is going to melt, this means that you can repair a thermoplastic component by welding. Martensitic Based on a chromium content of 11-14 per cent, although some grades may have a small amount of nickel. Floating blow, where the stake is not directly under the hammer. Movement of the damaged area will take place as long as pumping is
continued. The equipment was introduced to the commercial industries a year later and it immediately proved successful. The laminates have similar strengths in all directions because the fibres are random in orientation. In their simplest form calipers are usually termed 'firm joint' calipers and consist of two legs riveted together at the top. 3 It is
dangerous when used in combination with other materials. Excessive scrap is formed during blanking and therefore it is a very inefficient operation. 12.5.1 Power unit Standard AC and DC welding equipment may be used, but in most cases special welding units are used which are capable of producing AC or DC, have automatic control of argon and
water flow, and have fine current control switches for the stopping and starting of welding. Vector pulling This is achieved by attaching a chain to the damaged area, then passing it over a hydraulic ram set as near to 45 degrees as possible, and anchoring it to either a rack, a tie-down system or a special clamp. Do not open the door or doors when the door or door
tools are fitted on them: there is a risk of damaging the panel or the tools. Hot melts The advantages of hot melt adhesives and sealants are their ability to bond to both pervious and impervious substrates and the speed with which the ultimate bond strength is attained, the latter being particularly valuable in high-rate production. The top of the bed
has a location slot into which the bending tools slide. Knock the trim panel fasteners into place with a fist or rubber mallet. Non-toxic. First, that you need a special plastics welder and 154 Repair of Vehicle Bodies second, if it is not a thermoplastic bumper you may well damage it beyond repair and set the workshop on fire too. For example, if the
barrier cream dispenser is empty, see the chargehand for permission to install a refill from stores. The inner cone will become shorter and sharper and the flame will turn a deeper purple colour and emit a characteristic slight hiss. As the rod melts in the pool, advance the torch forward. This behaviour also facilitates repair by replacing the damaged
bolton or bonded panels using recognized approved methods. They can be of the one-piece variety or can have separate disposable hoods (Figure 2.1a, b). When this is not possible, overspray can be redissolved by mist coating the affected areas with a high-boiling (slow drying) thinner, or by flatting and burnishing. The body scanner housing and the
two laser beams striking the target form a triangle. Thermoplastic Plastic which can be softened by heating, and which still retains its properties after it has been cooled and hardened. The correct pulling angle is essential for successful alignment work. In the UK the Department for Transport (DfT) works with a number of bodies on vehicle safety,
much of the DfT work is sub-contracted to Transport Research Laboratory (TRL) Ltd - formerly a wholly government funded institution. With a monocoque body, the engine, suspension and steering rack all contribute to the final strength and shape of the vehicle, so it is important not to remove them unless absolutely necessary for the type of repair
being carried out. Normally pure tungsten electrodes are used, but to improve are striking and stability an addition of either thorium oxide or zirconium oxide is added to the tungsten. With practice the wrist becomes strengthened, and consequently working in restricted places becomes easier where an even In minor repair work which can be carried
out using hand tools, the first major operation is to reshape the damaged area back to its original contour. In order to move over flat ground, a car must overcome two forces: Figure 1.17 Interior styling model (Ford Motor Company Ltd ) and can be produced on an automatic drafting machine. It seals off the boot or luggage compartment from the
main body or passenger compartment. Plastics can also be chrome plated, either over a special undercoating which helps to protect and fix the finish, or by metal spraying or by vacuum deposition in which the plastic part is made to attract metal particles in a high-vacuum chamber. 2.8.12 Where there is a conflict over limitation of damage priority is
always given to the person's safety You can always buy a new wing for a car, but you cannot buy a new arm for a mechanic. The rate at which the distance travelled. 10.9.1 Setting up equipment for use The most important points to be considered in setting up the equipment are: 1 Thickness of the sheet
metal to be welded 2 Accessibility of the parts to be welded 3 State of the surface of the surfa
cutting and results in greater accuracy and better edge finish, particularly when used for making single and double V edge preparation. 12.2.2 Helium Helium is a colourless, odourless inert gas almost as light as hydrogen. Usual rivet materials are steel, aluminium alloy, copper and Monel. This immediate, accurate information regarding the extent of
the distortion sustained by the vehicle determines whether or not the vehicle will need straightening and subsequently pulling. The larger automotive companies in Europe started CAE activities in the early 1970s - about the same time as the Japanese companies. They do not follow any one particular paint manufacturer's specifications but are
intended as a guide to the use of the various paint types. AC welding equipment has many advantages, namely: 1 Low initial cost 2 No moving parts and therefore negligible maintenance 3 Higher electrical efficiency 4 Ease of transport 5 AC can be converted to DC by means of a motor generator or rectifier, thus making both types available. 16 Show
with the aid of a sketch, a repair situation where resistance spot welding can be substituted by a MIG/MAG spot weld. This stress level often exceeds the elastic limit of the material 336 Repair of Vehicle Bodies and plastic deformation takes place. Figure 9.32 Plasma arc cutting machine in use (SIP (Industrial Products) Ltd ) 14 The operator must be
constantly aware of the risk of fire and fumes, and therefore proper health and safety precautions must be adhered to at all times. 6 Acetylene can form explosive compounds in contact with certain metals and alloys, especially those of copper and silver. Hammers can be obtained for light or heavy work with weights from 12 oz (340 g) to 18 oz (510
g). Pole test Accident patterns vary from country to country to country within Europe, but approximately a quarter of all serious-to-fatal injuries happen in side impact collisions. Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) The measuring system (mechanical) (Car-O-Liner (UK) Ltd.) The measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.42 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) The measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.42 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.42 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.42 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.42 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.42 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.42 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.42 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner (UK) Ltd.) Figure 14.43 Mark 5 measuring system (mechanical) (Car-O-Liner
system can be either mechanical or electronic. It is not necessary to remove the battery. If the settings are correct, the joint will 'unbutton', that is 287 the weld nuggets will be on one sheet and the holes on the other (Figure 10.16(a)). Most MIG/MAG welding sets that are manufactured for the automobile repair trade are semi-automatic, the operator
only being concerned with the torch-to-work distance, torch manipulation and welding speed. Also a corrosion protection for vehicle underbodies against elements such as moisture, road stone chippings. To wheel a panel that has been preshaped by blocking in a sandbag, it is necessary to smooth its surface without altering its shape, and
for this reason the panel should be pulled right through the wheels at every stroke. All electrical equipment must be frequently checked and maintained in good condition. These may be further subdivided depending on the joining process, and therefore cannot be called welding
because the parent metals are not melted to form the joint but rely on a filler material of a different metal of low melting point which is drawn through the joint. If you feel more comfortable, take photos of the attached cables to the old mirror so you can replicate it with the new unit. Step 3 to Replace the Entire Unit: Connect Wires and PanelsNow,
you'll attach the wires to the new mirror unit. However when mild steel, low-alloy steels or high-strength steels are to be welded, argon/carbon dioxide mixture or carbon dioxide is generally used for reasons of overall efficiency, weld quality and economy. Maturing time This may be hours, several days or even weeks depending on the resin and curing
system, and is the time taken for the moulding or laminate to acquire its full hardness and chemical resistance. 4.11.4 Modern trends The interior furnishing of a car is gaining in importance within the automotive trade. With all these parts assembled, and with the final drive unit and the power steering unit in place, a set of temporary road wheels can
be fitted which make the car mobile. One important point to consider is the choice of spray booth. A minor repair can also involve adjustment to door locks and window mechanisms, the restoration of body apertures, and the use of hydraulic equipment to realign body panels and apertures to their original shape. For instance the dangers of oil and
grease and the requirement to wear a hard hat. Generally used for load-bearing applications in dry conditions, as they are prone to moisture attack. Its fine cut is ideally suited for panel replacement where joints have to be cut and welded. Machine at 1800 rpm using a G-mop foam finishing head. (c) Dirt on air cap seat or fluid tip seat. However, there
are some exceptions: the undertray, bulkheads, bumper armatures and door inners are thicker to contribute to the structural performance (Figure 16.33). The types of blow that can be struck on sheet metal are three: Solid blow, where the work is struck solidly over a steel stake. The heat generated at the point of contact results entirely from
resistance. Complex phase (CP) steel has a yield strength of 800-1200 MPa. CP steel has a very fine microstructure using the same alloying elements as in DP or TRIP steel with the possible additions of niobium, titanium and/or vanadium. being sprayed. A further advantage is that polyester stopper can be used, if necessary, between coats of
polyester primer filler. Pan the flame over the entire buckled area so that it is heated uniformly. Open-ended spanners can be single-ended, or double-ended to fit nuts of consecutive sizes. During this operation great care is essential if the panel face is not to be marked (Figure 13.63f). Lift is the force generated by an aerofoil section normal to the
direction of fluid flow. Adjustment for the front wing is usually provided for by slotting the bolt holes so that the wing can be moved either forwards or backwards by loosening the attaching bolts. 610 Repair of Vehicle Bodies Figure 17.53 Low-bake oven joined to spray booth, with through doors for flow line
Stoving The usual stoving schedule is 30-40 minutes at 80-100 °C, following which the body should be allowed to cool for about 45 minutes (longer if necessary) before further masking up for duotone work is carried out. Determine a method of correct positioning of replacement panels and sections such as B-posts, A-posts, or any prominent feature
from which measurements can be made, and scribe these clearly on to the section which is to be used. These fabrics are cheaper to produce and can be much heavier in weight (Figure 16.8). It is very important that the cast iron cools very slowly, or the metal will crack. First the damaged area must have its paint removed and be sanded down to a
bare metal finish in order to give a good electrical contact between the pin and the welding gun. In the case of a fire the normal alarm is a form of siren or bell. Some versions cannot be considerable added rigidity without
greatly increasing weight. Glass fibre should be stored and tailored under dry conditions and separately from the moulding area. As previously stated, there are many variations of materials with these products, and so there is no basic system or process which can be described. It is designed to strengthen the front end; it is part of the crumple zone
 giving lateral strength on impact and absorbing energy by deformation during a collision. A body repairer is expected to provide a safe working environment and advise on suitable safe working methods. The lower critical point is the same for all steels, but
the upper critical point varies with the carbon content as shown in Figure 5.1. Briefly, steels undergo a chemical and structural change, forming austenite, when heated to a temperature above the upper critical point; if allowed to cool naturally they return to their normal composition. Overheating can result in toxic fumes being given off and a
charcoal filter mask should be worn as a safety precaution. Leaching indicates either that the resin used The identification of this fault is visual. The shafts are usually arranged so that they have a 1:1 rotation. (c) When brushed, allow to dry for 6 hours between coats. Figure 1.50 illustrates the completed structure with all panel assemblies in place.
Figure 17.61 Short-wave infrared heater IRT 100 (Infrarödteknik AB - Stanners) A further development is the infrared drying arch, designed to be mounted inside an existing spray booth. 2 Explain the theory of collapsing metal panels when they are involved in collision. Its weight is 2 lb 4 oz (1020 g). Planning plays an essential role in the day-to-day
running of a bodyshop and has a dramatic impact on the overall profitability. As the material is cut, it coils up in front These are often used by the body repair worker for cutting out components which cannot be cut be snips or
hacksaws. These clamps each have two sets of jaws so that the thrust of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest part of the equipment is spread over four points at the strongest pa
in use there are a number of other factors which influence the desirability of a gas for arc shielding. 6 When you are satisfied that the entire surface has remained cold for one hour, submerge the cylinder in water carefully, avoiding shocks and bumps. Figure 3.48 Power saw (Desoutter Automotive Ltd.) 3.22.1 Standard drills There are two types of
power drill used in the bodyshop: the majority are usually electrically driven and require a 13 A electrical power point (Figure 3.50), while the others are air powered and require a compressor and air points (Figure 3.51). The tops, on cars which had them, were of rubberized canvas or other fabrics. Legal standards include material performance in
relation to energy absorption and deformation under impact. Punches are available to remove old rivets. 18 Explain the working procedure of a pincer-type welding gun. Table 11.5 gives the nominal lengths of electrodes. Already there is a widespread use of plastics for front and rear bumpers. Latex A natural rubber used for making flexible moulds.
It is used for press moulding and various low-pressure injection, vacuum and pressure bag. It is a very abundant material and easy to recycle. This mat has a high resin pick-up owing to its bulk, and cannot be used satisfactorily in moulding methods where no pressure is applied. The limits to which these snips can cut
satisfactorily, leaving a good edge, is a thickness of 20 SWG (1 mm) in mild steel and slightly greater thicknesses in aluminium when bought in the quantities needed by a car maker. Craft techniques and minor accident damage 371 area has been
patched, by hammering the patch down below the original level of the panel. The hook nozzle is best here, as the spray from the flexible lance would go everywhere and cover everything with wax. 17.3 Basic composition of paint Pigments Fine solid particles which do not dissolve in the binder. Several other types of coloured prints are also produced
by industrial contact photo equipment, but in spite of their colour these are still generally known as blueprints. Aerodynamics was for many years about observing the air flow over a vehicle, with sample calculations could be done many times faster than by long hand.
16.5.7 Formers A former is anything which provides shape or form to a GRP laminate. Dry sanding tools which incorporate dust extraction methods. Semi-crystalline plastics Semi-crystalline plastics are in two basic types: Polyamide 6
and 66 types Polybutylene terephthalate (PBT). Finally, some panel assemblies are bonded with adhesives. 2 State three advantages of reinforced composite materials when used in vehicle body construction. It is also strongly resistant to soiling, and when it does get dirty the dirt can usually be removed fairly easily without special materials. There
are two reasons for this: first, if you touch an electrically live part you may get an electric shock; second, the machine may be accidentally started which could cause injury or damage. As a long hosepipe will reduce the flow of water, the length of the wire will increase the electrical resistance. 3 Switch function selection switch to resistance spot
welding. It then graphically illustrates how existing positions compare with vehicle specifications and provides direction and distance information for planning the repair. A single quick-fix hose connects the hand tool to the power source. The torch, sometimes known as the blowpipe, mixes acetylene and oxygen in the correct proportion and permits
the mixture to flow to the end of the welding tip or nozzle, where it is burned. In most cases the following parts are usually replaced rather than repaired: 1 All chrome exterior trim. Then working from the base or point of the tuck, this surplus metal is malleted out over a stake towards the edge of the disc. By 1965 Ford had changed all of their
colours to a high-bake acrylic finish, which was a product of the paint industry only, being thermosetting. Incidentally, GRP is also used to cover all glass reinforced plastics are cured by heat during manufacture. Distance cutting This is used for materials
over 5 mm thick. The flow of this thin film of bronze is known as the tinning operation. The higher the density of the gas the more resistant it will be to disturbance, and gases which are heavier than air may offer advantages in the downhand welding position (Table 12.2). Before any pulling commences, the angle of the pull is already known, but
difficulties can arise in setting up the precise angle with the equipment. As the panel is pushed through the wheels the pressure can be increased gradually until the desired curvature is obtained. 460 Repair of Vehicle Bodies Figure 14.95 Drilling out spot welds for the removal of damaged panels (Motor Insurance Repair Research Centre) Figure
14.97 Cutting out damaged panels with a power saw (Motor Insurance Repair Research Centre) Figure 14.98 Alignment of new panel sections (Motor Insurance Repair Research Centre) Figure 14.99 Cleaning up the locating flanges (Motor Insurance Repair Research
Centre) cases it is helpful in confining the heat, and thus reducing the chance of distortion, to place wet cloth packing either side and a little distance away from the weld; alternatively there is a foam type of material which will act as a heat barrier (Section 14.4.7). Figure 5.8 Bending action 172 Repair of Vehicle Bodies Calculation of the bending
length The formula for calculating the bending allowance is (r/2) 

T. Computer-aided manufacturing (CAM) Preparation of production processes. Wash out ashtrays. Burnish surrounding panel. 30 Explain the differences
between a hydraulic push ram and a hydraulic push ram and a hydraulic pull ram. The base frame of the alignment bench is a welded structure built from square cross-section tubing, and can be fitted with an integral scissor lift or a single column lift. 12 Explain the operation of the swaging machine. As plastic materials are increasingly used to replace aluminium, zinc die
castings and other metal parts, so new fasteners have been designed capable of joining plastic components together. The mechanical system consists of a measuring tapes for length measurements. Representative test samples produced under similar conditions
to the in-service components, for example welding procedure tests, are normally used, and accurate comparisons made. In cases of this nature a compromise must fit correctly into the opening provided for them, because if the door is
incorrectly positioned it will Major accident damage 445 Figure 14.69 Alignment and repair using a laser measuring system (Dataliner, Geotronics Ltd.) Figure 14.70 Autorobot L using full measuring system (Kroll (UK)
Ltd ) not close properly and the gap around the door will not be uniform. Figure 11.7 Arc welding positions 301 302 Repair of Vehicle Bodies 11.5.3 Vertical position Vertical welding is done by depositing a weld in an upward or downward direction. xxvi Glossary Foams (flexible) A resin which is often used for cushioning in the automobile industries.
Pour a small quantity of the solvent into the container and spray it through the gun to flush out the fluid passages. Superficial defect repairs Pin holes or air voids Either drill or rout out so as to leave a larger hole with near vertical walls, or enlarge by gouging or picking out. In composition the wires are usually quite similar to those used by most
other bare wire processes. The most common sizing system uses numbers which are marked on the nozzle; nos 1-35 are for use with thicknesses up to 10 mm and nos 35-90 are for 10-25 mm (see Table 9.1). The measuring system can be used with all Universal Bench
units. The bending machine is only suitable for single bending operations. Socket sets can be purchased in 4, 8, 3 1 2 and 4 in drive sizes. Neutral flame contracts and the white cone assumes a definite rounded shape.
Bulkhead A transverse support in a body structure. To give some idea of the range of choice in two pack base-coat-and-clear materials, the following list will be helpful. Direct damage marks are usually scratch marks where the paintwork has been damaged; they are an excellent guide to what happened, and indicate the possible location of any hidden
damage. Figure 8.2 shows a selection of soldering bits. It should be of sufficient capacity to hold the largest electrode easily. Under the COSHH Regulations, respiratory protection is essential and therefore must be used. 13 Use air line to dry engine.
43 How can you ensure that road wheels are fitted securely? In order to initiate the standing arc it is necessary to produce an ionized path in the gases. When too wet a coating is applied, the metallic flakes move freely within the wet film, and when solvent evaporation takes place they are generally in a fairly upright position. The result of mixing in
the wrong proportions can give rise to an exothermic (heat releasing) reaction; in extreme cases the mix can ignite. It offers high- and low-crowned faces for work on small areas of damage. 1923 (b) Gordon England Ltd, 1922 (National Motor Museum, Beaulieu) selection of Austin vehicles from 1909 to 1992. The next stage is to establish a chalked
centre line through the diagonals. Use a fairly course blade, Forrest Blades aluminium saws have alternate a precise and four sided teeth. The repair system offers specific anchorage that can guarantee a precise and four sided teeth. The repair system offers specific anchorage that can guarantee a precise and reliable repair.
with filler as the applicator is cleaned off, or simply owing to forgetfulness. Whilst it is not possible to achieve a factory-type flow line for refinishing jobs that may vary tremendously in their requirements, e.g. size, extent of repair and amount of work to be carried out, the desired continuous supply of vehicles to the spray booth may be achieved. Four
special anchor clamps are supplied. The condition in which heat-treatable alloys are supplied should be related to their application or 141 use in bodywork. Attached to one end of the shafts are male and female rollers shaped to produce a swage of the desired form. 7 Illustrate types of joints that would be suitable for spot-welding applications. The
pressure will force the paint Automotive finishing 791 Figure 17.25 Basic parts of a standard spray gun (DeVilbiss Automotive Refinishing ring for air cap Air
packings Fluid needle packing nut Valve assembly Kit of five circlips Kit of five orings Fluid needle Spring Kit of five gaskets from the gun and fluid hose back into the tank. Many models have spring loaded hinges so that the tension of the springs holds the bonnet firmly in place at the hinge side. As far as possible, health and comfort depend in the
first place on planned extraction, and in the second place on workshop education in the nature of the materials used. A coat of sealer could be added to the process, where costs permit, between stages 10 and 11. Be careful, this heat can cause fire and other damage. A more rapid and more even rate of cooling can be obtained if the steel is moved
about in the cooling liquid, but only that part of the steel which is to be hardened should be moved up and down in the liquid in order to avoid a sharp boundary between the soft and hard portions. Before the sheet is formed in the press the grain structure is constant and the thickness uniform throughout (see Figure 13.28). Good-quality transitions
can even be obtained when spot grinding. The upper surface of the frame is milled flat to serve as a reference plane, and there are milled tracks on all four sides for attachment of bench wheels, bench mountings and jack plates. Place the plunger on the floor and slowly push down until it collapses, expelling all the air. These locking elements utilize
most of the threads that come within the depth of the collar (on the flange nut) or the element (on the flange nut) and distribute locking pressure over wide areas. The identification of nuts is outlined in Figure 7.49. The arm is
fitted with an extension for high pulls. In the first instance it is necessary to determine the number of operatives at Bodyshop, whether the bodyshop planning 503 the bodyshop, whether the bodyshop planning 503 the bodyshop, whether the bodyshop planning 503 the bodyshop plann
keep out dust, dirt and overspray and also prevent long hair (tied back) becoming entangled in moving equipment. Must be mixed Needs to be heat cured Must be mixed Needs to be heat cured Must be mixed. Low-carbon steel tolerates excess heat well. • Carry out any diagnostic procedures using the correct equipment. The surfaces are then prepared with the materials included in the
individual manufacturer's glass replacement kit, that is sealer application gun with bonding material, suction cups and leak test equipment, following the instructions provided. The welding clamp must not be moved during cutting; the machine should be disconnected. The three main requirements of an air line installation are: 1 Low pressure drop
between the compressor plant and the points of air consumption 2 Minimum of air leakage 3 High degree of contamination filtering throughout the system is as follows: 1 Clean off all traces of traffic dirt, grease, wax and silicone polishes by using water miscible cleaning solution. Note that the gun is aimed at the top
Automotive finishing and refinishing 593 Figure 17.30 Alternative panel spraying method Figure 17.28 Tilting spray gun Figure 17.31 Spraying and refinishing 593 Figure 17.30 Alternative panel spraying method Figure 17.31 Spraying large panels Figure 17.30 Figure 17.30 Alternative panel spraying method Figure 17.30 F
moisture can gather here and start rust. 13 Compare the use of a head shield to that of a hand shield for continuous welding operations. Dry off and tack off. 17.6 Spray painting equipment in a spray painting shop are basically as follows: air compressing unit, air line, air filter, pressure regulator; air hose and finally spray gun.
They are particularly effective for dealing with class B fires and with fires started by an electrical source. In some models the headlights are recessed into the front wing and fastened in place by flanges and reinforcement rims on the wing. Careful consideration of the problems of the vehicle movement will enable this supply to be
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obtained with the minimum of time, labour and space. 9.5.1 Filler rods for use in oxy-acetylene welding are available in the following metals: mild steel, wrought irons, high-carbon steel, alloys, zinc-based die cast alloys. This reduction in
thickness can be made without loss of strength. Double Berlina A longer version of the Berlina but having the driving position separated from the rear panel of the driving cab, or the rear window of a saloon body. At higher
temperatures temperature viscosity is negligible, but there is a sharp variation within normal atmospheric temperature range (Figure 17.70). 4.3.1 Low-carbon steel For many years low-carbon steel (sometimes referred to as mild steel) has been the predominant autobody material. 13.3 General guide to the fabrication of hand-made panels When a
panel is required to be made by hand, the first essential is that a jig or former should be made to resemble the exact line and contour. Wheel alignment has an important role to play in the overall safety of the modern vehicle, and proper testing equipment in this area is now vital. After this inspection the assessor will send written instructions on
behalf of the insurance company; these constitute the authority to repair. 16 Identify the control measures already in place, including information, instruction and training. Glassmatrix communication links. Powdered mineral fillers usually increase compressive strength; fibrous fillers
improve tensile and impact strength. or o DTI dia. Boot lid Door covering luggage compartment. Leave polish applied at this stage. Whether the metal ultimately fails by fracture or by breaking depends on a number of factors associated with the type and conditions of service. They should be designed to spread loads over wide area. Up to the 1960s
the whole of the body shell was built by the company from a number of different panels, all made with the help of a stretch-press. The change to lighter monocoque construction introduced one other dimension which demanded further consideration.
removed and a feather edge achieved. Domed tips are recommended; they adapt themselves best to panel shapes and last longest. When not in use as a body repair system, the jig makes an ideal general service lift, as the vehicle can be supported either on its own four wheels or on its underside using the wheel-free system. 2 Which three conditions are recommended; they adapt themselves best to panel shapes and last longest.
are essential to achieve a good soldered joint? This ensures high grinding performance, with multiple contact between the grinding particles and virtually all materials: wood, paint, plastic, filler, metal, non-ferrous metals and so on. The mould itself can be made of any material which will remain rigid during the application of the resin and glass fibre
which will not be attacked by the chemicals involved, and which will also allow easy removal after the resin has set hard. (g) Simple butt. In the water-cooled models a third cable is added to carry the water to and from the torch. However, it is quite customary to combine cloth and mat, not only to obtain adequate thickness, but because if the
sandwich of resin, mat and cloth is arranged so that the mat is nearest to the surface of the final product, the appearance will be better. 6 Remove all plastic labels from bodywork using hot air gun. It also has the maximum bulk strength of all tin-lead solders, and is used for fine electrical and tinsmith's work. Where the surface is not too rough, a
better method would be to use cellulose primer surfacer thinned 1:1. Product Figure 10.5 (a) Resistance spot welding system (b) relationship between weld formation, current and pressure in welding system (b) relationship between weld formation, current and pressure in welding system (b) relationship between weld formation, current and pressure in welding system (b) relationship between weld formation, current and pressure in welding system (b) relationship between weld formation, current and pressure in welding system (b) relationship between weld formation, current and pressure in welding system (b) relationship between weld formation, current and pressure in welding system (b) relationship between weld formation, current and pressure in welding system (b) relationship between weld formation and pressure in welding system (b) relationship between weld formation and pressure in welding system (b) relationship between weld formation and pressure in welding system (b) relationship between weld formation and pressure in welding system (b) relationship between welding system (c) relationship between well and pressure in welding system (c) relationship between well and pressure in welding system (c) relationship between well and pressure in well and pres
normal access to both sides of the overlapping panels to withstand such electrode forces. RRIM polyurethane has the properties of good recovery from deformation, outstanding resistance to wear, impact and abrasion, and a fast cycle time in manufacture. This is the name given to 16.5.2 Pre-accelerated resins Reinforced composite materials 541 the
addition of a catalyst to start the curing reaction at room temperature. The Genesis system measures using the principle of triangulation. 11.6.6 Methods of welding Tapping method The tapping motion method is as shown in Figure 11.10. Gas pressures are shown as bar: 1 bar \in 14.505 lbf/in2; 10 lbf/in2 \in 0.689 bar. As the goggles become pitted in
time and obscure the work, it is usual to protect the tinted glass with a plain one which can be replaced at low cost. 5 If you are on the hard shoulder get as far over to the left as possible. In case of fire in the vicinity, they can be kept safe by drenching the containers with water. Reinforced composite materials 573 Furane resin Extinguish all naked
lights, open doors and windows. Primer filler A primer filler is similar in function to a primer and a filler. Read instructions on adhesives for stick-on styles or just snap in the new unit. The reception area is very important. Ensure gloves are free from holes and are clean on the inside. These three things result in the visibility of the damaged area being
affected. The following are the terms in most common use: 1.5.17 Trims Some details of exterior and interior trims are shown in Figures 1.48 and 1.49. Apply as many coats as may be necessary. If this is impossible owing to inaccessibility, the weld should be hammered in using a shrinking dolly and the weld area filled. As the paint solvent is
extremely volatile, the cap must be screwed down tightly on the tin when not in use. 4 Customers become less likely to look for a special assessment of work done. Pure catalysts are chemically unstable and liable to decompose with explosive violence. For the purpose of locating the leak the vehicle should be considered in three specific areas: the
front interior space, the rear passenger space, and the boot space. It is a text book and reference work which covers the concepts, principles and skills needed to carry out effective vehicle body repair and re-finishing. Vehicle thermoplastic components are made to operate normally over a wide temperature range, so obviously they need to get very
hot before they will melt and very cold before they become brittle. 22 Explain the importance of the use of a barrier cream. 4.13.7 Painting Plastics materials require a suitable keying primer and/or undercoat. Abbreviations for automotive plastics materials require a suitable keying primer and/or undercoat.
Polypropylene* Polyethylene* Polyethylene tetraphtalate* Polyurethene (thermoset) Unsaturated polyester (thermoset) Unsaturated polyethylene tetraphtalate* Polyurethene tetraphtalate* Polyurethene tetraphtalate* Polyurethene tetraphtalate* Polyurethylene* Polyethylene* Polyethylene
polyethylene Vinyl Low density polyethlene Polystyrene Other 1PETE 2HDPE 3V 4LDPE 5PP 6PS 6OTHER 4.13.1 Types of plastics is being used here because it is technically correct to describe the range of manmade materials. It is unique in that the frame may be disengaged from the lifting mechanism, allowing a
repaired vehicle to Figure 14.22 Mobile bench with autocontrol measuring system and swivel pull post (Car Bench International) 420 Repair of Vehicle Bodies raised by using a mobile control unit with a lifting capacity of 3.5 tonnes, which allows adjustment to height levels to secure the frame in any comfortable working position. 4 The piston rings
are worn. Putting a low density core between two layers of composite material will add stiffness with minimum weight and at reasonable cost. The oxygen is turned on and the supply is gradually increased until the flame, though still of abnormal size, contracts towards the welding torch tip, where an inner white cone of great luminosity commences
to make its appearance. Deep well sockets are made extra A variety of threaded fasteners used in the automotive industries are assembled by the use of a screwdriver. Punches should be ground so that the grinding scratches lead to the point. 30/68.5/1.5 solder, known as plumber's solder, is also extensively used by the car body repairer. Additional
qualities are necessary for tilt covers, headlinings and hoods for convertibles; the material for hooding convertibles must be resistant to mildew, to shrinkage and to wicking, this last term relating to the absorption of water on the inside surface
table where random checks can be made on each part of each chassis to enable the accuracy to be maintained (Figure 13.17). 14.2.1 Dozer equipment Blackhawk Automotive Ltd have a portable pulling frame that can be taken to the car in any part of the body repair shop and then moved on to the next job once straightening has been completed. The
small manufacturer produces bodies with skilled labour and a minimum number of jigs, while the mass producer uses many jigs and automatic processes to achieve the necessary output. Some pigments possess good anti-corrosive properties and are used in paints designed to give protection to the substrate. The single-strap butt joint consists of two
plates butted edge to edge with a strap covering the centre of the butt and riveted down each side (Figure 7.3). This means that they must be put into a large tank for bulk incineration. The system works, as follows: 1 All foreign
materials and crushed glass are carefully removed from the centre of the damaged area to open up an airway into the break. Place the glass fibre mat into the resin and complete impregnation by stippling on more resin. For this reason a mixture of argon with 2 per cent oxygen and 12 per cent carbon dioxide is used to give better heat flow, greater
tolerance to variation in setting, and low spatter generation. This tool is ideally suited for the small body shop where limited cutting is required. Work the torch slowly to give the heat a chance to penetrate the joint, and add sufficient filler rod to build up the weld about 2 mm above the surface. The first step in smoothing is to try to level out the
uneven surface by working the high areas into the low areas. Moulded felt can be supplied covered with a range of woven textile covers or with various grades of PVC and heavy-layer bitumen EVA products. Never grip this holder in a tense manner; a firm but relaxed grip will produce a steady hand which is essential while striking and maintaining the
arc. Nowadays the windscreen and door glasses are made of laminated and/or toughened safety glass. Spray over the repair with acrylic sealer. 13 Describe the movement of a dual-action (DA) sander. 4 Vacuum clean inside of car. Many paints, refinishing chemicals and bodyshop materials will cause irritation on contact with the skin and must be
removed promptly with a suitable cleansing material. The table below lists some of the common terms. It produces a tenacious bond while maintaining flexibility, even in cold temperatures. The wire is given a circular forward action and the welding torch is moved steadily along the weld seam. The panels were either cedar or Honduras mahogany
about 9.5 mm thick, glued, pinned or screwed to the framework. Modern toughened glass is produced by heating the glass in a furnace to just below its softening point. As the nut is pushed on the panel edge and over a predrilled hole, thus holding the nut in position. For example, at 20 °C with a relative
humidity level of 65 per cent, a 6 mm diameter bead will be tack free within 1 hour and fully cured in 24 hours. Therefore the wires used must always be as long as possible, with suitable temper for being fed smoothly and continuously by motor driven mechanical means through the welding apparatus. It is designed to replace panel welding with a
minimum of surface preparation; it will also protect against corrosion. The centre Measuring and marking-out instruments 189 square tool is used in conjunction with a scriber. Sand the repair using a DA sander: start with a coarse grit disc, feather edging the whole repair. When welding in this position the electrode
should be at an angle of 60-70° to the plate surface or horizontal. Test penetration before spraying to ensure adequate clearance for lance. Figure 3.46 Pneumatic metal shear (Desoutter Automotive Ltd.) Figure 3.45 Air shears (Desoutter Automotive Ltd.) This is a
portable nibbler which uses a punch and die (Figure 3.47). Circuit The path along which electricity flows. The jack is placed across the aperture of the boot lid, with a wedge head attached to Figure 13.61 Repairs to a door opening (Blackhawk Automotive Ltd.) Craft techniques and minor accident damage 379 Figure 13.61 Repairs to a door opening (Blackhawk Automotive Ltd.)
and rear windscreen (Blackhawk Automotive Ltd ) Figure 13.59 Repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk Automotive Ltd ) repairs to a door opening using push ram (Blackhawk A
floor sections. 2 List the hand tools which you would expect to find in a body repairer's toolkit. As a rule the composition as nearly matches that of the base material as is practicable, while also ensuring good weld properties and work together to achieve the standard with external
support. The parts department is a very valuable item in the profitability and efficient running of the business. As the various detailed parts are made, by either simple press tools or traditional hand methods, they are spot welded into minor assemblies or subassemblies; these later become part of a major assembly to form the completed vehicle body.
2 Provide the environment in which the participants can work together towards the required standard. 6 Provide equipment that conforms with EC product safety Directives (see below). Oxyacetylene welding and manual metal arc welding were the first processes to employ total fusion. Cyanoacrylates Also based on acrylic resins. This method of
 welding is an electric arc process using DC current and a continuous consumable wire electrode without the addition of flux. The mandrel is drawn through the rivet towards the head, and is thus part of the placing tool rather than the component. If the metal is prevented from springing back by other strains imparted to it by additional bends or
creases that have been formed by accident, the metal can then be restored to its normal contour by relieving whatever new strain is holding it out of position. The advantage of this mode of operation is the cathodic cleaning effect which removes the tenacious oxide film from the surface of aluminium alloys. 20 Describe a method of resistance weldings are the cathodic cleaning effect which removes the tenacious oxide film from the surface of aluminium alloys.
that would be used on the assembly line to weld a roof panel into position. Wax polish and polythene sheet are other suitable release media (Figure 16.38). 4.12.3 Thermoplastics and thermosetting plastics The simplest way of classifying plastics is by their reaction to heat. The technique on car bodies is to arrange for spot-welded flanges to be either
covered with trims (door apertures), or with a sealing weather strip (window and screen surrounds). Pneumatic tools, by contrast, are more complex. Fabrics in leno weave are usually used in conjunction with other weave style fabrics as leno weave are usually used in conjunction with other weave are usually used in conjunction with other weave style fabrics as leno weave are usually used in conjunction with other weave style fabrics as leno weave are usually used in conjunction with other weavers.
from a centre-line reference on the rear axle and then checks all steering geometry angles on all four wheels, a simultaneous four-wheel check will speed up the entire operation. 17.16.1 Spray nozzles Rigid lance (1100 mm) This produces a 360 degrees spherical spray pattern at right angles to the lance, combined with a forward and backward
directed spray that allows all surfaces - front, back, sides, top and bottom - to be coated in one single sweep or stroke. Volt This is the pressure of the electricity. The gripped end of each electricity and sketch two types of mole grips used in body
repair applications. 9 Calibrate alignment equipment. 21 Draw up an action plan and prioritize risks to be tackled. Apply a strong force from a mechanics hand and these components will break. The other leg is then set and locked at the correct distance by the aid of a locking screw fixed in the head. Wheel alignment The adjustment of a vehicle's
wheels so that they are positioned to drive correctly. If the cup is turned inside out during reduction, the operation is called reverse redrawing. 13 Make a list of hand tools, power tools and safety equipment needed in a workshop. A tape runs along each side of the frame, and slides within its housing for instant setting. The result is a relatively small
and cool weld pool, limiting burn-through. All repaired vehicles should be thoroughly inspected for quality control. 11 Tools and jack should be cleaned, and repainted if necessary. When the vehicle is stationary, it can be difficult to reproduce these conditions to a realistic level. 22 Why are the teeth on a body file milled in a curved formation? This
assists in locking the repair in place (Figure 16.37). Its uncoated side provides a good surface for paint appearance, so it is used mainly for outer body panels. When this patch is cured, fix a loop of wire through two holes in the centre. Once the arc is struck the arc voltage will drop to 20-25 volts. Quarter panel The side panel extending from the door
to the rear end of the body (including rear wing). As a trainee you must follow the health and safety advice issued by your employer, unless you know that it is wrong, in which case you should point this out and seek advice from your union safety representative. Apply the wax to the surface. 6 What is the basic difference between those paints classed
as lacquers and those classed as enamels? Any bodyshop currently operating below these levels is not required to register. The underbody is made up of formed floor sections, channels, boxed sections, formed rails and numerous reinforcements. The bend should not be too sharp, as the metal has to be worked round the wire. For use on long seams.
The base of the level has a concave groove along its length which allows it to lie on curved work. In this method the tools may be taken to the job and the work carried out on the spot. For snap head rivets, a punch or tool (snap) having a half-spherical cavity similar to the rivet head is used to support the rivet head, while the other-end of the rivet is
riveted over by holding a similar punch to the rivet end and striking it with a hammer, thus forming a second cup head on the other end of the rivet. Face shields with an adjustable head harness and deep polycarbonate brow guard with replaceable swivel-up clear or anti-glare polycarbonate visor BS grade 1, which gives protection against sparks,
molten metal and chemicals (Figure 2.4a, b). 3 Improper use of the gun, such as making incorrect strokes or holding the gun too far from the surface. Aluminium For pure aluminium sheet, either paint both sides of the metal with flux or dip the hot rod into the flux and allow the flux to coat the rod like varnish. Figure 7.19 The Chobert and Grovit
riveting systems (Avdel Ltd ) 1 2 Place Chobert rivet or Grovit in prepared hole Draw steel mandrel, which has opposite taper to rivet, through from tail end of rivet, expanding rivet tail around rear side of hole, to form shoulder. They are suitable for general areas. (d) (c) (b) (a) Figure 3.1 (a) Standard bumping hammer (crowned faces) (b) standard
bumping hammer (flat faces) (c) light bumping hammer (crowned faces) (d) light bumping hammer (crowned faces) (d) light bumping hammer (flat faces) (d) light bumping hammer (flat faces) (e) light bumping hammer (flat faces) (flat faces) (flat faces) (g) light bumping hammer (g) light bump
always pick up the same thread, thus maintaining a strong joint. Blisters can appear on surfaces which have been freshly painted or which have been freshly 
because of its rotary gearing. Many now include adaptive in-process control units (pulsing weld timer). Computers are rapidly losing their mystique, and are becoming as indispensable to the bodyshop as the spray booth and chassis jig. Employers also have duties to: 1 Assess the risks and PPE intended for issue, to ensure that it is suitable. Volvo do a
very unusual promotional crash test which involves propelling a car from the top of a tall building (Figure 1.23). Viscosity The degree of resistance to flow of a liquid. Ahmed model, is used, see Figure 1.31. Phaeton A term from the days of the horse-drawn
carriage. The best rule to follow when selecting a wheel is to use the flattest wheel possible for the job you are doing. Extremely adherent to raw, degreased, bonded, primed and painted sheet steel. Remove DVCs with a tool called a hooked pick. Step 2 to Replace the Entire Unit: Disconnect WiresThen, disconnect the electrical wires and connectors
to the mirror, and finally, unscrew and remove the old mirror from the door. Mechanical measuring rods are used to remeasure the chassis and body. 26 Describe the advantages of socket sets in removing and replacing damaged panels. Higher-strength steels are used for selected panel sections, but as they are vulnerable to heat they are not as
easily welded as mild steel. Stage 6 in the process summary refers to the application of cellulose stopper. An incorrect setting would cause excessive tyre wear. Substrate must be primed and can be readily painted over. 4.6.3 Manufacturing process Sheet products are first cast by the semicontinuous casting process, then scalped to remove surface
roughness and preheated in readiness for hot rolling. The unit has three jobs: it monitors the system for faults, controls the operation of the airbag and seatbelt pre-tensioners, and stores electrical charge for emergency use. It is imperative that after repairing all major accident work the vehicle's steering geometry is checked with optical alignment
equipment and a road test carried out to assess its roadworthiness and handling capabilities. 4 Connect the main supply, set the wire speed selector, pull the welding torch trigger and feed the wire through the hose to the wain supply, set the wire speed selector, pull the welding torch trigger and feed the wire speed selector, pull the welding torch trigger and feed the wire speed selector, pull the welding torch trigger and feed the wire speed selector, pull the welding torch trigger and feed the wire speed selector, pull the welding torch trigger and feed the wire speed selector, pull the welding torch trigger and feed the wire speed selector, pull the welding torch trigger and feed the wire speed selector, pull the welding torch trigger and feed the wire speed selector.
voltage and power are desirable for welding thick material and metal with high heat conductivity such as copper. Rotary coupling, between the steering wheel and the outside of the steering wheel and the outside of the steering wheel and the outside of the steering column, is unlike any other electrical coupling. The use of heat soaks in the form of damp material is one way of doing this; but make
sure that this is clean and thoroughly dried off afterwards to ensure that no corrosion can occur later. 14.5.2 Costing The determining factor when deciding whether to repair or replace lies in the comparison between the cost of repairing the damaged part as against the cost of a new replacement part. High-carbon steels require similar treatment
except that the temperature to which the steel needs to be heated is somewhat lower and is in the region of 800 °C. 2 Clean chrome bumper bars with rubbing compound. Also it gives rise to additional dirt, air pollution and fire hazards. This essential stage in the repair of the vehicle is carried out by first inspecting the damage and checking its
alignment by one of the recognized methods to locate the exact position and extent of the damage. Figure 7.60 Plastic capture nut (TRW United-Carr Ltd.) Methods of joining 223 They allow panel removal for repair, service or inspection
purposes. The cooling unit and the fan will start and the indicator 'on' lamp will light. The hammer is used on the initial stages of shaping metal, the component normally being planished or wheeled to its final shape. These sheets undergo several deformations during the time they are being formed into components, yet because of their outstanding
ductile properties they seldom fracture. When the welding torch is lit, the acetylene is turned on first and ignited, giving a very smoky yellow flame of abnormal size which shows two cones of flame in addition to an outer envelope; this is an exaggerated form of the carbonizing flame, but gives out comparatively little heat and is useless for welding.
The process can utilize argon, argon/carbon dioxide mixture or carbon dioxide as the shielding gas, the choice being dependent upon the type of material being welded and the economics associated with the rmosets. Figure 6.14 Radius gauges (external and internal radii) (Neill Tools Ltd
(Moore and Wright)) 6.2.20 Drill gauge The drill gauge (Figure 6.15) is a flat piece of metal having a selection of holes of accurate diameters. Of the contact resins in the preparation of glass reinforced laminates because of their combination of low cost and
 ability to be moulded without pressure, and because their conditions of use fitted into normal workshop practice. The respirator draws contaminated air through filters with a motor fan powered by a rechargeable battery and supplies clean air to the wearer's face. These are new colours only, and the total number of colours that the refinisher may
have to match can run into thousands. When working in a spray booth, the spray painter rarely, if ever, requires an air hose greater than 6 m in length. 8 They are then trimmed and ready for use. Alternatively the seals can be adjusted by carefully setting the mounting flange after making sure the fit of the door is correct. Failure usually occurs in the
parent material; therefore exact measurements are not usually obtained for the weld itself, although in this case the ultimate tensile strength (UTS) of the 340 Repair of Vehicle Bodies weld is higher than that of the parent metal. Its weight is 3 lb (1360 g). The depth of impression can be adjusted by turning the knurled head. The template is now
ready to be used either for checking or for marking out predetermined shapes directly on to sheets. The vehicle starts with the new body shell being cleaned down with a mild acid preparation called deoxidine. 7.7.7 Non-metal clips 1 2 3 (b) Figure 7.59 (a) Simple push-on clip showing clip in position (b) tubular clip, showing fitting sequence (Forest
Fasteners) 1 Clip enters hole: cut-outs register with panel, allowing clip to expand and hold 2 Second part of assembly is lined up and rivet and integral stub inserted 3 Rivet pressed home, engaging turned-in end of clip which expands to bite on rivet The use of plastics has given rise to the development of new types of fastenings. 17 Describe, with
 workshop easily and quickly. These types of car parts are designed to be removed in order to access and repair the car. The trickiest part about a car mirror repair, states Family Handyman, is finding the hidden fasteners and panel screws behind little decorative vanity caps (DVC) or within other nooks and crannies. Most mass produced car bodies and repair the car. The trickiest part about a car mirror repair, states Family Handyman, is finding the hidden fasteners and panel screws behind little decorative vanity caps (DVC) or within other nooks and crannies.
valuable savings in time, labour and handling. 17.5.8 Solvents The paint to be used with hammer and dolly to manipulate the panel and reduce
dust entering your eyes. Effective lighting is not necessarily a question of increasing the level of lighting: this can be counter-productive as it produces what is known as disability glare which can effectively blind the operative, preventing him from seeing surface faults. Its main uses are for riveting, chiselling, forming angles and brackets, planishing
heavy welds to refine their structure and flattening heavy-gauge plate. 36 List the consumables used in plasma arc cutting. For these reasons most welding shielding gases are based on the inert gases argon (Ar) and helium (He). 9.14.3 Cutting methods The equipment can be used for contact or distance cutting. Other materials needed Advantages of
reinforced composite plastics (Owens-Corning Fiberglas) Compared with metals 1 Higher strength weight ratio 2 Easier and cheaper manufacture of complex shapes 3 Good corrosion resistance 4 Ability to incorporate self colours Compared with injection
moulded thermosets Compared with wood 1 Greater scope in 1 Far higher strength 1 Much highe
better electrical resistance dimensional stability properties 5 Higher water resistance 6 Ease of fabricating complete structures 534 Repair of Vehicle Bodies Figure 16.1 Flow chart showing the principles of reinforced composite materials are the releasing agent, filler and pigment concentrates for the colouring of glass
insurance claim. If you go the aftermarket route, get the exact mirror your vehicle on the bench. Though bolts are shown. A try square consists of a stock and a blade, and these may be made separately and joined together, or the
whole square may be formed from a single piece of metal. Contact moulding can be further subdivided into hand lay-up and spray lay-up. 4 Ensure that these procedures are written down, understood and followed by all personnel within the workshop. These torches have three tubes leading to the nozzle, and require special three-seat nozzles (Figure special three-seat nozzles).
the major causes of death in car accidents is damage to the brain caused by deceleration rates which are too high. Mould cleaner Absorb into sand or earth, remove to landfill or controlled incineration. Some require heating to induce a chemical reaction to create adhesion, whilst others will cure at room temperature. A direct glazed windscreen can
also be replaced to its original specification without affecting the structural integrity of the vehicle. By doing this, Car Bench has transformed the idea of a traditional bracket, fixed and rigid, to a more functional system which can be adapted to suit each individual repair regardless of the make or model of the vehicle. However, some stand tools are
available. Cutting should be carried out in a well ventilated area, and the operator should always be alert to fume build-up. If the base metal is too hot, the bronze will tend to bubble or run around like drops of water on a warm stove. 531 15 Name five of the main health and safety legislation Acts which affect the workshop. Many types of proprietary
fluxes are available for brazing aluminium. If they are cracked, replace them immediately. It is vital that all tubes fitted in a spray booth should be the same colour. A special air cap is provided with the gun. High-speed steels are based on tungsten or molybdenum or both as the primary heat-resisting alloying element; chromium gives deep hardening
and strength, and vanadium adds hardness and improves the cutting edge. 9 State the minimum noise level at which ear protection must be used. Multibraid hoses are available for high-pressure work. Polyester resins are supplied as viscous liquids which solidify when the actuating agents, in the form of a catalyst and accelerator, are added. Painting
should always be carried out according to the paint manufacturer's instructions. Their strength is often employed in bonding larger components. The working height of the track is adjustable, and the work platform makes it easy to reach all points of vehicles being repaired. Hand-lamps should operate at 50 volts, or preferably 12 volts to give the
highest level of safety. Rovings can be supplied to suit a variety of processes, including projection moulding, continuous laminating, filament winding, pultrusion and as reinforcement for sheet moulding compound. This can be prevented by: avoiding large amounts of resin (but where this is necessary the build-up should be gradual); using the correct
amount of ingredients; being aware of any increase in workshop temperatures; and noting any variations in the correct percentages of etch primer are two-pack materials, the base and activator being supplied separately. The gun is usually used with small compressors having a limited output
and having no unload or pressure switch. Throughout the repair the computer compares vehicle specifications with the manufacturer's current reference point measurements. Place protective paper on floor mats. This is to allow access to items subject to examination. 8 Illustrate the two types of calipers which are used in the workshop. Denib and
dry. Has excellent adhesion to raw, primed and painted sheet metal, and can be painted over after drying Specially used for the underbody area of the vehicle. Tempering is carried out to allow the steel to regain some of its normal toughness and ductility. An adjustable 170
Repair of Vehicle Bodies hold-down is usually fitted to the top member to hold the spring clips used on many modern door handle spring clip removers These are specially designed pliers for fitting or removing the spring clips used on many modern door handles
The Ahmed model can be made from a wooden block and used in any wind tunnel. If, on the other hand, the blister is below the surface, the cause is likely to be imperfect wetting of the glass fibre by the resin during impregnation. The severity of the damage decides the method of repair and techniques to be used. Figure 17.2 illustrates the
composition of paint. The high joint integrity achievable combined with good strength and toughness permit fabrications to be made to a high standard. In accidents this feature protects the occupants from injurious shock loads and greatly reduces the danger of entrapment by deformation of body panels. All road dirt, grit and moisture must be
cleaned from the area of repair to allow effective adhesion of the new material (Figure 16.35). Aluminium clogs files, so keep the file clean using a stainless steel or brass wire brush. It is used for bending, seaming and forming curved radii. Good system of alignment that can be used without too much dismantling of mechanical components (dual
systems are sometimes preferable). The equipment itself is very portable, consisting of a transformer, rectifier, built-in feed wire system, lightweight welding torch with interchangeable nozzle heads for conventional welding and spot welding torch with interchangeable nozzle heads for conventional welding to the convention
trolley which lends itself to body work application in the workshop (see Figure 12.31). Air should flow from the torch; if it does not, check the warning lamps on the machine. This triggering action must be practised and perfected to avoid a build-up of paint at the panel edges and to reduce paint wastage due to overspray. Place a bead of new sealing
compound all round the weatherstrip in the glass channel. MIG/MAG welding has numerous advantages over the majority of processes likely to be encountered in automotive production. When considering metals with regard to their bending properties, the following facts are most important. Figure 12.15 MIG welding control panel (Migatronic
Welding Equipment Ltd ) Gas shielded arc welding 3 Overheating warning light If this light comes on, the welding equipment is automatically switched off owing to overheating of the transformer. The upper limit is usually about 6 mm thick for aluminium, which does not allow for the free access of a 6 mm diameter filler rod. 11 What is meant by the
pot life of a two-pack paint? The high energy of the arc melts the material which, as long as it is within the cutting range of the equipment, will be displaced by the gas flow. 4.12.2 Polymerization The raw materials for plastics production on
these repairs. Interchangeability The ability to substitute one part for another. This approach and the enthusiastic cooperation of the vehicle manufacturers at all stages ensured that when a car was mounted on the equipment, the damage of distortion showed up in an unmistakable fashion. From the safety point of view it is essential that the welding
circuit is efficiently earthed. One of the important factors when estimating for insurance claim damage is to examine carefully every section of the vehicle, especially those parts which are a known weakness in the construction and therefore liable to be affected directly or indirectly by a collision. However, should the ambient temperature be 15 °C or
above, a good hard glossy finish can be obtained straight from the gun which does not require polishing. A weld is made by applying the arc heat so that the edges of the metal are melted and joined together as the weld metal solidifies. 54 Repair of Vehicle Endows Finish can be obtained straight from the gun which does not require polishing. A weld is made by applying the arc heat so that the edges of the metal are melted and joined together as the weld metal solidifies.
code plate is riveted on the toe board inside the engine compartment. Apply Duramix to the plastic panel. This reduced air pressure results in greatly reduced overspray, and as a further bonus 65 per cent of the mixed paint reaches the surface. By virtue of the millions of minute air spaces between the fibres and bundles of fibres, leather is able to
 'breathe'. 29 State the function of the controls of standard MIG/MAG welding equipment. Binder Reacts to form a film, and binds the pigments together and to the surface. It is installed from one side of the workpiece, thus making it a blind fastener. This form of construction allowed flexibility in the framing and made a very light and quiet body
frame, but the outer covering had a very short life. The area which the roof covers varies between different makes and models of cars. A hydraulic push and pull unit can be quickly clamped to the jig bench at any point. 5 Smooth and finalize minor damage to body panels with hand tools. The first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing to ensure the first step is to check the underside of the wing the first step is to check the underside of the wing the first step is to check the underside of the wing the first step is to check the underside of the wing the underside of the wi
that it is free from road dirt and anti-drum compounds; then the damaged area is roughed out and the wing reshaped to its original contour. 11.3 Metal arc welding equipment either direct current (DC) or alternating current (AC); both systems possess certain advantages, depending on the purpose for which they are employed. It is ideal for general
planishing and roughing out. They are a mixture of highpurity helium and argon, with small controlled additions of carbon dioxide. The principal purpose of the panel hammer is for the smoothing and finalizing of a panel surface after it has been roughed out to the required shape. I wish to thank my wife Norma for the many hours spent working at
the computer to assist me again throughout the revision of this edition. 2 A digit indicates the recommended welding positions for electrodes: 1 2 3 4 5 all positions all positions all positions all positions for electrodes: 1 2 3 4 5 all positions except vertical/down flat and, for fillet welds, horizontal/vertical 6 any position or combination of positions not
classified above Strength, toughness and covering (STC) code 1 The letter E indicates a covered electrode for manual metal arc welding. The high spots can be corrected by spring hammering, pick hammering, or in some cases by using the corner of a dolly block. (M is the metric screw thread designation, and
when followed by a number, e.g. M4 is a metric thread of 4 mm diameter.) Sealed or open types are available with flat or countersunk heads. 23 Explain the different properties of heat-treatable aluminium alloys. The panel is inserted between the two pieces and clamped, then the metal edge protruding is carefully hammered
over. If one tube in the spray booth should fail and a direct matching replacement is not available immediately, it is actually better to run Return on investment This is simply the profit made from the amount invested in the workshop and equipment. Harmful. 15.6.2 Regulations covering paint storage, fire precautions and fire fighting The storage of
paints with a flashpoint below 22 °C is governed by the Petroleum (Consolidation) Act and the statutory rules and orders 1929. 594 Repair of Vehicle Bodies Figure 17.35 Spraying external corners Figure 17.36 Spraying internal
corners: method for better finish 17.10.4 Spraying internal corners strokes in order to avoid overspraying or double coating the adjoining surface. In use, the blades are placed in turn on to the profile of the thread to be checked until an Figure 6.13 Screw pitch gauge (Neill Tools Ltd (Moore and Wright)) 192 Repair of Vehicle Bodies exact match is
is the most difficult to assess, but generally only the obviously burnt or charred sections will need to be replaced or reinforced. All integral sets incorporate a number of check brackets which are fitted without stripping out mechanical components. Fastening device may be bolts, screws or rivets. Allow to dry hard (preferably overnight) and wet flat
with P200 grade paper. This assembly prevents road dirt being thrown upwards between the outer panel and inner panel construction. Maintenance of controls: Regulation 9 Controls must be maintained in efficient working order and good repair. It is supplied with pointers, cones and magnetic bases so that accurate measurements can be taken on
various parts of the vehicle without difficulty (Figure 14.62). Never drill holes in a panel to give the filler and the metal surface, leading eventually to the separation of filler from the metal surface. The progress of a vehicle's path through the bodyshop should be
carefully planned with control cards from the raising of the job to its completion and final costing. With the standard equipment a pull converter set is available to enable the one push ram to fulfil both functions, but it gives an off-centre pull and is less convenient to use than the separate pull ram. For example, if a section is to remain straight and is
part of a framework which is to be bolted, riveted or welded in place, it is obvious that the material used should already be fully heat treated so that maximum strength is provided to support the framework or structure of the body. Apart from covering the suspension construction, the wing prevents water and mud from being thrown up on to the body.
by the wheels. The vertical stroke should be followed with short horizontal 17.10.5 Spraying sequence An automobile should be sprayed in sections, spraying one section at a time before moving on to the next one. Serpollet did a speed of 74 km/h in a steamcar. Figure 17.16 Internal-mix spray head External-mix gun This is the most widely used type
of gun, and can be used to spray most types of paint. When using two-pack materials, burnishing can be carried out after 16 hours at a workshop temperature of 15-20 °C. Help is also offered to develop potential repair talent by encouraging educational institutes, such as technical training colleges, to visit the Centre. The characteristic stiffness of
the ridges prevents the panel returning to its original shape unless additional force is applied to release the stress in the famous designers are the Italians Pininfarina (Lancia, Ferrari, Alfa), Bertone (Lamborghini), Ghia (Ford) and Issigonis
(Mini). Some act as an additional brain for organizations who want to inject new ideas into their own production. In principle, however, nozzles are the same: they have a central orifice for the cutting oxygen stream, surrounded by a ring of orifices for the preheat flame. Gravity-feed gun The fluid cup is mounted above the spray head and paint is fed
to the gun by the force of gravity. When acetylene and oxygen are mixed in the correct proportions and ignited, the resulting flame reaches a temperature of 3200 °C. Hardener A chemical curing or hardening agent. The principle of rust-proofing is to prevent the atmosphere and corrosive substances from attacking the metal of the car body by
applying an impermeable layer to the metal. Solvent evaporation from the wet paint film is governed to some extent by the workroom temperature, and should this be below 15 °C a special quick repair thinner should be used. Organize staff fire drill and training procedures, Bodyshop planning and make sure that all fire extinguishers are maintained.
2 Manufacturers or companies upgrading booths will be required to provide a guarantee confirming that the equipment conforms to the emissions limit. A complete set comprises 22 units, with between 2 and 6 of each height depending on the frequency of use. When the ram is extended, the upright beam is pushed in an arc backwards, thus putting
tension on to the chain attached to the damage. Many, of course, are multipurpose alloys and can be considered for more than one of these functions. Airbags The air bag is designed to protect the occupant's head and upper torso - not to take all the weight of the body. Certain types of damage may need to be precision drilled (Figure 14.113). When
can be used for metal such as aluminium, copper, stainless and galvanized steels. The models are placed in a wind tunnel, an experimental installation producing wind of a certain quality and fitted with the means for measuring the various forces due to the action of the wind on the model or the vehicle. Use the hook nozzle to get a good finish around
the edges and to reach into awkward corners, then wipe away any excess sealant before it sets. An important aspect of the mould is bumpy or rough so will be the final article. This means that whenever steel and aluminium come into
contact there is likely hood that galvanic corrosion is going to take place. The patch is preferably the same material as the damaged item; the bonding could be by a number of materials, including superglue. 12.14.2 Incorrect weld geometry and appearance, defects, loss of properties Overfill Overfill or excessive reinforcement may be described as the
presence of weld metal which exceeds that required for the joint (see Figure 12.36). 17.2 Glossary of terms used in spray painting In order to be able to appreciate more fully the descriptions of processes and practices in the paint shop, the reader should make himself acquainted with the following trade terms and items of equipment. It provides
 increased working room between the jig and the vehicle, therefore allowing ease of access for movement and tools. The scuttle and windscreen unit, including the front standing pillar or A-post (15), provides the front bulkhead and seals the engine from the passenger compartment. The disadvantage is that because they have their own power supply
together until an arc is established. It provides a strong, accurate measuring device for suspension mountings and is also used for checking the upper body measurements (Figure 14.28). Figure 9.30 An air-cooled plasma cutting torch (SIP (Industrial Products) Ltd ) 1 2 3 4 5 6 Handle Electrode Insulator bush Spring Plasma nozzle Protection nozzle
9.14.2 Setting up the equipment for use 1 Select the electrode type according to the cutting gas used. 2.8.6 Approved/safe methods and techniques are used when lifting and handling Do not attempt to manually carry a load which you cannot see above and around. When hard these fillers have excellent bonding
the lock pillar; if there is any up and down movement, the door is out of alignment but is being corrected by the dovetail of the lock as the door closes. They are required to be there by law in the interests of your safety. The joints which may be welded by this process include all the standard types such as square Gas shielded arc welding Table 12.3
313 Gas mixtures available and their applications Gas Applications Features Argon TIG: all metals. Conductor Any material or substance that allows current or heat to flow through it. The ring spanner is much safer to use as more force can be applied without slipping and rounding the corners of the nut. An adjustable guide is provided to ensure that
12.14 Principles of the MIG/MAG welding process: argon, argon/CO2 or CO2 tinuously fed electrode passes through a gun, during which it passes through a contact area which impresses the preselected welding current upon the wire. Destructive testing: peel test After setting up the equipment a test weld should be made, using sheet metal of the
give a very hard sharp cutting edge (Figure 3.14b). A clock face system is used as an alternative method of indicating the strength grade. 3 Appoint competent people. All necessary that the parts to be soldered should be quite clean before
applying oil and resin as a flux. The surface can then be filled with plastic filler and finished by filing. A good quality solvent, however, will contain both high and low boilers in well balanced proportions. Solvent A chemical fluid which will dissolve, dilute or liquefy another material. The most obvious is its capability of being used either semi or fully
         atically, thus giving it virtually unrivalled versatility. Advance this puddle about 2 mm with each complete motion of the torch. Body measurements are made in the same way in both composite and mono constructed vehicles. As a further precaution, emissions from spray booths should be tested at least once a year to monitor particulate matter
emitted. Independent front suspension Suspension Suspension System in which each wheel is independently supported by a spring. Many windscreens and rear windows are held in place by a rubber weatherstrip which is usually of single-piece construction. Methods of joining 211 Figure 7.31 (a) Standard Nutsert placement (b) Thin sheet Nutsert with bolt in
place (Avdel Ltd ) Figure 7.32 Monobolt and placing sequence (Avdel Ltd ) 7.6 Screws and bolts with special power operated screwdrivers which are either electrically or pneumatically operated. The Act requires that the storeroom should be licensed and constructed to approved standards. (d) The wrong size fluid tip for the paint (b) Obstruction on
top or bottom of fluid tip. Centre-post bench This is suitable for workshops with an existing centre piston installed. The maximum amount of stretching must take place on the outside of the flange, gradually diminishing to nothing at the inside. The physical system must be regarded as part of a broader health and safety housekeeping policy aimed at
keeping the whole area dust and fume free. If, however, the temperature of the heated steel is suddenly lowered by quenching it in clean cold water or oil, this change back from austenite does not take place, and instead of pearlite, a new, extremely hard and brittle constituent is formed, called martensite. However, if a completely new engine
transmission or driveline configuration is to be adopted, development work must be well in hand by this time. The pyrotechnic device is ignited by a low voltage electrical current and small tablets fill the airbag with nitrogen in about 30 ms (0.030 sec). If too great a time lapse is allowed, then problems of lifting or wrinkling may be encountered. The
steels used in the motor trade may be grouped as follows: The temper rolled coils can be slit to narrow coil, cut to sheet, reinspected for surface critical applications, or flattened for finish can be achieved using
these plastic fillers if the correct working procedure is adopted. Clean with high-pressure washer. Another widely used machine enables sharp acute or obtuse angled bends to be produced in long lengths of sheet metal for the making of sections. 32 List and
describe four types of self-locking nuts. Once the weld is completely finished and flattened in this manner the final finish can be obtained by further planishing and filing which, if done correctly, should make the weld indistinguishable from the parent metal. As well as cleaning the metal, flux also ensures that no further oxidation from the atmosphere
which could be harmful to the joint takes place during soldering, as this would restrict the flow of soldering. One of the problems encountered by the refinisher has always been to obtain a close match to the original finish. 7 Give reasons for the difference in floor areas between a panel bay and a bay with a static jig. The second panel is aligned and
the screw is driven through this panel into the captive nut, which holds it in place. Where the work to be welded is of thin mild steel the distortion, but where the work is of thin mild steel the distortion through this panel into the captive nut, which holds it in place. Where the work to be welded is of thick steel plate, the plate itself may be sufficiently strong to counteract or minimize some of the distortion, but where the work is of thin mild steel the distortion through this panel into the captive nut, which holds it in place.
of alloys in use as brazing rods; the most popular compositions contain copper in the ranges 46-50 and 58.5-61.5 per cent, the remaining percentage being zinc (Table 8.2). The main components of the measuring system are: a set of measuring rods; the most popular compositions contain copper in the ranges 46-50 and 58.5-61.5 per cent, the remaining percentage being zinc (Table 8.2).
transparent scales. The pure metal work hardens much less rapidly than copper, though some of the sheet aluminium alloys are too hard or brittle to allow very much cold working. It should be borne in Figure 17.5 Method of fixing masking tape to paper mind that newspaper is extremely porous and subject to solvent penetration, and it is therefore
recommended that at least two layers be used over existing paintwork. The laminate is allowed to cure and then finished off flush and smooth with a standard two-compound gap filler. Eyes are irreplaceable: therefore it is advisable to wear safety goggles, glasses or face shields in all working areas. 13.8.2 Sanding discs The coated abrasive disc is the
part of the sander that does the actual sanding, and selection of the right grit and coating for each job is important. Adjust the contour of the surface on which you intend to work. In the MIG welding process, gas shielding enables a high degree of mechanism of welding to be
achieved. This is so that the necessary preventive and protective measures can be identified bot, in which case it requires no thinning. The current regulations which affect those who work in the motor repair industry are given in this long list which you are not expected to remember: Factories Act 1961 Offices, Shops
and Railway Premises Act 1963 Abrasive Wheels Regulations 1970 Fire Precautions Act 1971 Highly Flammable Liquids and Liquefied Petroleum Gas Regulations 1974 Control of Lead at Work Regulations 1970 Fire Precautions 1971 Highly Flammable Liquids and Liquefied Petroleum Gas Regulations 1974 Control of Lead at Work Regulations 1974 Control of Lead at Work Regulations 1974 Control of Lead at Work Regulations 1975 Highly Flammable Liquids and Liquefied Petroleum Gas Regulations 1974 Control of Lead at Work Regulations 1975 Health and Safety (First Aid) Regulations 1976 Fire Precautions 1976
Diseases and Dangerous Occurrences Regulations 1989 Control of Substances Hazardous to Health Regulations 1988 Electricity at Work Regulations 1989 Pressure Systems and Transportable Gas Containers Regulations 1989 Noise at Work Regulations 1989 Pressure Systems and Transportable Gas Containers Regulations 1989 Noise at Work Regulations 1989 Pressure Systems and Transportable Gas Containers Regulations 1989 Noise at Work Regulations 1989 Pressure Systems and Transportable Gas Containers Regulations 1989 Noise at Work Regulations 1989 Pressure Systems and Transportable Gas Containers Regulations 1989 Noise at Work Regulations 1989 Pressure Systems and Transportable Gas Containers Regulations 1989 Noise at Work Regulations 1989 Pressure Systems and Transportable Gas Containers Regulations 1989 Noise at Work Regulations 1989 Noi
main regulations. If required, clean with steel wool and thinners. 6 Proper training with time off for this purpose. Other specially acres for hard wear and general repair work in the bodyshop; and welding gauntlets, which are made from specially
treated leather and are longer than normal gloves to give adequate protection to the welder's forearms. Figure 11.9 Correct speed and current setting Table 11.6 Current setting for electrode (mm) Current (A) 1.0 1.2 1.6 2.0 2.5 3.2 3.2 -9.5 9.5 and over 1.6 1.6 2.0 2.5 3.2 4.0 5.0 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 110 120 -6.3 8 mm 30 35 50 80 12
160 250-400 400-600 Scratching method The scratching method (Figure 11.11) is where the electrode is tilted at an angle and is then given a slight circular movement similar to that of striking a match. It is important because in most cases of collision causing the damage of body panels, stretching of the metal takes place. The front edge of the rear
seat panel is stiffened by the rear seat heelboard, and the rear edge of the seat panel is stiffened by the rear squab panel. It is also inadvisable when working on soft metals, such as zinc, aluminium and copper, to scribe along the full length of fold or bend lines, because this could result in cracking during the bending of the metal. Then, replace it
using the following steps, as explained by O'Reilly Auto Parts: Step 1: Wearing heavy-duty or leather gloves, remove the old glass from the backing plate. They can be pressed, stamped, blow moulded, vacuum formed and injection moulded into any decorative shape required. 13.6.2 Direct hammering Direct hammering is in fact the process of
planishing, and the body repair worker uses it as a finishing process after the work has been preshaped and roughed out (Figure 13.33). The chances of survival are much reduced if the occupant is thrown out. The general methods of operating the beam are mechanical or hydraulic. When the skin has been washed, after-work creams will help to
restore its natural moisture. To cater for variations in width or length, the tower unit is mounted offset on its base. Sectional repairs to vehicles damaged in an accident should be confined to body parts in which the damage has not produced any loss of strength sufficient to jeopardize safety. In spot welding if the repair is visible the joints, which in
most cases are lapped, must be solder filled to achieve an acceptable finish. To repair severe side damage, push out and stretch the crushed side, It will also help to pull from the outside; this is because the passenger compartment is very strong, and repairing damage to it requires considerable force. 13 What type of vehicle finish is liable to become
viscid when dry sanded with a sanding tool? Choosing between pneumatic or electric power tools has always been difficult because, while they are designed to perform basically the same function, the particular advantages and disadvantages are disadvantages and disadvantages and disadvantages are disadvantages and disadvantages and disadvantages are disadvantages are disadvantages are disadvantages are disadvantages are disadvantages are disadvantages.
tempering, the steel is either quenched or allowed to cool naturally. Further friction is created and both forces combine to give a smooth, progressive and increasingly self-locking action. The annual build figure for this truly hand-made vehicle is between 250 and 300. 10.8 Resistance spot welding of high-strength steels The rigidity of the body and its
ability to withstand high torsional and other stresses depend on the assembly method used to bring the various body panels together. With the vector method of pulling, parallel pulling can be carried out in the following way. In addition the use of the body, allows full use of the attachments designed for
roughing out such parts. Then lift the trim panel retaining clips from the door inner panel, and disconnect all wiring so that the trim panel may be removed. Although the flask cracked it did not fall into pieces, and he found that it was held together by a film of celluloid adhering to its inner surface. Care should be taken at this stage when passing the
metal through the wheels not to twist or jerk the panel, as this could result in ridged sections and an uneven surface. These operations will be identified by the risk assessment carried out under the Management of Health and Safety at Work Regulations 1992. 2.5.1 Voltages The normal mains electricity voltage via a three-pin socket outlet is 240
volts; heavy duty equipment such as vehicle hoists use 415 volts in the form of a three-phase supply. This may be due to the following (numbers correspond to those on the figure): Figure 17.38 Spraying a vehicle roof (Racal Safety Ltd.) 1 Insufficient paint in the cup or pressure feed tank so that the end of the fluid tube is uncovered 2 Tilting the cup
of a suction-feed gun at an excessive angle so that the fluid tube does not dip below the surface of the paint 3 Some obstruction in the fluid passageway which must be removed 596 Repair of Vehicle Bodies Figure 17.40 Identification of parts of gun responsible for fluttering spray Figure 17.41 Faulty spray patterns: (a) correct 4 Fluid tube loose or
cracked or resting on the pattern (b) top or bottom heavy (c) right or left sided bottom of the paint container (d) heavy centred (e) split 5 A loose fluid tip on the spray gun 6 Too heavy a material for suction feed cup or caused by:
fluid hose to the spray gun (a) Right or left side horn hole in air cap par9 Loose fluid needle packing nut or dry packing. 3 Check tyre size and type: same brand and tread pattern. This may give glass fibre reinforced plastic mouldings of incorrect shape, since although conventional materials are well suited to straight lines and
flat surfaces, the properties of glass fibre reinforced plastic components are improved by the introduction of curvature, and if possible double curvature, to the design. Shrinkage This refers to the manner in which some paints decrease in size not only vertically but also horizontally, door openings. It should be noted that the total time for each
complete replacement includes a time allowance of 0.5 hours for the body repairer to move the vehicle as needed and obtain special tools and parts from the stores, this is called job allowance. 2.8.23 Appropriate safety clothing and equipment is used when working with hazardous cleansing agents and equipment To protect yourself from the cleaning
agents which you are using you must, where appropriate, wear personal protective equipment (PPE). The Metro 90 can also be used in conjunction with Celette's ECO 2000 mobile lifiting trolley. Adequate service and back-up by the manufacturer. To correct defects 1 and 2 (top or bottom heavy pattern, or heavy right or left side pattern) determine
whether the obstruction is in the air cap by spraying a test pattern; then rotate the air cap half a turn and spray another test. Press the gun to the surface of the metal, press the trigger for 1-2 seconds only and remove the gun to the surface of the metal, press the trigger for 1-2 seconds only and remove the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the metal, press the gun to the surface of the gun to the gun to
but unfused joint surfaces, and the interfusion of the filler and parent metals does not take place, is known as adhesion. 4 Always use the correct tools for the job. Figure 7.58 Cable clip used for latching: sectional view shows clip in position in a panel (Forest Fasteners) 7.7.6
Push-on clips In addition to spring steel fasteners that are associated with threaded members, there is a wide variety of push-on clips (Figure 7.59). The lacquer coats should be applied within 2 hours. 624 Repair of Vehicle Bodies 17.19.11 Runs, sags, curtains Each of these defects is the result of applying too heavy a coating thickness. The blades
have a very pronounced angle or set to permit the blade to pierce the sheet for internal cutting. 39 Explain why careful study of the accident damage is important before any stripping or repair work is carried out. 11.7.2 Welding light-gauge steel The manual metal arc process offers a number of advantages for the welding of thin-gauge mild steels.
Objectives of the Act 1 To repeal, replace or modify existing regulations 2 To maintain or improve standards of health and welfare of people at work 4 To control the keeping and use of dangerous substances including explosive and
highly flammable materials (paints, solvents, resins) 5 To control the emissions of toxic substances into the atmosphere (dust, fumes, smoke, gases). If you are using a filler rod it is a good idea to 'vee' the 156 Repair of Vehicle Bodies edges of the joint to accommodate the filler, this can be done using a file. It is essential that this buckle be removed,
and the best way of carrying this out is by hot shrinking the edge. Metal fatigue A metal structural failure, resulting from excessive or repeated stress, finally resulting in a crack. Steel varies from iron chiefly in carbon content; iron contains 3-4 per cent tarbon while carbon steels may contain from 0.08 per cent to 1.00 per cent carbon. 1.5.11 Rear
quarter panel or tonneau assembly This is integral with the side frame assembly and has both inner and outer construction. Solid wire is the most common and widely used filler material for MIG/MAG welding car body replacement panels. Valeting and wax injection area This is designed for the cleaning of the vehicle's interior and exterior back to
showroom condition as well as for replacing the corrosion prevention treatments of undersealing and injection wax treatment. In some (Facing page) Figure 14.93 (continued ) (b) Castor The castor angle is the forward or backward tilt of the king pin or ball joints, and is measured as an angle from the vertical. The stands are adjustable to compensate
for uneven flooring. A flashback arrester is a device designed to quench the flashback. Leave the adhesive to harden for 30 minutes before removing the tools. A weld cycle which includes all these stages added together, will take less than 0.75 s. A mallet is greatly used in the initial stages of smoothing and roughing out of a panel prior to planishing.
11.5.4 Overhead position Welding in an overhead position is probably the most difficult of operations. Exhaust ducting (the chimney) must be a minimum of 3 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level, but it also has to be a minimum of 8 metres above ground level.
height. This is done by increasing the ratio of atomizing air to paint at the appropriate angle. One disadvantage of this type of edge treatment is that when the edge suffers a severe blow, the metal tends to crease badly and the edge
may crack. It also offers a multi-grip facility. The tool can be used to cut a wide variety of materials including lightgauge steel, aluminium, reinforced glass fibre, wood and hardboard. Another advantage of the system is that, with the use of beams and towers, it can be used simply as a bracket system, as this mobile bench has also been specifically
designed to accept the MZ diagnostic repair system. These joints are very susceptible to peel and cleavage forces, which toughened adhesives withstand exceptionally when viewed under sodium or mercury street lights. Fractures begin to
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run into the metal thickness from the points of contact of the top and bottom cutting blades, and if these are positioned correctly relative to each other, the fractures meet and the metal is sheared before the top member penetrates and cuts the whole thickness of the metal. The hammering of each course has to be done with steady and even blows to
bring up a regular curved shape. Limousine A longer version of the coupé with double side windows in the rear compartment. Robinson 1973, 1989, 1993 © A. The outrigger and A- and B-posts are manufactured from 18 gauge steel, E coated and wax Reinforced composite materials 561 injected for maximum corrosion resistance prior to assembly. 33
Describe in detail how to check for door aperture alignment. 3 Brazing makes possible the joining of two dissimilar metals; for example, brass can be joined to steel. 3 In the case of electric shock turn off the electricity supply. Apply Duramix directly to the V-grooved area, slightly overfilling the area; then within 30 seconds overlay a sheet of
contouring plastic and use the flat side of a plastic spreader to compress and smooth the Duramix into the V-grooves. 15.2.1 Reception area Figure 15.1 (continued ) Vehicle damage assessment area This is where the vehicle is first assessed for the degree of damage in order that an estimate may be written for customers and insurance companies.
Raising the open-circuit voltage increases the 327 Figure 12.21 Incorrect settings for wire speed (Stanners Ltd.) 328 Repair of Vehicle Bodies Figure 12.23). The main advantage of this material is rapid air drying. The tensile
strength, and in the case of sheet and strip steel the bend test, are the properties of most interest, but the British Standard specification also defines the elongation, the yield point and the hardness of the steel. With this process the choice of filler material and shielding gas is important if the necessary flat bead is to be achieved, otherwise excessive
amounts of dressing would be required. Discard hoses that show signs of general deterioration. Glossary xxv Condensation A change of state from a gas to a liquid caused by temperature or pressure washer with appropriate deterioration.
As a general rule there should be a bonded joint wherever two panels touch, or wherever they close on important points. One of the most recent is the Control of Substances Hazardous to Health (COSHH) Regulations 1988. 29 What type of attachment would be used on the end of a body jack to spread the force of the load during a repair? The
excessive current leaves a groove in the base metal along both sides of the bead, which greatly reduces the strength of a weld (Figure 11.12). 2 To cooperate with his/her employer or any person on whom a duty or requirement is imposed. As
the carbon content increases so does the strength and hardness, but at the expense of ductility and malleability. 7.7.3 Captive nut, J type This is similar in concept to the U-nut but with a shorter leg designed to snap into a clearance hole (Figure 7.56). Running board. Another alternative is the Zipcut tool, which again will fit into a conventional drilling
machine and which cuts round the spot weld leaving a hole in the top panel surface (see Figure 14.96). The body jack is also useful for providing support 9 10 11 12 Wedge head Plunger toe Spread ram Flat base or pressure at otherwise inaccessible portions of the outer panels, as well as applying controlled pressure in a higher degree than is
possible with hand tools on the various panels. On some cars, the roof panel ends at the windscreen. A wire brush is used for cleaning purposes. Existing bodyshops who registered by the deadline set for their area of the country (in England and Wales by 30 September 1992, and in Scotland by 31 March 1993) have until October 1998 to fulfil all their
legal obligations under the Act. Corrosion The wearing away or gradual destruction of a substance, e.g. rusting of metal. 8.4 Hard soldering sheet metal panels and other automobile parts. In some cases a filler rod may be used to reinforce the
weld metal. The soldering temperature for pewter is rather lower than for most soldering operations, hence the use of a thinner oil as a flux. Do not use a jet of water of such strength that it would knock over a free-standing cylinder. It is not necessary to have the chain vertically in line with the direction of pull, but it is important the ram should not
be set at an angle lower than 45 degrees; that the chain links are set in line without any twist; and that the chain between the ram and chain anchor point should always lean towards the car. 12.2.4 Argon mixtures that are suitable for vehicle body repair work consist of 95 per cent argon and 5 per cent carbon dioxide, or 80 per cent
argon and 20 per cent carbon dioxide. The tail of the bolt breaks off at the deep breaker groove, flush with the collar. Overwelding and excessive reinforcement should be avoided in fillet welds and flat butt welds. Check your work as you go. The movable blade which indicates the angle reading is secured by a locknut which can be set and tightened
at any angle, thus allowing angles to be read directly from the workpiece. 7 All bushings, front and rear. The bolt has not changed much in design since it was first developed, apart from the use of special materials for certain application over all types
of existing finishes, and is suitable for hot or cold spray application. With the two-stage regulator the gas flows from the cylinder into a first chamber where a predetermined high pressure is maintained by means of a spring and diaphragm. On a composite designed body the body bolts provide ideal locating points. After drying and tacking, the colour
coats are applied. Although the vehicle cannot be expected to withstand collision with obstacles or other vehicles, much can be done to reduce the effects of collision by the use of careful design of the overall shape, the selection of suitable materials and the design of the components. These anchor pots are like long plugs with chains attached to the
base and a cap on top which leaves a flat floor when the system is not in use. The T is always follows: AlMn AlMgMn Heat-treatable aluminium alloy plate, sheet and strip: 2014A Clad 2014A 2024 Clad 2024 Clad 2024 6082 AlCuSiMg
AlCuSiMg clad with pure aluminium AlCuMg Alc
developed from the use of an ordinary hydraulic jack for this purpose. 24 Which mode of metal transfer uses the short-arc process in MIG/MAG welding? Those who have already met the requirements of BS EN ISO 9001-2000 and passed assessment by BSI Quality Assurance agree that a considerable effort is required. 4 To ensure that employees
receive adequate training in health and safety matters. Cutting may be done by means of a simple hand cutting torch, or by a more complicated, automatically controlled cutting machine. Empty surplus paint from the tank and pour in a small quantity of solvent, replace the lid firmly and pressurize the tank at about 0.3 bar (5 psi). 3.15.4 Hacksaws
The hacksaw is used by the body repair worker to advantage where a clean, neat cut is required, usually where two pieces have to be cut to form a welded joint, and is ideal for cutting irregularshaped panels which could not be cut with snips or chisel. The fluid cup is pressurized and can be either attached to the gun (Figure 17.18) or remote from it
(Figure 17.21). The equipment is available in a single-pull or a two-pull version. Acetylene and propane must never be stacked horizontally in storage or in use. Dash panel A panel attached to the front bulkhead assembly and which provides a mounting for all instruments necessary to check the performance of the vehicle. The blade holding shoe is
designed in a spiral so that it parts the metal as it cuts it. Always wear goggles to protect the eyes from flying particles of metal and from small abrasive particles that come loose from the grinding disc (Figure 9.24 (a) One-piece acetylene nozzle (b) two-piece LPG nozzle (BOC Ltd ) 9.11.4 Hand cutting procedure First remove any oxide
or scale from the line of the cut. The toolchest is on castors so that it can be conveniently located in any working area of the body shop. Stowage of tools when not in use is also important, but this will depend on the working conditions in the bodyshop. Unfortunately there are many parts of vehicle surfaces where there is no alternative but to carry out
these processes without the aid of power tools. Seam Welding starts when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding starts when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the welding trigger is actuated and stops when the switch on the switch of the switch on the switch of the switch on the switch on the switch on the switch on the swi
flexible skirt which seals the mounting hole against entry of dirt or water (Figure 7.62). Bumpers, grilles, light surrounds and even complete body panels have enabled designers to enhance vehicle aerodynamic styling and cosmetic appeal while retaining impact resistance and eliminating corrosion from these areas. BS EN ISO 9001-2000 also
supplies the basic management controls upon which the business can build a documented management system, allowing recognition and acceptance by a wider number of people within the vehicle industry and by those wishing to either supply or purchase from the company. The job is again completed using body filler and P600 to feather in the
paintwork. Of the many welding techniques used in the engine compartment wax, which is designed to withstand high temperatures. Upper body and strut tower positions are similarly located to provide height, width and length specifications
relevant to the lower body. As well as improvements in finishing materials, changes in painting techniques were being evolved. Welding electrodes and rods Ductility is an essential property in the production of electrodes, rods and wires. Apply second coat. A convex punch may be used for large sizes to spread the spigot but a flat tool must be used
for the riveting operation 3 An ordinary screw or bolt is then used for making an attachment to the clinch nut (European Industrial Services Ltd ) through the nut these arms are forced out towards their original position, thus causing them to grip the thread very tightly. When designing new work the main factor is usually the
shear or tensile strength required from the riveted joint. 14 Explain the process of body soldering when used in the repair of a damaged body panel, and list the necessary equipment. Narrow gap butt welds, for example, give a reduction in weld time and, depending on the process, may reduce the complexity of plate preparation. The time for the
combination of panels is read off vertically in Section C. 1.5.16 Bonnet The bonnet (Figure 1.45) is the panel which covers the engine compartment of a rear-engined vehicle. In some cases the joining weld is made between these edges. The sandwich of glass and interlayer is
then heated under pressure for a specified period in an autoclave. 14 Name three reinforcing materials that could be added to a GRP moulding to give strength to the laminate. Factors such as energy costs and availability of resources may play a greater part in the total picture than simple objects like vehicle weight reduction. 2 Feather edge all
damaged areas including parts damaged by stone chips (generally on sills). Both cylinders must be securely fastened but at the same time easy to replace. This operation is referred to as tinning the bit, and makes it easier for the bit to pick up solder and then discharge it on the workpiece. The skill and judgement of the trained and experienced
automotive designer is vital to the creation of any design concept. Some means of heating the soldering iron is necessary, together with a quantity of selected solder, file, emery cloth and a tin of flux, either corrosive or non-corrosive to suit the work in hand. 5.11 Swaging machines These machines (Figure 5.18) can be used on sheet metal blanks to
carry out a large number of different operations such as swaging, wiring, joggling, flanging, beading and many other edge-type treatments. 6.2.5 Try square (engineer's square) This is the most common tool for testing squareness, and is used for internal and external testing to check whether work is square (Figure 6.5). 17.7 Types of spray gun Figure
17.9 DeVilbiss DVFR-1 filter regulator assembly and DVF2-2 filter regulator coalescer (DeVilbiss Automotive Refinishing Products) 17.6.4 Air hose The compressed air is led from the transformer to the spray gun by means of an air hose. 1.5.4 Front side member assembly This is an integral part of the front-end assembly; it connects the front wing
valances to the cowl or dash assembly. Vulcan, the blacksmith of the gods, in one day made 20 tricycles which 'self-moved obedient to the beck of the gods'. The other explanation area This is for the pretreatment of the repair in the form of sanding, priming
and masking before painting. The elasticity of mild steel is very useful in both the manufacture of highly curved articles by press work and in the repair of motor car bodies. Plasma cutting and welding torches are designed with a small orifice which constricts the arc. However, this is not usually practical for the smaller repairer, or the general
accident repairer. The wheel arch is welded to the rear floor section and is totally concealed by the rear quarter panel around the wheel opening. In some cases the BMC may be a recycled material filler, but this will have low strength. A spray booth is in most cases the
single biggest purchase decision made by the bodyshop owner. Aramid has good impact resistance. Having decided whether the panel will be repaired on or off the job the actual repair can then be roughed out, keeping in mind the fact that the shape needs reforming with as little stretching of the metal as possible. The voltage in a circuit is measured
by connecting the voltmeter red to positive and black to negative each side of a component, that is, in parallel with the component, that is, in parallel with the component that long energy-absorbing distances should be
provided in vehicle design, and the panel assemblies used for this purpose should have a lower stiffness than the central section or passenger compartment of the vehicle. Wheel alignment is still used in many workshops as it takes less workshop time, is easier and requires less expensive equipment. The rapid cooling
hardens and shrinks the outside of the glass; the inside cools more slowly. Wheel arches and underbody Before applying a coat of sealant or heavy-duty wax, first remove any loose or flaking materials. Tallow and palm oil is often used as a flux for soldering lead. When the nut is screwed on to the bolt it runs freely until the end of
the bolt meets the nylon insert. Computer-integrated manufacturing (CIM) All computer-aided activities from idea to serial production. The results of the spot welding 315 T should not exceed 3 mm for manual welding or 5 mm for machine welding
without filler wire. It is usually caused by the action of the solvent in the top coating attacking and softening the binder of the previous coat, such as when cellulose materials are applied over synthetic paints. 21 What is the purpose of 'hold time' when carrying out the process of spot welding? The Genesis system begins with the vehicle specification
data base. Ratchet wrenches can have 83 in or 12 in drives (Figure 3.64). Resin The capacity can be 6 or 9 litres, and operation can be by CO2 cartridge or stored pressure. Characteristics: distinctive garlic smell. The lights on vehicles
now are much more efficient than on earlier models. Perfect coordination between your two hands is necessary to enable you to move the dolly around under the damaged area and still continue to hit squarely over it with the hammer. 9 Increase the spot size setting from zero in single steps, and make five trial welds in each setting. Under normal
circumstances movement of the weld bead is restricted by the adjacent body panels in the vehicle structure, and the stress which could be generated is given by the Young's modulus of the material. With oxy-fuel gas equipment, flashbacks can and do occur because the recommended pressures and procedures have not been observed, and because of
nozzle blockage, faulty equipment or leaking equipment. With fixed machinery, for instance a pillar drill, you will need to switch off the power supply at the isolator switch. These are usually called alkyds, and have long been important in surface coating formulations because of their toughness, chemical resistance, and endurance. 12.10.1 Power unit
DC power units are used as either rotary generators or rectifying units which are specially designed to give full versatility of arc control. Glass is often supplied with moulded-on finisher (encapsulation). If the repair is in such a position as to make the use of hand tools difficult because of the strengthening struts, the area should be roughed out using
very thin body spoons and then filled Craft techniques and minor accident damage 387 with plastic filler, as the heat produced when soldering might distort the panel. 25 With the aid of a sketch, illustrate one method of metal transfer used in MIG/MAG welding. Size of filler rod Half the plate thickness up to a maximum of 6.4 mm. 17.11.1 Fluttering
spray Sometimes the gun will give a fluttering or jerky spray (Figure 17.40), caused by an air leakage into the paint supply line. The Avdelok is a two-piece high-strength fastener consisting of a moulding is so 548 Repair of Vehicle
Bodies Reinforced composite materials 549 complex that it defeats analysis. In addition various heads are available for attaching to either manual or power operated tools which spread clamp-up load over a wide area. R. A second layer
of mat is applied Figure 16.18 Rolling impregnated mat (Scott Bader Co. Ltd.) Reinforced composite materials 545 6 The mould is allowed to cure naturally or heat is used to speed up the curing process. Oil paints The drying of an oil paint depends on the ability of certain drying oils to dry by a reaction that involves atmospheric oxygen, a process
which is confined to relatively thin films. Heavy, coarse or fibrous materials require small nozzle sizes to prevent an excessive flow of paint. 6 Pressure wash engine compartment to remove degreaser. Nor is it suitable for use on wood or the repair
of synthetic coach finishes. It remains captive to the panel, anchored by means of a sheared tongue on the lower leg which drops into the mounting hole and holds the nut in the screw receiving position. 23 Name three important Acts of Parliament which influence the working procedures in a bodyshop. Foam is produced when a solution of foam liquid
and water is expelled under pressure through a foam-making branch pipe at which point air is entrained, converting the solution must obviously be governed by the size and shape of the workshop (Figures 17.55-17.59). The art of production planning for spot
welding is to simplify the presentation of panels in the region of mutual panel overlap. However, the same procedure applied to thicker metal is unlikely to result in complete fusion, and the fusion faces must be bevelled to enable the torch flame to be directed into the root of the weld in order to obtain complete fusion. When repairing such a fracture,
care should be taken to avoid rigidity at one point, which often results in further cracks appearing some distance from the repaired portion. The thorough removal of all anti-drum material is essential before any actual planishing is commenced. However, it could be wrongly assumed that the windscreen seal was at fault. Glazed edges of glasses
should be finished with a small chamfer known as an arrissed edge, while edges of glasses that are visible or which run in a felt channel should be finished with a polished, rounded edge. Another flash-off period of 15 minutes should be finished with a polished, rounded edge. Another flash-off period of 15 minutes should be finished with a polished, rounded edge. Another flash-off period of 15 minutes should be finished with a polished, rounded edge.
panels, difficulties may arise when identifying specific panels. The basic parts of these types of spray guns are seen in Figure 17.23. 15.6.6 Management of Health and Safety at Work Regulations set out broad general duties which apply to almost all work activities in Great Britain. The J-nut is easily started over the edge of a
panel and pressed into position with the thumb. 388 Repair of Vehicle Bodies (a) (b) (c) (d) Craft techniques and minor accident damage 389 (e) (f) (g) Figure 13.64 Pull pin kit used with a spot welding gun (ARO Welding Ltd ). The conclusion of all repairs must restore the vehicle to its original safe, roadworthy condition to the satisfaction of the owner
and the insurance company. 200 Repair of Vehicle Bodies Figure 7.4 Riveting procedure 7.4 R
rapidly over the first few hours. The guidelines published by the Health and Safety Executive (HSE) and motor vehicle textbooks usually identify industry accepted safe working practices. This usually occurs when the gel coat is too thin or when the reinforcement has been laid up and rolled before the gel coat has hardened sufficiently, or when the
moulding is removed too early from the mould (Figure 16.49). The vehicle is attached to the frame using sill clamps which are wedged into lateral beams. facility to ensure that engine cleaners and traffic film removers work quickly and effectively Electric/air polisher, 1500-2000 rpm, with polythene foam and lamb's-wool polishing heads Fine grade,
100 per cent cotton, polishing cloths Vacuum cleaner and/or shampoo vacuum cleaner with assorted upholstery brushes and crevice tools Hand-pumped, pressurized sprays for dispensing engine and carpet brushes Good-quality chamois
leather, sponges, polishing cloths (100 per cent cotton, knitted stockinette type), steel wool, spatula, glass scraper, buckets, hot air gun (useful for removing PVC stickers, self-adhesive design trims). 9 Prevent welding cables from coming in contact with hot metal, water, oil or grease. 15.5 Essential equipment for the bodyshop In the utilization of
equipment there are two important factors: Figure 15.5 Lighting for the spray booth (Fifth Generation Technology Ltd.) existing booth. 5.1.6 Compressibility may be defined as the property by which a metal resists the action of a compressibility may be defined as the property by which a metal resists the action of a compressibility may be defined as the property by which a metal resists the action of a compressibility may be defined as the property by which a metal resists the action of a compressibility may be defined as the property by which a metal resists the action of a compressibility may be defined as the property by which a metal resists the action of a compressibility may be defined as the property by which a metal resists the action of a compressibility may be defined as the property by which a metal resists the action of a compressibility may be defined as the property by which a metal resists the action of a compressibility may be defined as the property by which a metal resists the action of a compression of a compr
of provision, hearing protection is mandatory. Until the metal fits the former it is often necessary to check repeatedly to find any high or low areas which may prevent the workpiece from fitting the former correctly. This corresponds to the yield point of conventional materials. The multi-orbital action reduces work surface heat generation, which is
particularly important when sanding fillers and paint. Rules are made of hardened and tempered high-grade steel and are usually graduated in the English and/or metric systems of measurement. Sealed rivet consists of a tubular rivet with a sealed end containing a steel or stainless steel mandrel. Wagon saloon A particularly luxurious saloon used for
official purposes. When you are lifting items from the floor always keep your back straight and bend your knees. 19 With the aid of a sketch, show how to locate the centre between two points using dividers. Sections 3.10 to 3.16 cover fabrication tools. 1.2.10 Computational fluid dynamics Definition Any material which flows, such as air or water, can
be referred to as a fluid; 'dynamics' simply means moving and 'computational' is about calculations. The reinforcement materials have high tensile strength, but are easily chaffed and will break if folded. These vehicles are expected to exceed an average of seven years without structural or cosmetic deterioration due to corrosion. The four operations
are as follows: 1 The vehicle is brought up above the bench on the drive-on ramp with or without the aid of a winch. These kits, produced by an automotive paint manufacturer, work by a process of solvent application to the material surface. Pulse control roller spot welding This gives a continuous spot weld along an overlapped edge of metal. Low-
carbon steel is soft and ductile and cannot be hardened by heating and quenching, but can be case hardened and work hardened. First, the electrodes are brought together against the metal and pressure is applied before the current is turned on. Figure 9.17 Methods of welding (a) the leftward method and (b) the rightward method 9.7.1 Leftward
welding This is used on steel for flanged edge welds, for bevelled steel plates up to 3.2 mm, and for bevelled plates up to 4.8 mm. Either contact your supervisor or a known first aid person. In all cases it is essential that the aperture is Major accident damage 467 correctly painted prior to refitting any of the weather seals. Material can be supplied
with a protective coating oil, and packed to prevent damage or rusting during transit and storage. Its main use is to pick up small, low areas on the surface of a panel which is in the process of being repaired by planishing. 6 Shake the tin containing the glass primer for at least 30 seconds. The ability of polyester resin to cure at room temperature into
a hard material is one of the main reasons for the growth of the reinforced plastics industry. The Elan body platform is a one-piece 3 mm nominal thickness vacuum assisted resin injection (VARI) moulding which is riveted and bonded to the welded steel reinforcing outriggers comprising: inner sill, toe board, heel board, A-post and B-post
sided spot welding equipment has a low current intensity, which ensures safety for the operator. Residual stresses in the weld and also balancing compressive stresses in the sheet material (Figure 12.34). The MIG brazing process can
18 When making gas-welded butt joints in sheet steel, which common faults should be avoided? Properties of HSS High-strength steel has a yield strength ranging from 300 to 1200 MPa compared to LC steel which has a range of 140-180 MPa. However, although the metal is stronger, it is not necessarily stiffer. The liquid, being of acid content,
shown as a range or a minimum. There must be space to pressure wash vehicles to get cleaner paintwork before they enter the paint shop. As with needled materials, these are mainly used for flat products, especially where low density is required such as in sound absorption pads and floor mats. Nickel Degrease with solvent Degree with Solvent Deg
and feathered back around the repair. The plasma jet is controlled by adjusting current, gas velocity and type of gas. 121 18 Explain two safety precautions which must be observed when using a cold chisel. AFFF is a fast and powerful means of tackling a fire and seals the surfaces of the material, preventing re-ignition. From 3.2 mm to 4.8 mm: 80 °V
preparation. Pick hammers are likely to be unsuitable because they are too sharp. Fine cut blades are 13 tpi and used for aluminium, copper and brass. The choice of shielding gases commonly used can be seen in Table 12.6. Under the right conditions, any of the gases in the table can be used for the range of thicknesses encountered in the body
are expecting their suppliers to have formal and verifiable quality management systems as a guarantee that work will be completed with an acceptable level of assurance of quality. If the acid or alcohol used contains an unsaturated materials such as styrene or diallyl
phthalate. The thicknesses are carefully graded in order that various clearances ranging from 0.01 mm to 1.0 mm can be measured. The diameter of the face will directly influence the size of the nugget. The foam can also be moulded directly on to the hard layer, allowing simple tailoring of insulation thickness. Health and safety 19 Always keep a
vehicle the anchorage brackets are bolted to the predetermined holes in the frame as specified on the jig charts. Door skins Outside door panels. It is sometimes referred to as semi-killed steel that has been fully deoxidized Material produced by hot rolling. Rectification of vehicle bodies, following a true assessment of the damage, can be divided
into two stages: roughing out or straightening of the reinforced sections and panels to approximately their original shape, and the finishing or preparing of the surface to a smooth appearance for repainting. 13.18.1 Electrical terms Amp The unit of current is the amp and is the quantity of electricity which flows in a circuit. ECUs are usually attached
to the panel with two screws. The job allowance is calculated by allowing 0.5 hours for each subsequent panel or sheet, the straight edge is held against the panel and then moved over the surface, and any distortion or unevenness is shown as gaps
between the edge of the straight edge and the edge of the straight edge and the edge of the work will require the use of the body jack to push or pull large areas or sections back to, approximately, their original positions. Only the
cutting edge of the chisel is hardened. Spray booth and painting area The lighting requirements in the spray booth are similar to those of the preparation area but with an even greater necessity for avoiding glare. In addition, this method of sanding helps to clean the surface but also presents certain problems. A typical example would be that of a
comparatively new car with paintwork in excellent condition but with local damage such as would be sustained in a collision. They can be bulk solid materials, rigid or flexible foams, or in the form of sheet or film. Usually the lowest convenient current should be used; weaving should not be wider than twice the diameter of the electrode, and
electrodes of like composition to the parent metal must be used. 597 3 Fluid needle packing nut screwed up too tightly 4 Broken fluid needle spring 5 Wrong size needle for the fluid tip. On completion of the welding operation the following procedure must be carried out to render the equipment safe. A possible cause of this defect is the use of MEKF
rather than cyclohexanone peroxide paste. PAT tested equipment should be numbered and carry a test date label. Sufficient weld time to develop enough heat to bring a small volume of metal to the correct temperature to ensure proper fusion of the two metals. Spray transfer
Argon \le 8 to 15\% CO2 \le up to 3\% CO2 Argon \le 16 to 25\% CO2 MIG/MAG: plain carbon and low-alloy steels. The distortion on the embossed metal face is low and is negligible on heavy metal thicknesses, although in the case of dissimilar thicknesses it is preferable to emboss the projection on the thicknesses, although in the case of dissimilar thicknesses it is preferable to emboss the projection on the thicknesses, although in the case of dissimilar thicknesses, although in the case of dissimilar thicknesses it is preferable to emboss the projection on the thicknesses, although in the case of dissimilar thicknesses.
in efficiency and staff morale have made it worthwhile. In order to enable this system to work, documented records must be kept at all stages of the repair from the car being booked in for repair until it is returned to the customer. Until fairly recently polymer materials were joined only by means of adhesives. Preheat before welding. The handle can
be screwed into the pump in two different positions for ease of operation. In body work, steel rivets are used on commercial chassis frames and also on fabricated sections such as subframes and laso on fabricated sections are subframes and laso on fabricat
arm which allows for repairs needing high pulls. There is no environmental hazard, and no fumes which might constitute a health risk. In certain cases the police will automatically be called, for instance in the case of a severe fire. Skin fusion Temperature range: 620-950 °C approximately. In this case it would only be necessary to repaint the
repaired areas. These are available in both hot dipped (BS 2989: 1982) and electrolytically deposited (BS 6687: 1986) versions in a range of coating weights or thickness. The next stage in the manufacture of the template, if it is to be marked straight on to metal, is to take the sizes from the appropriate drawings and, using such instruments as
appearance was of a very high standard and extremely durable. Stage 3 (and 4 if needed) will provide further precise timed pulses to bring the weld from the desired size, taking into account the number of sheets of metal and their thickness and the distance of the workpiece. In a metal crystal the atoms are in layers; when the
crystals are stretched (as in forming), one layer of atoms slides over another. This technique reduces over-spray and ensures complete coverage of the surface. Brush brake dust deposits. Before removing the coupling, the steering wheel must be centralised and the road wheels set to the straight ahead position. 10 Pressure wash wheel arches to
butchers and slaughterers wrapped joints of meat in this material - hence its name. Nozzles should not be interchanged between different fuel gases. Safe place of work with safe access and exit. For cutting mild steels they are used with blade lengths up to 500 mm for cutting 3 mm material, or with a length of about 200 mm for material up to 6 mm
In the next stage the aluminium oxide is reduced to the metal aluminium by means of an electrolytic reduction cell. The remaining 10 per cent is divided between MIG/MAG welding and gas welding and gas welding a high-
crowned surface will tend to stretch the metal much quicker than one having a low-crowned surface; hence the choice of block depends on whether the particular section under repair needs to be stretched quickly or just smoothed and planished without stretching. If you do not strike squarely over the dolly, you will be hitting an unsupported area of
the repair and will displace the metal, creating further damage that must be rectified later. This process of hammering in courses and rotating the blank is reached; by this time it will have taken on a double-curvature shape, but should greater depth be required the whole operation must be started
again, working gradually from the edge towards the centre of the work until it is completely to the desired shape and size (Figure 13.3). Direction of welding Flame points away from the edge towards the centre of the work until it is completely to the desired shape and size (Figure 13.3).
effect bonding. Methods used for controlling the tempered upon the size and class of the article to be tempered. Sockets are available not only in standard faceto-face diameters, but also in various lengths or bore depths. Chassis clamps hold the vehicle secure while pulling is taking place. Welds on panel edges which have no access
This is the most popular sander. The purpose of KPI is the same as for camber. It is suitable for materials from light gauge metal panel, too thin for self-tapping or set screws, to plastic sheet up to 16.5 mm thick. The edges of the plate must butt closely to the filler strip throughout the whole length of the weld seam. This would be due to the fact that
16.10.7 Crazing Crazing can occur immediately after manufacture or it may take some months to develop. 49 State the reasons for swaging certain areas of a vehicle floor pan. The manufacturers use anthropometric dummies suitably instrumented with decelerometers and strain gauges which collect 26 Repair of Vehicle Bodies (a) (b) (c) (d) Figure
1.21 Basic frontal crash and side impact (angled side swipe) tests (Vauxhall Motors Ltd.) Figure 1.22 Standard frontal impact test relevant data on the effect of the collision on the dummies. When the weld has cooled the slag forms a brittle coating which can be fairly easily removed by chipping and brushing (Figure 11.1b). Allow to dry and then appl
ground coats as soon as possible. Contact moulding advantages are easily made. 4 Heat the bronzing rod and dip it in the flux. Use of the equipment will include starting, stopping, repairing, modifying, installing,
dismantling, programming, setting, transporting, maintaining, servicing and cleaning. 3 Fire in a rubbish bin, cause unknown - the use of a fire bucket full of sand or a fire blanket spread over the top of the bin should extinguish this fire. In addition to the permanent stresses present in the material, the vehicle body as a whole is subject to shock
stresses due to road conditions, and these must also be taken into consideration by the designer. At-source extraction of welding fumes is far more energy efficient than using central ventilation systems. Some nuts with a strength grade marking
Multipulling repair systems were introduced, which were either static or mobile and which used the vector pulling principle. Small mouldings of simple shape, taken from a suitable GRP mould, should require only a film of polyvinyl alcohol (PVAL) to be applied as a solution by cloth, sponge or spray. Silver solders are made in strip, wire (rod) or
granular form and in a number of different grades of fusibility, the melting points varying between 630 and 800 °C according to the percentages of silver, copper, zinc and cadmium they contain (Table 8.3). With conventional structural sills being increasingly replaced by aerodynamic skirts, the clamps can use swivel jaws that clamp on to the lower
sill panels where conventional clamps cannot be used. The body is then assembled on to the chassis with mounting brackets, which Figure 1.29 Grid of cells on a Volvo car (Dr Ramnefors 1994) The history, development and construction of the car body Figure 1.31 The Ahmed Model, a simplified shape of a hatchback vehicle (Dr Ahmed 1984) Figure 1.29 Grid of cells on a Volvo car (Dr Ramnefors 1994) The history, development and construction of the car body Figure 1.31 The Ahmed Model, a simplified shape of a hatchback vehicle (Dr Ahmed 1984) Figure 1.31 The Ahmed Model, a simplified shape of a hatchback vehicle (Dr Ahmed 1984) Figure 1.31 The Ahmed Model, a simplified shape of a hatchback vehicle (Dr Ahmed 1984) Figure 1.31 The Ahmed Model, a simplified shape of a hatchback vehicle (Dr Ahmed 1984) Figure 1.31 The Ahmed Model, a simplified shape of a hatchback vehicle (Dr Ahmed 1984) Figure 1.31 The Ahmed Model, a simplified shape of a hatchback vehicle (Dr Ahmed 1984) Figure 1.31 The Ahmed Model, a simplified shape of a hatchback vehicle (Dr Ahmed 1984) Figure 1.31 The Ahmed Model, a simplified shape of a hatchback vehicle (Dr Ahmed 1984) Figure 1.31 The Ahmed Model (Dr Ahmed 1984) Figure 1.31 The 
1.32 Composite construction (conventional separate chassis) 33 34 Repair of Vehicle Bodies have rubber-bushed bolts to hold the body to the rigid chassis. Nylon fabrics for airbags are supplied in two basic designs depending on whether the airbag is to protect the driver or the front passenger. He is expected to make full use of his skill and
Bodies Exposed monitoring: Regulation 10 Air sampling is required to monitor exposure every twelve months if: 1 It is needed to maintain control. 5 Estimate of cost including running costs. Some accelerators have only limited or specific uses, such as quaternary ammonium compounds, vanadium, tin or zirconium salts. The applications are: 1 Body
embellishment 2 Interior cladding 3 Lighting where, apart from existing applications of back lamp clusters, polycarbonate is expected to replace glass for headlamp lenses. Cyanoacrylates set in seconds and reach full strength in minutes. Solvents fall into two categories, high boilers and low boilers. The retail rate or set rate per hour is the amount of
a reasonable amount of profit. The chassis frame is now mounted on a wheeled subframe which makes it mobile, and it is then ready for the body shell to be fitted. The individual components may differ considerably, depending upon power requirements and the type of work to be carried out. In DC the current flows constantly in one direction. The
feeding of the wire is achieved by the unit feed mechanism housing the necessary drive motor, gear box and feed rolls which draws wire from the adjacent reel, or by an integrally built motor drive connected to the torch which pulls the wire in the desired direction. The application of brazing is generally limited to joints where a close fit or mechanical
fastening serves to consolidate the assembly and the joint is merely strengthened or protected by the brazing material. This guarantees complete control over the straightening operations from the first pull to the final adjustment of the damaged area. If properly used the solder plates will withstand a pull of 13 800 kN/m2. When the chisel has been in
use for some time a ridge forms on its head which is called a burr; this needs to be removed because it may lead to accidents during use. 11.3.3 Choice of systems. Acetal resins are mostly used for mechanical parts such as cams, sprockets and small leaf
springs, but also find application for housings, cover plates, knobs and levers. The tool is supplied with a complete range of interchangeable bits. Neither MIG plugging nor cold working are recommended. Two-electrode single-sided spot welding Suitable when unable to attach the earth clamp satisfactorily. (b) Figure 2.7 (a) Standard cartridge mask
with filters (Racal Safety Ltd ) (b) Cartridge mask and protective coveralls being used while spraying (Gramos Chemicals International Ltd ) Where the second or third levels are reached, employers must designate ear protection zones and require all who enter these zones to wear ear protection. However, the problems are basically the same: to
maintain strength and stability, a good standard of finish and ease of production. The system's electronic body scanner houses two spinning hubs, each of which emits a laser beam. Do not dispose of dangerous fluids by pouring them on the ground, or down drains or sewers. They have the highest fatigue endurance limits of any of the commercial
thermoplastics, and these properties, coupled with those of reduced friction and noise, admirably qualify the acetal resins for small gearing applications within the vehicle. Most sanding and flatting tools have adjustable speed control. The pan head, similar to the snap head, is also used where strength is required. Pads or gussets are desirable where
stiffeners intersect a flat, flexible area. Double tunneau A longer version of the tonneau in which the front seats were completely separated from the rear seats. 20 Explain the term BS EN ISO 9001-2000 and its relevance to bodyshops. Exhaust fumes are very dangerous, they can kill you. The development of pulling systems has meant that in dealings
with major body repair work it is possible to get a direct upward or downward pull to the front, rear or either side of the vehicle using single or multiple pulling equipment. By extending the timer which carries the welding
things in common. There are check valves for both oxygen and acetylene connections. You must ensure that you do not exceed these maximum load figures. The test piece is the full thickness of the material, with the weld bead reinforcement dressed flush on both sides. It is this physically separate but chemically linked zone which absorbs fractured these maximum load figures.
energy and prevents crack propagation. 9.8.1 Control of distortion A proper understanding of the problems of distortion or buckling associated with the welding of sheet metal is of the utmost importance to the panel beater working on thin sheet metal. The operator who buys a leasehold site pays proportionally less but may not be able to make the
necessary profit within a set number of years. 28 Describe a method of repair by replacement of a front wing which has received major accident damage. Acceleration Acceleration is the rate of change of speed. Use a fire extinguisher to put out any fire caused. Type (b) permits the use of smaller, lighter bogies which are on selected pairs of rails from
each set (Figure 17.74). A featheraction trigger in the handle allows for variation in the strength of the blow according to the amount of pressure applied. Alternatively a cobalt drill specially designed for cutting out spot welds can be used, either in a conventional air or electric drilling machine, or fitted to an air attachment designed specifically as a
spot-welding removal tool. A diamond can be difficult. Pressure drop in an air line is caused by the frictional action of the air molecules on the inside surface of the pipe, as well as pressure build-up at angles. Basket weave is fundamentally the same as plain weave except that two or more warp fibres alternately interlace with two or more warp fibres
material and finished. Table 4.12 indicates the use of various undersealing materials. Questions 1 Why were the earliest motor vehicle bodies made almost entirely of wood? Testing The sequence of testing is particularly important. This will cause the metal to warp and buckle both in and out of the stretched area, owing to overheating of the stretched
section. Also cut out and weld in any replaced buckled panels and reinforcing members which are beyond repair. Peel test the second weld, i.e. tear the test piece apart and check whether the nugget is the size approximately to the weld strength needed. Screws are available in stainless steel and in steel with various finishes, and gauges range from
no. Masking machines are also available in which a roll of masking paper and various widths of masking tape are mounted. When this happens the paint film becomes thinner and projections on the substrate come through it. The UB Modular system gives positive repair with jig brackets. Attach the appropriate hoses to the regulators and the welding
torch, and fit the latter with a suitable welding tip. The loose end of the chain is then fastened to another ram foot anchorage point. Care must be taken not to allow the bit to become red hot, as overheating of the bit causes heavy scaling of the surface due to oxidation; this will mean refiling and recleaning the bit, and hence unnecessary wear and a
shorter service life. A variation on this type of heater is a vertical heater mounted on castors for force drying of doors, quarter panels and so on. Catalysts are extremely irritating to the skin and can cause burns if not washed off immediately with plenty of warm water. The openended spanner fits both square head (four-cornered) or hexagonal (hex)
head (six-cornered) nuts. If you fail to clean the surface of this material it will not only stick to your dolly but will to a large degree destroy its effectiveness. Coated steels will often cause particles of the coating to become embedded in the surface of t
filler strips should not exceed approximately 3 mm. 2 Rectify any misalignment of underframe or chassis using hydraulic body jack, and alignment and repair system. It is this portion of the weatherstrip that holds the entire assembly in place. This process differs from flash welding in that constant pressure
10.5 Resistance flash welding In the flash welding process (Figure 10.9) the two pieces of metal to be joined are clamped by copper alloy dies which are shaped to fit each piece and which conduct the electric current to the work. The main causes of shelving are: 2 Paint manufacturers then reproduce this colour and carry out the usual tests for colour
stability, durability, etc. To calculate the actual cost of a job it is necessary to establish a set rate per hour for all repair shop, and therefore an accurate total repair each section of the body. To dissipate the heat at the weld as quickly as possible, the electrodes are sometimes watering time can be calculated on the time taken to repair each section of the body. To dissipate the heat at the weld as quickly as possible, the electrodes are sometimes watering time can be calculated on the time taken to repair each section of the body.
cooled. Once the metal is back to its original contour, additional hammering will cause the surface to sink below its original contour line, and it may not be possible to raise it readily. 9 Describe the type of tools that would be used to trim the edges of reinforced laminates. Spray two or three coats, allowing a flash-off period of 30 minutes between
coats, and the surface will appear completely matt. 10 With the aid of a diagram, explain the fire triangle. However, owing to the contribution of halons to atmospheric ozone depletion most companies have decided to cease production of halons to atmospheric ozone depletion most companies. In conversation it is
normal to say plastic for both cases as it is unlikely that there will be any confusion. In blanking the cutting action cuts out the whole shape of the part in one operation. Central heating relies on a central boiler feeding a number of convector radiators. The lacquer is touch dry after 15 minutes and can be safely handled after 1 to 2 hours, depending
on room temperature. Hand and power tools 107 3.17.2 Socket sets In many situations a socket ratchet is much faster and easier to use than an open-ended or ring spanner because of its versatility in use, and in some body repair applications it is absolutely essential. Body mounting Conventional body mounted on car chassis in composite method of
body construction. 2.8.21 Used agents are safely disposed of according to local and statutory regulations. The Environmental Protection Act (EPA) and local by-laws in most areas require that used cleaning solvents must be disposed of safely. Before cleaning inside an engine bay with a pressure cleaner the electrical components and engine bay with a pressure cleaner the electrical components and engine bay with a pressure cleaner the electrical components and engine bay with a pressure cleaner the electrical components and engine bay with a pressure cleaner the electrical components.
should be covered over with polythene. If the building is more than about 17 metres wide, additional heaters can be installed. This flame is known as the neutral flame, and is the one most extensively used by the welder. Such a process reduces the labour content of producing panels, but much increases the initial tooling charge. It was during this
period that the all-steel body was developed, along with rapid advances in streamlining. There was good cause for this distrust, as one of the difficulties encountered was that blistering occurred when it was used with nitro cellulose materials. For alternating current welding zirconiated electrodes are used, while for direct current welding thoriated
electrodes are used. 7 Consult safety representatives and employees about work and perceived hazards. Slide front seats forward. Vehicle lighting is connected in parallel. Glass fibre is therefore the ideal reinforcing material for plastics. The usual cleaning procedures should be carried out between each process. Removal of fuel This is not a method
that can be applied to fire extinguishers. Figure 1.40 illustrates four types of body shell - a saloon with a boot, a hatchback, an estate car and a light van. If no manager or other senior person is available you should either dial 999 for an ambulance or telephone your company doctor, then inform the garage manager. Many insurance companies now
make an allowance for valeting within their agreed repair price, and this provides the opportunity for the bodyshop to produce a first-class factory finish to both the exterior and interior of the repair. Hand and power tools 113 Figure 3.47 Metal cutting nibbler
(Desoutter Automotive Ltd.) 3.21 Power saw This is a high-speed pneumatic tool using interchangeable, reciprocating hacksaw blades (Figure 3.48). 18 Describe a method of repairing a sill panel which is showing signs of corrosion. Pressure-feed gun This type of gun sprays paint that has been forced from the paint container by compressed air.
Surrounding the boot lid opening there is a gutter to carry away rain and water to prevent it entering the boot; opposite the hinges, provision is made for the boot lid lock striking plate (11) to be fixed. The advantage of the 12-point ring spanner is that it can hold the nut in twelve different positions, which is ideal for working in confined spaces. The
former itself provides none of the extra stiffness; this results entirely from the box section of the laminate rib. The cost of replacement parts differs between one manufacturer and another, and even between models. Ground coats The paint coats between the primer and finishing coats. Methods of describing major damage Parallel side damage is
caused by the impact object moving parallel to the vehicle and causing substantial damage along the full length of the side of the vehicle, e.g. wing, doors, rear quarter panel. It is written to be as comprehensive as possible. This point should be in the centre of the tyre where it contacts the road. 1740 Jacques de Vaucansen showed a clockwork
carriage in Paris. The weld time has to be short to reduce the heataffected zone around the weld. The system uses the vector principle of exerting pressure on chains to pull or push in any direction to carry out repairs on any part of the vehicle. Within Europe, two systems of type approval have been in existence for over 20 years. The equipment is
now fully set. The squares are then considered as imaginary cube shapes, see Figure 1.30. It is not necessary to outline a complete paint system for metallic finishes; this section deals with the application of the finishing coats. Under the code of practice, the waste must be: 1 Identified (paint, solvent, paper and tape, dust, loaded extract filter media,
scrap metal, tyres and batteries) 2 Categorized 3 Kept in appropriate containers (external skip, internal container, paper baler, can crusher, solvent/paint 'closed loop' system, parts for recycling) 4 Collected and disposed of by a registered operator (transfer note signed by the disposer and collector, and a written description of the waste) 5
Documented at all stages. (a) (b) (c) (d) (e) (f) Figure 13.67 Minor panel repair using adhesive; (a) preparing surfaces (b) cleaning with solvent (c) applying adhesive, heating bond area, buffing joint (f) completed panel (Permabond Adhesives Ltd.) 392
Repair of Vehicle Bodies 13.17.2 Galvanic corrosion Aluminium is the fifth least noble metal, it is almost at the end of the anode-cathode scale, and it has an anodic index of 0.95. A two-pack stopper, usually based on polyester resin and a catalyst, is used for this purpose. When two or more of these lines have been scribed the point of intersection is
the centre of the bar. Others are designed so that they can be opened from both sides and removed altogether. The spent portion of the mandrel is then ejected from both sides and removed altogether. The spent portion of the mandrel is then ejected from the tool. To ensure accuracies, either the vehicle or the measuring frame must be adjusted so that they are parallel. 14 What causes the defect known as
undercutting, and how can this be avoided? Unlike anaerobics, they require surface moisture as the vital catalyst in hardening. 3 Do not overuse waterless hand cleaners, soaps or detergents, as they can remove the skin's protective barrier oils. Bodymaster 2000 is particularly versatile owing to its 5 metre long tubular steel rigid base. 3 What is an
inert gas? Clean the surface of the workpiece All metals have a covering of oxide on their surface, although it may not be visible to the naked eye, and this oxide film will prevent the solder from bonding to the metal to be soldered and therefore create a weak joint. In the rightward and leftward techniques it is seen that edge preparation becomes
necessary at 7.9 mm and 3.2 mm respectively, in order to obtain complete fusion without fear of adhesion. Usually 4 mm (3/16 in) holes at each end of the crack will be sufficient to remove the internal stress. 598 Repair of Vehicle Bodies 17.11.8 Compressor overheating An overheated air compressor is caused by: 1 No oil in the crankcase 2 Oil which
is too heavy 3 Valves which are sticking, or dirty and covered with carbon 4 Insufficient air circulating round an air-cooled compressor due to it being placed too close to a wall or in a confined space 5 Cylinder block and head being coated with a thick deposit of paint or dirt 6 Air inlet strainer clogged. Finally, all connections are made externally so
that there is no necessity to strip interior trim or remove assemblies to provide access (Figure 14.7). A rather common trouble that arises when repairing bonnets is the development of a loose edge. V-groove the area using a coarse 3 in disc, then feather back the paint around the V-groove. If more than one panel is being replaced, the combination
panel time is used. It is not possible to obtain incorrect readings. Excessive pressure also increases the tendency to blow the edges of the steel away as they are melted. It cures to a flexible rubber which bonds firmly to wood, metal, glass and GRP. Thermoplastic materials soften to become plastic when heated, no chemical change taking place during
this process. 9.8 Edge preparation and types of joint In order to produce a satisfactory butt weld it is essential for the edges to be joined throughout their entire thickness; this necessitates complete melting of the edges to be joined throughout their entire thickness; this necessitates complete melting of the edges. The steam cleaner, often referred to as a steam jenny (jenny generator), produces hot pressurized water with the option of
detergent. POP is the registered trademark of Tucker Fasteners Limited who were the pioneers of blind riveting. Hydraulic body jacks can be extended to any desired length by incorporating a number of attachments which are available for pushing or pulling. These defects reduce the loadcarrying area of the joint and produce stresses, and are
therefore unacceptable in welds which are subjected to fatigue loading or static loading starts when the switch is actuated and is subsequently controlled by the welding timer for a time between 0.2 and 2.5 s. The composition of the core wire is important and in general falls into three types: pure aluminium, aluminium silicon or
aluminium manganese. Insert the prepared patch through the panel, keeping hold of the wire loop. 14.5.3 Estimating The ability to estimate can only be gained through practical experience in the field of body repair work. Some machines have a quick pressure release mechanism attached to the spindle. If this chalk line is visible around the entire
weatherstrip, the boot lid sealing is perfect. The possibilities for sectional repairs to load-bearing parts have been taken into account during the initial phase of development by manufacturers. 17.5.5 Abrasive papers The type of abrasive paper mainly used by the spray painter is known as wet-or-dry paper. This system is used on
most cars and light vans, all the circuits returning to the battery negative via the body/chassis. The system can also be used for pushing or as a crane using optional accessories. xxviii Glossary Specifications Information provided by the manufacturer on vehicle data in the form of dimensions.
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