

## PART 2. BODY REPAIRS

### 1. INTRODUCTION

This section has been compiled to assist the vehicle owner who feels they are sufficiently competent to carry out their own basic bodywork and paintwork repairs.

Bodywork and paintwork repair is a more complicated subject than first imagined, there is more to panel beating than swinging a hammer and there is more to painting than squeezing the trigger on the spray gun. No two tradesmen will approach a repair job in the same manner, but possibly each method of repair will have its own points of merit. Where possible, it will greatly assist the amateur repairer to just sit and observe a good tradesman at work.

Normally too much emphasis is placed on the painting side of the repair and not enough on the surface to which the paint is being applied. Paint was never designed, to fill dents or cover up a shoddy repair job. The final paint finish is totally dependent on the surface to which it is being applied.

Before starting any repair job it will be necessary to thoroughly inspect the vehicle for more than just the obvious damage. On modern vehicles where the materials used in construction are relatively light, structural damage may be sustained even though the external panels have only minor damage. Where structural damage has been sustained the vehicle should be taken to a competent repairer who has the necessary pullers and jigs to ensure that the vehicle is returned to a structurally sound condition.

In some instances where a panel is bolted to a vehicle it may be cheaper and less time consuming to purchase a secondhand panel from a wreckers yard, but ensure that the panel being purchased is in a sound condition ie: no hidden rust or excessive amounts of body filler from a previous repair job.

There are many different procedures, techniques and precautions to be observed when painting a motor vehicle. It is therefore recommended that this section should be studied in its entirety to avoid the possibility of damaging the paintwork on the vehicle even further.

Touching up the paintwork with a brush or carrying out spot repairs with an aerosol can are fairly simple operations which should be within the scope of the amateur repairer.

Spraying of repaired panels or the complete respraying of the vehicle is a fairly involved procedure which requires specialised equipment and knowledge, but even so this is not beyond the scope of the amateur repairer if care and common sense are exercised.

The initial purchase price of the equipment required for respraying a motor vehicle is the factor which will determine its economic feasibility. The purchase of sound second hand equipment or the renting of such equipment from a reputable hire firm should not be overlooked as a means of reducing costs.

The final paint finish is only as good as the surface to which it is applied, automotive paint was never designed to fill scratches or imperfections in the surface.

### 2. SAFETY

The operators safety is the single most important factor to be considered when carrying out repairs to a motor vehicle.

Never work under a vehicle which is supported only by the vehicle jack, bricks or similar materials as these are seldom stable. Always support the vehicle on chassis stands or use car ramps. When lifting either end of the vehicle ensure that the wheels remaining on the ground are fully chocked in both directions.

Avoid spilling oil or water around or under the working area, apart from the mess, you can easily lose your footing when exerting force on a particularly stubborn component.

When power tools are used make sure that they are correctly fused and earthed with all connections and plugs tight and effectively insulated.

Avoid at all times inhaling any form of body filler dust, paint dust or primer or paint fumes. Certain types of paint fumes can be fatal if inhaled for any length of time. Paint suppliers usually stock suitable breathing masks for most applications.

When using a welder of any type on a vehicle always have a suitable fire extinguisher on hand for emergencies. Never use a welder or have any type of naked flame near paint or thinners.

When working on the damaged portion of a vehicle bodywork always take care to avoid injury on any sharp edges that may be present.

Always take care when working with compressed air or where metal fillings or dust particles are present, wear safety glasses to prevent eye injury.

### 3. TOOLS, EQUIPMENT AND MATERIALS

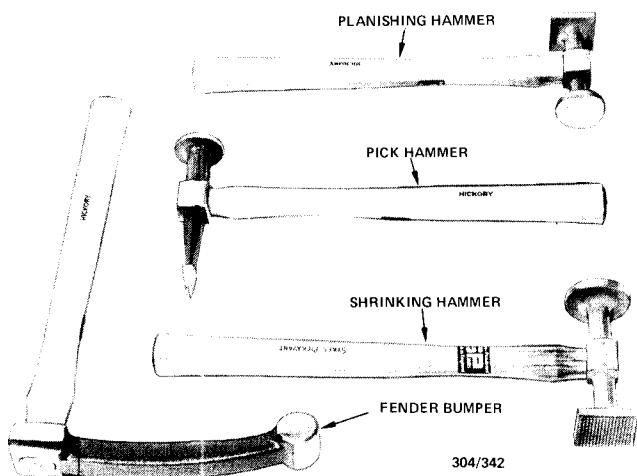
#### TOOLS

It is obvious that the amateur repairer does not require hundreds of dollars worth of tools to repair a small dent in a fender, therefore the type of repair required should be assessed and the tools required to complete the job should be purchased only. In many instances a tool may be fabricated or adapted from something found around the house or garage.

As sensible selection of tools can greatly influence the ease and quality of work performed, it is good advice to purchase the highest quality of tools that can be afforded. Tools which bear the makers name are usually best. The cheaper variety of tools should be avoided as their useful life can be surprisingly short.

To ensure that all hand tools see out a normal working life tool care is also very important. After each job undertaken all tools should be thoroughly cleaned.

If the tools are to be stored for any length of time it is also good policy to wipe them over with an oily cloth. To prevent hand tools and other equipment from becoming mislaid and to ensure uncluttered working surroundings all tools should be stored in a tool box.



Assorted panel beating hammers.

The following list of basic tools should familiarize the lay person with the tools used in bodywork repairs:

**Planishing hammer** — the most commonly used tool in panel beating. This hammer is mainly used with a dolly for the final smoothing process of a panel repair.

**Shrinking hammer** — this hammer is similar in weight and shape to a planishing hammer except that the faces have a regular patterned rough finish.

**Pick hammer** — this hammer can be used in place of a planishing hammer to bring down high spots of a panel surface.

**Ball pein hammer** — used for general work in conjunction with chisels, drifts etc.

**Fender bumper** — used for general roughing out of a panel where access is limited.

**File hammer** — this tool is useful in repairing large areas of damage at one time and is used in conjunction with a hand dolly.

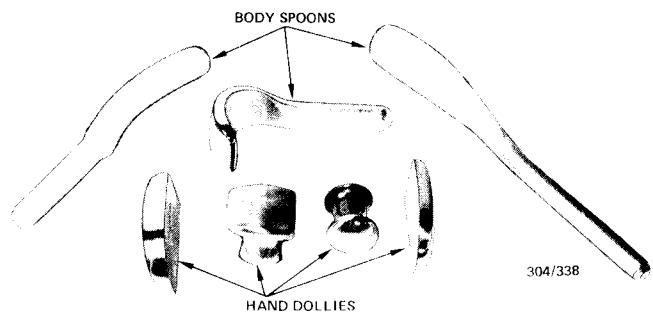
**Hand dollies** — hand dollies are cast iron or steel blocks which are available in various shapes and sizes. They are used in conjunction with a planishing hammer to remove dents and damage from panels.

**Cold chisels** — a good range of cold chisels is an advantage when carrying out bodywork repairs. The chisels when used on sheet metal should have a very sharp and drawn out cutting edge.

**Caulking chisels** — very simply a caulking chisel is a cold chisel with a rounded or blunt end and is used for repairing body creases and sculptured panels.

**Tin snips** — used for cutting sheet metal and are available in left and right handed types and various sizes.

**Flexible panel file** — this tool is used for a variety of tasks and the blade can be altered in contour to adapt to the shape of almost any panel. Various replacement blades are available for the file to allow the planishing of a panel or the smoothing of body filler.



Assorted hand dollies and body spoons.

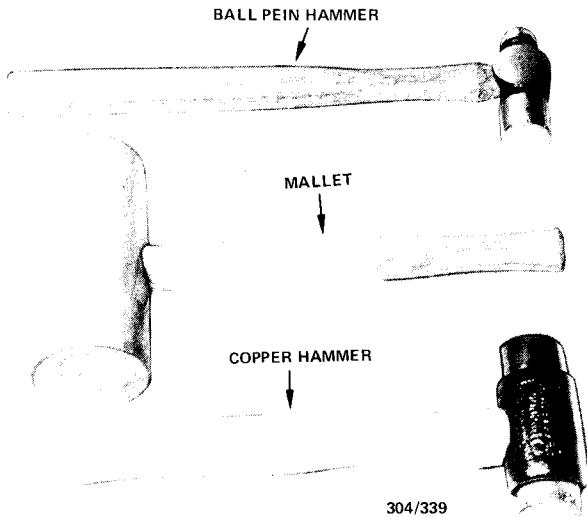
**Radius body file** — similar in function to the flexible panel file except that the curve of the file blade is fixed.

**Hacksaw** — used for cutting sheet metal whether it is in sheet form or box sections.

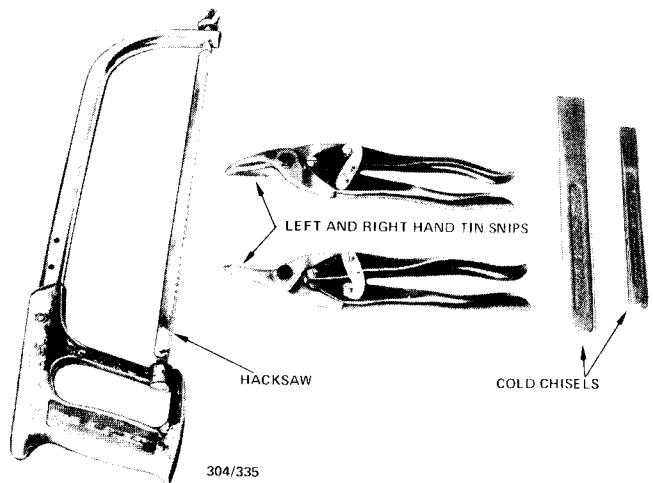
**G clamps** — available in numerous sizes, ideal for holding pieces of metal or box sections together while welding, brazing or rivetting.

**Pry bars** — variety of functions, mainly useful for pulling a non structural panel back into its approximate shape. Also known as crow bars.

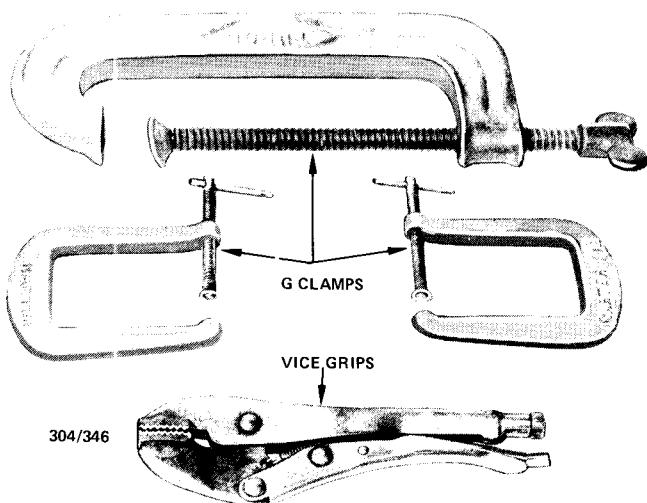
**Scrapers** — used for removing old paint after paint stripper has been applied.



Ball pein hammer, copper hammer and mallet.



Hacksaw, tin snips and cold chisels.



G clamps and vice grips.

**Mallet** — constructed of wood, useful for working metal while reducing the risk of stretching the metal.

**Copper hammer** — a useful hammer which can be used preceding a mallet to rough out a damaged panel.

**Body spoons** — used in the same manner as dollies, but have the advantage of being able to reach into confined areas.

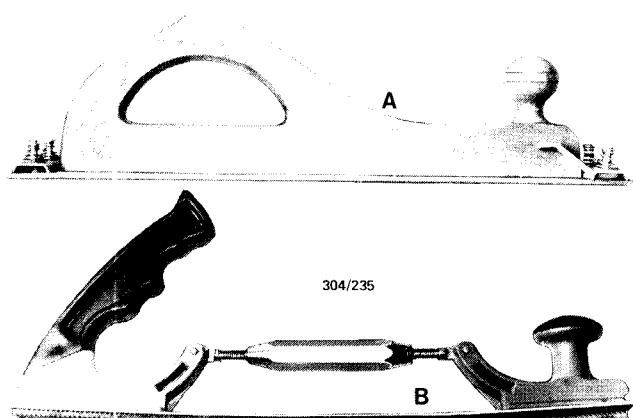
**Cheese grater file** — used to remove excess body filler before the filler has completely hardened.



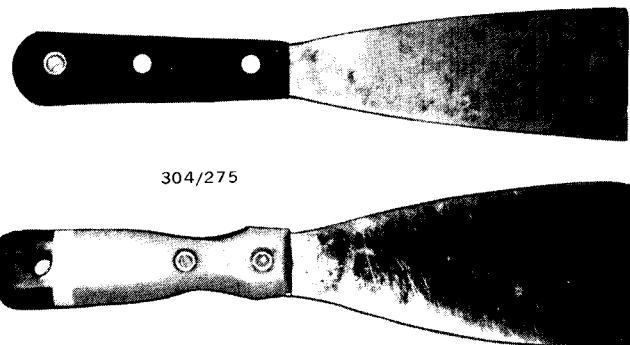
Pry bars.

**Speed file** — a wooden file to which coarse abrasive paper can be attached.

In bodywork and paintwork repairs it will also be necessary to have a basic kit of hand tools ie: spanners, screwdrivers, pliers etc to remove various body and trim components to facilitate repair procedures. Refer to Tools - Equipment - Safety in the front of this manual.



A. Speed file. B. Flexible panel file.



Scrapers.

## EQUIPMENT

The large initial expense of purchasing the equipment required for bodywork and paintwork repairs can be avoided if the equipment can be borrowed from someone or rented from a reputable equipment hire firm. In some instances though the convenience of having the equipment on hand at all times may warrant its purchase.

The following list of equipment is recommended for the efficient repair of bodywork or paintwork:

**Air compressor** — used for supplying a constant pressure of air to a spray painting gun or various air operated tools eg: air chisel, impact wrenches etc.

**Pressure regulator/filter** — used in conjunction with the air compressor to regulate the air pressure and rid the air of all impurities.

**Oxy/acetylene welding outfit** — invaluable when carrying out bodywork repairs, can be used for welding, brazing, soldering, stretching, shrinking, forming and cutting metal.

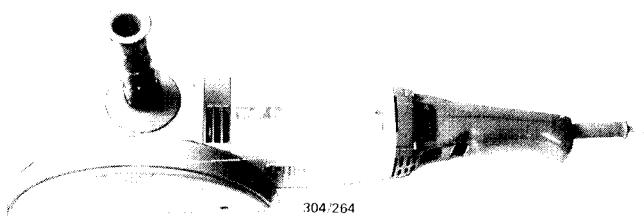
**Hydraulic body jack** — not an essential piece of equipment and can be successfully substituted by a mechanical lift type jack on minor repairs. Attachments for the body jack can be either purchased separately or fabricated from scrap water pipe and fittings.



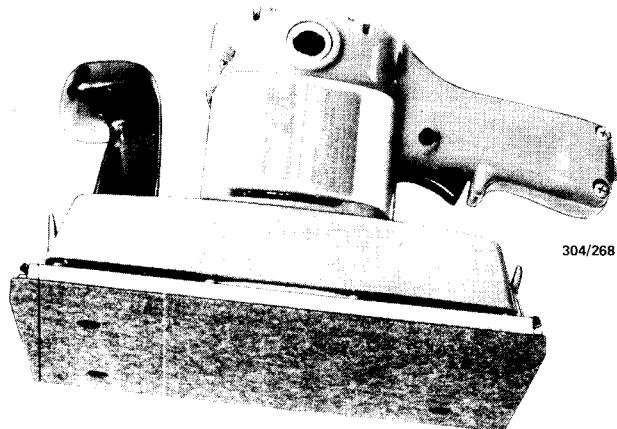
Slide hammer and P. K. screw attachment.

**Slide hammers** — available as kits or individually and come in a range of sizes and attachments. Particularly useful where access to the rear of a panel is not possible.

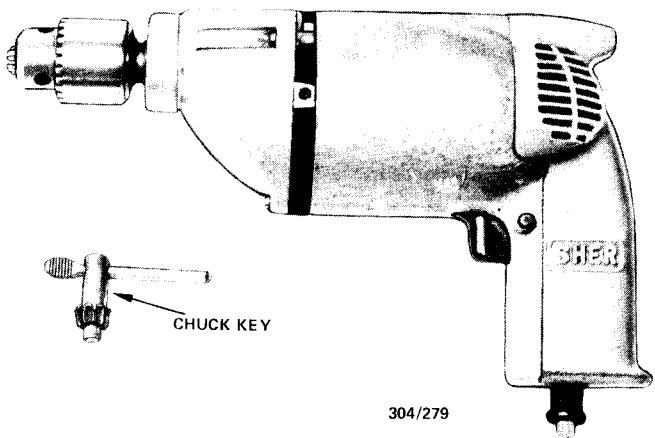
**Disc sander** — used primarily for cleaning the metal surface of old paint and rust and removing excess metal from a weld.



Multi-purpose sanding, grinding or polishing machine.



Orbital sander.



Power drill and chuck key.

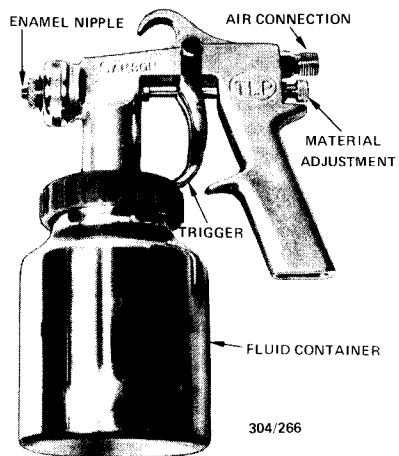
**Orbital sander** — used primarily for smoothing areas of body filler and as a substitute for the body file.

**Power drill** — variety of uses including; drilling out spot welds, drilling holes, drilling out rivets, etc.

**Polisher** — used in the final stages of repainting to bring up the lustre of the paint finish, is used in conjunction with a cutting or polishing compound and a lamb-swool pad.

**Riveting gun** — when used in conjunction with rivets can prove invaluable for simplifying the joining of metal panels.

**Breathing mask** — used to prevent the inhaling of



Low pressure spray gun fitted with enamel nipple.

body filler dust, paint dust or paint fumes while carrying out bodywork or paintwork repairs.

**Spray gun** — used for applying primer or paint to metal panels.

**Spray putty gun** — used to apply spray putty to panels. This spray gun is not interchangeable with a conventional spray gun.

In bodywork repairs it will also be necessary to have certain pieces of equipment not directly related to bodywork repairs eg: hydraulic jack, chassis stands etc. Refer to Tools — Equipment — Safety in the front of this manual.

## MATERIALS

A large variety of materials are required when carrying out bodywork and paintwork, repairs. The following list covers the common materials required and their applications:

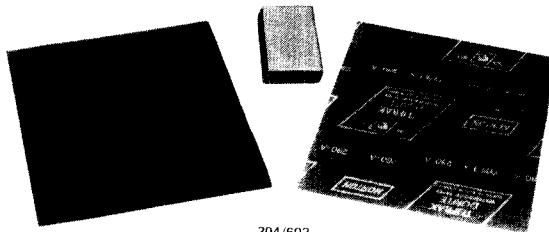
**Masking tape and paper** — used to protect or cover undamaged body panels or trim during repair or painting operations.

**Abrasive papers (Wet or dry paper, sanding discs, etc.)** — various types of abrasive paper, sanding sheets and sanding discs are used to carry out bodywork and paintwork repairs.

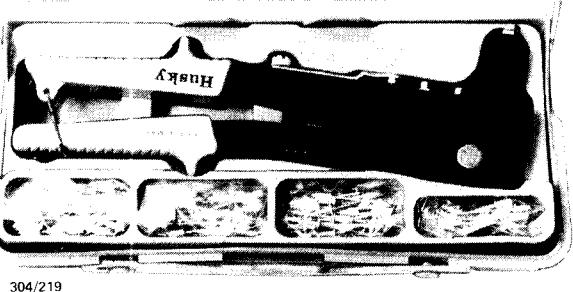
**Paint stripper** — used when the complete removal of the paint finish is required.

**Plain soap** — used as a lubricant and cleaning agent when rubbing back the paint surface.

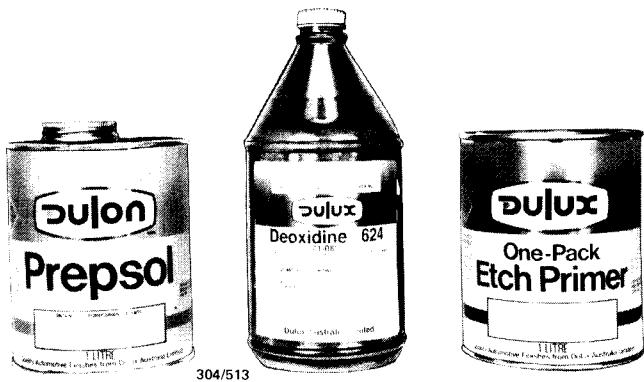
**Steel wool** — can be useful in the many operations involved in bodywork and paintwork repairs.



Abrasive paper and rubber block.



Riveting gun and kit.



#### Materials used in surface preparation.

**Body filler** — this material is known by many names, basically it is a two part putty which is used where an indent, crease or scratch in a body panel is too deep to be rectified by using a spray or stop putty.

**Deoxidising agent** — normally an acid based cleaner and conditioner, which removes rust, eliminates the rust inducing agents and leaves the metal surface clean and ready for painting.

**Etch primer** — used to promote the adhesion of primer surfacers to bare metal surfaces.

**Wax and grease remover** — a cleaning solvent used for the removal of wax, grease, tar and silicone polishes from painted surfaces.

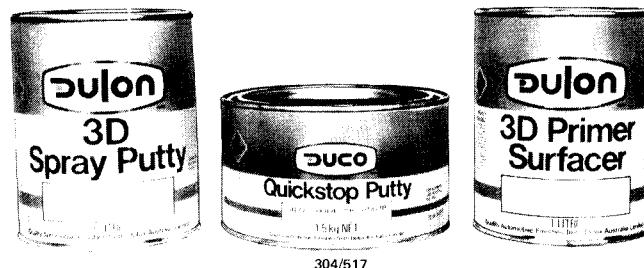
**Primer/surfacer** — used as a base coat to promote the adhesion of the paint finish to previously painted and small bare metal surfaces. Also used as a base for stop and spray putties as they will not adhere to bare metal surfaces.

**Stop putty** — used as a filler for removing indentations, disc and file marks and nicks before painting a body panel. Stop putty is applied using a rubber squeegee or flexible putty knife.

**Spray putty** — serves the same function as stop putty except it is applied using a special spray gun.

**Thinner** — used to 'thin down' the various types of paint, primer surfacer and stop putty available. The correct type of thinner must be used for each application.

**Paint** — numerous types of paints are available which exhibit different drying and final finish properties. The type of paint used on the original paint finish should be taken into consideration when selecting a paint type for refinishing as some types of paint are not compatible. The subject of paint type is best discussed with your local paint



#### Materials used in preparing the surface for the final paint finish.



#### Materials used in applying the final paint finish.

suppliers. For minor paint repairs it may be possible to purchase the correct color and type of paint in an aerosol can.

**Blending clear** — used as a base coat where only a part of a panel is to be painted. Blending clear promotes the adhesion of the new paint to the original painted surface without using a primer surfacer.

**Clear lacquer** — used as a top coat on certain types of paint finishes.

**Cutting compound** — two types of cutting compound are available, one is used by hand and the other is used with a buffering machine. This product is used to remove orange peel and overspray and to produce a lustrous, glossy finish.

**Polish** — used after cutting compound to remove the marks from the paint finish caused by the cutting action, polish also provides a protective coating for the paint.



#### Materials used for finishing off.

**Wax** — may be applied after polishing to provide extra protection for the paint finish.

**Caulking compound** — used as a sealer to prevent the entry of water and dirt into body seams. Preferably a non-hardening compound.

**Underbody sealer** — used to cover and seal bare surfaces on the underside of the vehicle after the completion of a repair. Acts as an anti-rust agent and a sound deadener.

**Glass Reinforced Plastic (GRP)** — more commonly known as fibreglass has a multitude of uses. Ideally suited as a filling medium for large holes and tears in metal panels. Consists of a woven glass matting which is impregnated with a polyester resin which hardens when set.

**Bleeder Sealer** — sprayed over the top of the primer/surfacer when it is applied to maroons and reds. Prevents the pigments present in these colours bleeding through and staining the final paint finish.

#### 4. RUST REPAIRS

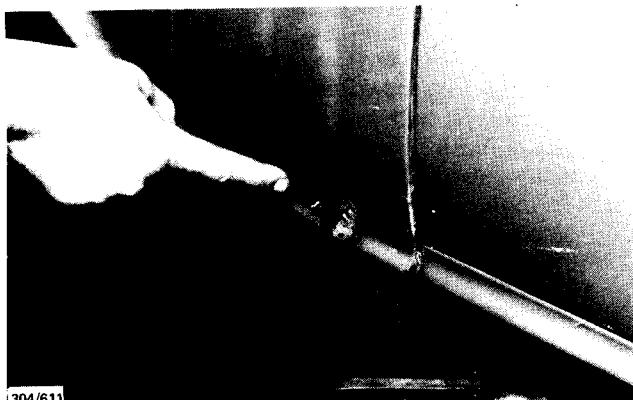
##### CAUSES AND PREVENTION OF RUST

Rust is the corrosion which attacks the surface of iron and its alloys when it is exposed to oxygen and water.

Modern vehicles with their all steel bodies and unitary body construction are particularly susceptible to rust. The various holes, ledges and recesses etc. which are part of the modern vehicle are traps for road dirt which when wet can retain moisture for several days.

Recently vehicle manufacturers have provided greater protection from rust at the manufacturing stage. The manufacturers have treated the vehicle bodies by varying methods including immersing the entire body in a rust preventing paint. A bitumen based sealer and sound deadener is also a popular method for preventing rust.

To prevent rust, ensure that road dirt is not allowed to build up anywhere on the vehicle and any bare metal caused by accident damage or stones is quickly treated and sealed. Also ensure that all body water drain holes are kept free of any obstructions.

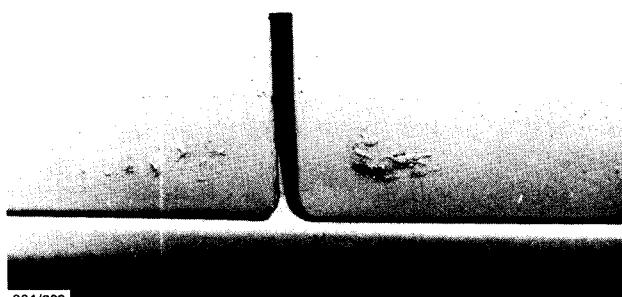


View of fender showing extensive rust penetration.

##### TO REPAIR RUST DAMAGE

Two methods of repairing rust damage can be employed: (1) Cutting away the affected panel and replacing it with a new panel or section. (2) Filling the affected area with plastic body filler, fibreglass matting and resin or a metal patch.

Unless the rust affected panel is only bolted to the vehicle, the amateur repairer should not attempt to repair



View of panels showing rust penetration in the outer skin.

rust damage by replacing the affected panel or section. The job of welding on a new panel or welding a new section into a panel is best left to a professional panel beater.

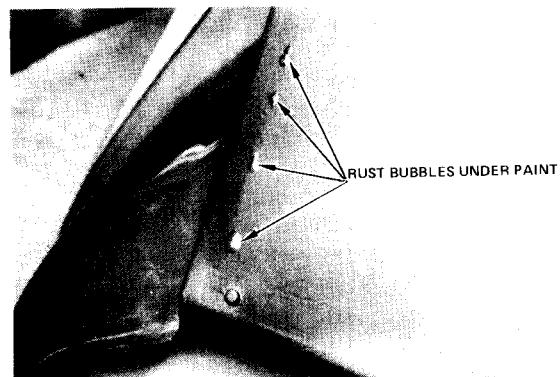
For replacement of rust affected panels refer to the appropriate heading later in this manual.

Structural rust in a motor vehicle can render the vehicle unsafe and as such should only be repaired by a professional panel beater.

##### HOW TO REPAIR RUST DAMAGE USING PLASTIC BODY FILLERS

###### Light Panel Penetration

Plastic body fillers can be used to repair rust where the panel penetration is not too severe i.e. no large holes in the metal.



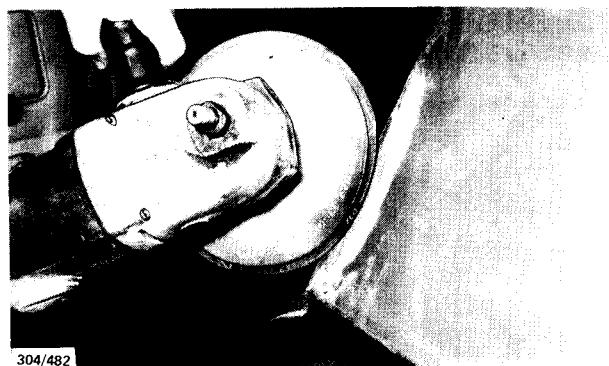
View of rusted area of panel prior to commencing repair operations.

(1) Using a paint stripper, disc sander or scraper remove all traces of paint or underbody sealer from the rusted area and its surrounds on the front and rear of the panel.

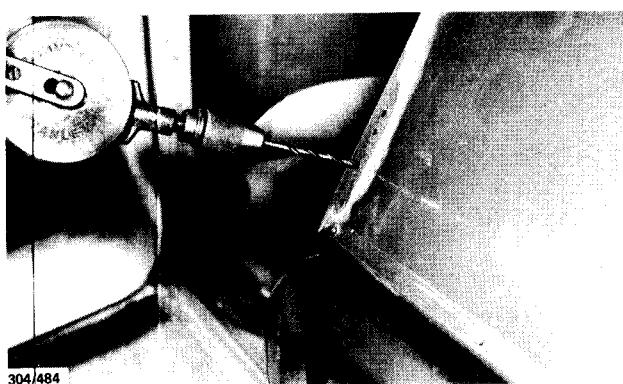
(2) Treat the rusted area with a rust converting liquid.

(3) Where necessary, using a ball pein hammer gently tap down the rust affected area of the panel until it is approximately 3mm below the level of the surrounding panel.

(4) Restore the panel to its correct level by using



Using a disc sander to remove all traces of paint from the rusted area and its surrounds.



In some cases a hand drill may be used to remove all traces of rust from the areas of penetration.



Using a ball pein hammer to tap down the rust affected area.



Applying the deoxidising agent/rust convertor to the rusted area.

plastic body filler as described under the appropriate heading later in this manual.

*NOTE: Ensure that the body filler is forced through the holes in the affected area of panel to provide a good bond.*

#### Extensive Panel Penetration

Reasonably large holes in a panel can be effectively repaired using the following method:

(1) Using a paint stripper, disc sander or scraper remove all traces of paint or underbody sealer from the

rusted area and its surrounds on the front and rear of the panel.

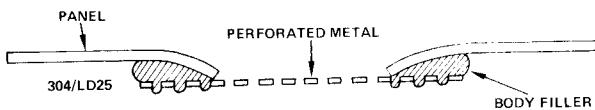
(2) Where necessary, cut any heavily rusted areas from the panel using tin snips.

*NOTE: Do not attempt to fill an overly large hole with body filler as the structural strength of the panel could be affected. If the hole is too large to be filled with plastic body filler or a small metal patch as later described, the vehicle should be taken to a competent panel beating shop where a new metal piece can be welded in.*

(3) Treat the rusted area with a rust converting liquid.

(4) Using a ball pein hammer tap down the edge of the hole, this will provide a tapering edge to the hole thus promoting the adhesion of the body filler.

(5) Cut a piece of perforated metal or close mesh wire screen to a size approximately 15mm larger than the hole to be filled.



Line drawing showing correct relationship of body filler, perforated metal and panel.

(6) Mixup a small amount of body filler following the manufacturers instructions and apply a small quantities of the filler to the perimeter of the perforated metal or wire screen.

(7) Place the perforated metal or wire screen over the hole, but from the rear of the panel and push it firmly into place.

(8) Allow the body filler to set, mix up a quantity of body filler following the manufacturers instructions and apply it to the affected area of panel and finish off as described under the appropriate heading later in this manual.

*NOTE: Ensure that the body filler is forced through the holes in the perforated metal or wire screen to provide a good bond.*

#### HOW TO REPAIR RUST HOLES USING A FILL-IN-ONE TYPE PRODUCT

As an alternative to the previously described methods of repairing rust holes the following procedure may be followed:

(1) Using a paint stripper, disc sander or scraper remove all traces of paint or underbody sealer from the rusted area and its surrounds on the front and rear of the panel.

(2) Where necessary, cut any heavily rusted area from the panel using tin snips.

*NOTE: Do not attempt to fill an overly large hole with body filler as the structural strength of the panel could be affected. If the hole is too*

large to be filled with body filler or a metal patch as later described, the vehicle should be taken to a competent panel beating shop where a new metal piece can be welded in.

(3) Treat the rusted area with a rust converting liquid.

(4) Using a ball pein hammer tap down the edge of the hole, this will provide a tapering edge to the hole thus promoting the adhesion of the body filler.

(5) Using masking tape secure the acetate sheet provided in the repair kit squarely over the hole to be filled.



#### Contents of Fill-In-One body filler kit.

(6) Using of felt tipped pin draw the outline of the hole on the sheet.

(7) Mix a quantity of filler as described in the manufacturers instructions of the product being used.

(8) Remove the acetate sheet from the panel lay it on flat surface and apply the filler to the sheet ensuring that it is kept within the drawn outline of the hole.

*NOTE: Apply the body filler to the sheet on the opposite side to which the outline of the hole has been drawn.*

(9) Apply the acetate sheet and filler to the hole ensuring that the drawn outline matches the outline of the hole.

(10) Tape the sheet into position while stretching it gently to ensure a smooth finish.

(11) Allow the filler to dry for the recommended amount of time, then peel off the acetate sheet.

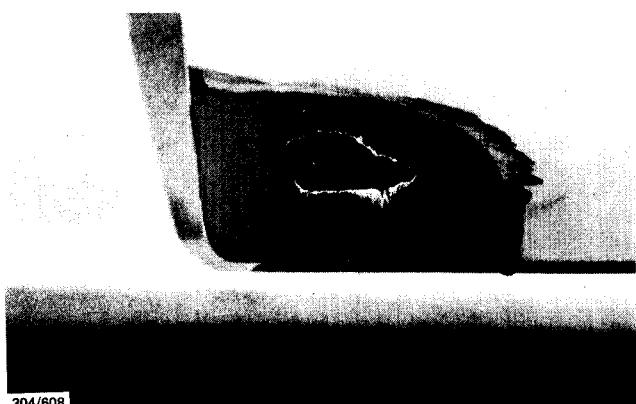
Any excess filler can be removed using a wet or dry abrasive paper and liberal quantities of water.

(12) Any hollows or holes in the filler may be built up using a fresh mixture of body filler applied with a spatula.

#### HOW TO REPAIR RUST HOLES USING A SOLDERED METAL PATCH

As an alternative to the previously described methods of repairing rust holes the following procedure may be followed:

(1) Using a paint stripper, disc sander or scraper remove all traces of paint or underbody sealer from the



View of rusted panel after it has been cut back using a disc sander.

rusted area and its surrounds on the front and rear of the panel.

(2) Where necessary, cut any heavily rusted areas from the panel using tin snips.

(3) Treat the rusted area with a rust converting liquid and clean the metal thoroughly.

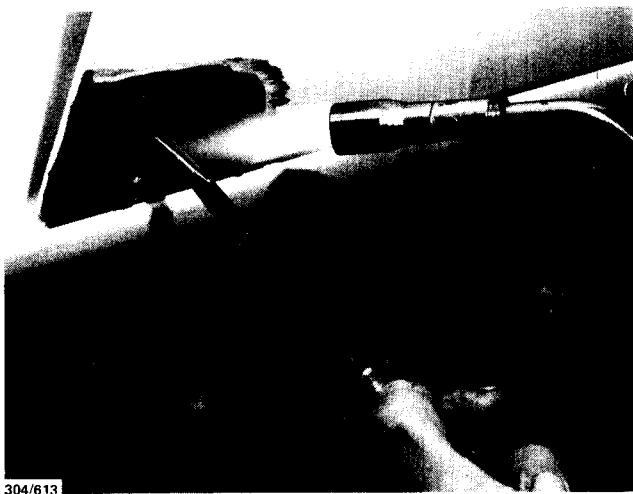
(4) Using tin snips, cut a suitable piece of metal from an old panel or metal sheet ensuring that it is approximately 10 mm larger than the hole to be covered.

(5) Using a suitable acid based flux treat the metal patch and the panel as described in the manufacturers instructions.

(6) Using a blow torch or oxy torch, heat the metal patch and panel in turn and flow a small amount of solder onto the mating surfaces.

(7) Place the metal patch centrally over the hole, hold the patch in place with a screwdriver and heat the patch and panel until the solder melts and bonds the patch to the panel.

*NOTE: Hold the patch in place with the screwdriver until the solder has solidified completely.*



Apply the heat to the solder coated metal patch while holding it in place with a screwdriver.

(8) Once the solder and areas of metal have cooled completely, tap down the area of the patch until it is flush with the surrounding area of panel.

(9) Remove all traces of flux and excess solder from the repaired area.

(10) Fill any indentations in the surface using body filler and finish off as described later in this manual.

## 5. PANEL DAMAGE

### WORKING METAL

#### Introduction

There are many operations required to completely rectify any damage to a body panel. The actual working of the damaged panel with hammers, dollies etc, is an important aspect of any repair job.

The need to analyse the extent of damage and its origin is an important aspect of the repair job. It is a waste of time trying to repair any damage starting at the point of impact, unless the damage is very minor, without relieving any strain in the surrounding metal. In some cases where the damage is minor and the strain around the damaged area is equal the panel may possibly be completely restored by bumping out the damage with the hand.

The various operations required to repair damaged body panels are described under the following headings.



View of vehicle showing extent of panel damage prior to commencing repair operations.

#### Roughing Out

Roughing out is the first step in the repair of any major panel damage. Its main function is to bring a damaged panel into something resembling its proper shape prior to hand bumping.

A copper hammer is used initially on the areas of severest damage, always taking care not to stretch the metal.

*NOTE: Before starting to rough out the panel damage, ensure that there is sufficient space behind the panel in which to work. If necessary, remove all trim and thoroughly clean the underside of the panel to remove all traces of dirt or underseal.*



Roughing out the damaged area using a mallet.

Using the copper hammer strike blows from the underside of the panel to the centre of each large dent, but do not attempt to fully repair the damage at this stage as stretching of the metal will result.

Once the panel is starting to form a state resembling its original shape, the copper hammer should be changed for a mallet which can be used to remove even more damage but lessening the chance of stretching the metal.

On sections of damaged panel which normally have a curve it can prove advantageous to use a body spoon in conjunction with the copper hammer to return the metal to its correct shape without causing additional dents.

Having roughed out the areas of greatest damage and the panel is beginning to resemble its original shape the next step in the repair procedure is hand bumping.



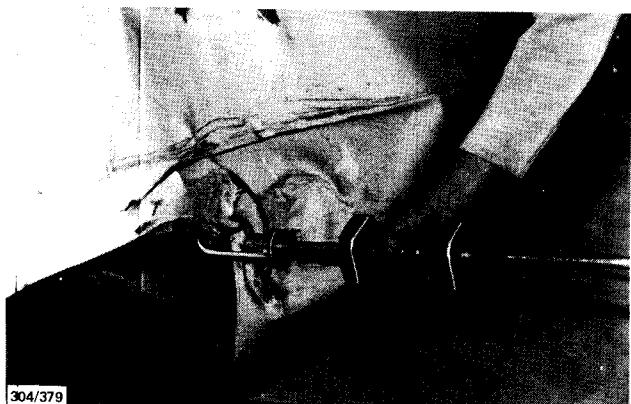
Using a caulking chisel to restore the damaged panel to its original contour.

#### How to Use a Slide hammer

The use of a slide hammer to pull out a damaged panel may prove necessary where access to the rear of the panel is not possible.

Care should be exercised when using a slide hammer as it can be very easy to tear or stretch the metal panel.

Various methods of attachment are possible with the slide hammer, the two most popular methods being; (1) Attaching the slide hammer to the edge or seam of a dam-



**Using a slide hammer with a hook type attachment.**

aged panel. (2) Drilling a hole in the damaged panel and screwing a self tapping (P. K.) screw attachment on the slide hammer into the hole.

In the cases where a slide hammer is necessary it may also not be possible to planish the panel to a smooth surface so a body filler will have to be used.

Because of the slide hammers limitations it should only be used to 'rough out' a panel.

#### **Hand Bumping**

Hand bumping while being a relatively simple operation requires more care to be taken than when roughing out.

The object of hand bumping is to reduce the damaged area still further and at the same time working the panel to the original shape.

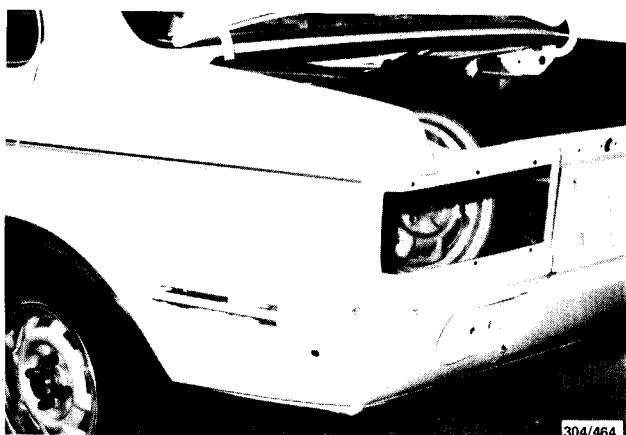
Select a dolly with a head approximately the same shape and of a lesser radius curve than the panel being repaired.

*NOTE: It may be necessary to change the type of dolly used during the repair operation if there are different contours in the same panel.*

Place the dolly on the underside of the panel with its head pushed hard up against the ridge of a buckle. Using a mallet lightly strike the opposite side of the panel directly over the area supported by the dolly. Using this procedure the dolly is used as an anvil.



**Using a hand dolly to hand bump the damaged area.**



**View of the damaged area after completion of the roughing out and hand bumping operations.**

After each blow of the mallet, move the mallet and dolly over and around the area of buckling, ensuring that at all times the dolly is directly below the area struck by the mallet.

Where necessary to raise areas that are below the level of the surrounding panel the dolly can be employed to bump up the depressed area. Where the depressed area is extensive a wide body spoon may be employed.

Once the hand bumping operation is completed and the entire panel is beginning to assume its normal shape, the series of minor indentations that remain may be removed by the method called planishing.

#### **Planishing**

Planishing is the method used to fully restore a damaged panel to its original shape. Planishing is used after the roughing out and hand bumping operations of an extensively damaged panel or for the repair of minor panel damage.

When damaged areas cannot be planished due to limited access, the damaged area may be restored to its original finish using body filler as described under a later heading.

Planishing is similar in procedure to hand bumping



**Using the planishing head of a panel beating hammer to repair the damaged area.**



304/462  
**Removing the old paint finish from the damaged area using a disc sander.**

except that a specialised type of hammer is used and much lighter blows are struck. Light blows are essential in planishing as heavy blows may cause stretching of the metal which would necessitate hot shrinking.

Place the dolly under the area to be worked and lightly strike the panel directly above the dolly using the planishing hammer. Move the dolly and hammer over the damaged area to reduce the buckles and indentations.

By using the hand to 'feel' the panel during the planishing process any high or low spots can be felt and removed by planishing.

Where necessary to raise areas that are below the level of the surrounding panel the dolly can be employed to bump up the depressed area.

*NOTE: It is recommended that only a small section of panel be planished at one time.*

When you are satisfied that a section of damaged panel is reasonably smooth, the area should be cleaned with a body file or disc sander until bare metal is showing.

*NOTE: Take care when cleaning a section of panel with the body file or disc sander as flat spots can develop. Do not remove more metal than is necessary to clean the section.*

The cleaning procedure will also assist in showing up any low spots on the panel. Low spots will show up immediately as areas where the paint has not been removed.



304/457  
**Using a pick hammer to bring down any high spots in the damaged area.**

The planishing procedure should be repeated until as many low spots as possible are removed.

To assist in obtaining a good surface finish when planishing, the face of the planishing hammer should be smeared with turpentine or ordinary machine oil.

Ensure that the faces of all hammers and dollies are free from surface blemishes otherwise any imperfections on the tool faces will be transferred to the panel.

When you are satisfied that the panel is returned to its original shape and surface finish it is now ready to be painted.

## HOT SHRINKING

### Description

Hot shrinking is possibly the single most important operation of any panel repair. Because of the properties of steel any deformation of a panel will cause the metal to be stretched. Hot shrinking is normally the method used to remove any stretching from the metal.

The shrinking process is achieved by bringing the stretched metal into a common area and then, by applying heat to this area, the metal is upset, which reduces the metals surface area causing it to shrink.

### Tools and Equipment Required

Before commencing the job all the tools and equipment required to carry out the process should be placed conveniently so that they will fall quickly to hand when required.

The tools and equipment required to carry out the hot shrinking process are as follows:

Oxygen/acetylene welding outfit.

Mallet.

Planishing hammer.

Dolly.

Wire Brush.

Scraper.

Damp cloth.

The oxy/acetylene welding outfit is the medium used to apply the heat.

The mallet is used because its large soft surface avoids stretching the panel unnecessarily.

The planishing hammer is used for the final smoothing process of the metal surface.

The dolly, which should have less of a curved surface than the panel, is used in conjunction with the mallet or planishing hammer.

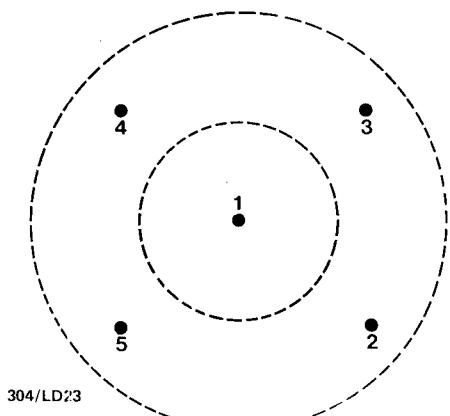
The wire brush is used to remove any burnt paint which may tend to flake off and burn the operator during the shrinking process.

The scraper is used to remove any underbody sealer or sound deadening material from around the area to be heated to prevent it igniting.

The damp cloth is used to localise the heat so preventing warpage of the surrounding undamaged area.

### Application of the Heat

When applying heat to the area of the panel to be shrunk care must be exercised to reduce the spread of heat throughout the panel surrounding the 'hot spot'. The



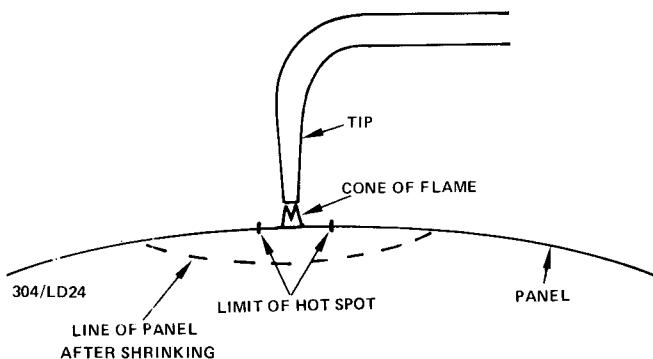
Line drawing showing the suggested sequence of hot spots to shrink a stretched area of panel.

spread of heat is best controlled with a damp cloth applied to the surrounding areas. To minimise the possibility of spreading the heat through the panel a hot flame is required so that the heating is done quickly.

The tip size recommended when using a standard blowpipe is a number 10.

The flame should be held with the cone of the flame not quite touching the panel and at 90 deg. to the surface. Care must be exercised when using this method to heat the panel as it is quite easy to blow a hole in the panel.

The size of the hot spot is critical, for effective shrinking of the metal the hot spot should be no larger than 12 mm in diameter. The area of the hot spot should be heated until it is a bright red.



Line drawing showing correct positioning of oxy/acetylene flame for shrinking a stretched area of panel.

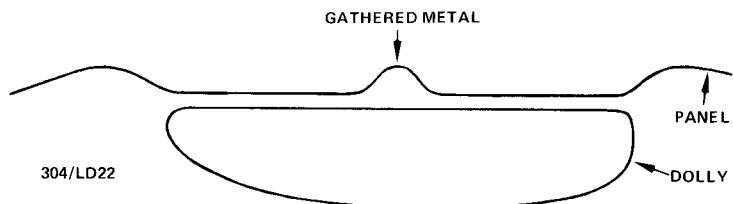
#### To Shrink Metal

(1) Using the oxy torch make the first hot spot in the centre of the stretched area.

(2) Quickly hold the dolly directly under the hot spot and using the mallet, hammer the area around the hot spot. This will force the surplus metal into the area of the hot spot.

(3) Ensuring that the hot spot is still a dull red, and using the mallet, hammer directly onto the hot spot, thereby upsetting the metal and removing the gathered excess metal.

(4) By repeating the above operations in ever increasing circles around the original hot spot the stretching of the panel can be eliminated.



Line drawing showing dolly correctly positioned for the reduction of the gathered metal in the centre of a shrink area.

*NOTE: After each shrinking operation cool the panel using a damp cloth.*

(5) Once the shrinking process has been completed planish or fill the remaining surface imperfections.

*NOTE: When shrinking areas on panels with a concave surface it is advisable to work from the inside of the panel as the outer surface of the panel will not be marked and a more effective shrink will be obtained.*

## 6. PANEL REPLACEMENT

In some cases of panel damage where the panel is simply bolted to the vehicle it may prove cheaper to purchase a second hand panel from a wreckers yard and replace the panel complete. Ensure that the panel being purchased is in a sound condition ie: no hidden rust or excessive amounts of body filler from a previous repair job.

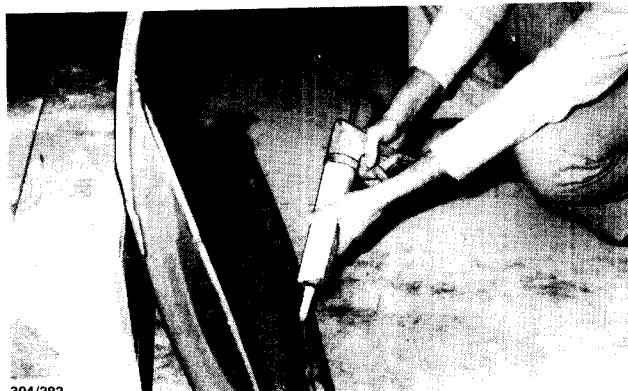
#### PRECAUTIONS

(1) Remove all trim and lamps etc. from the old panel before removing it from the vehicle.

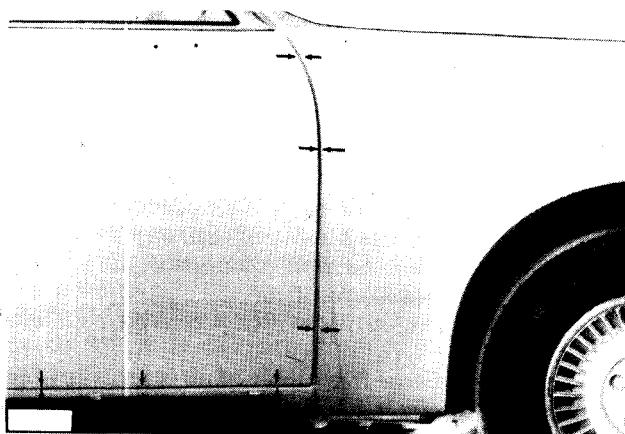
(2) Take care when removing the retaining nuts or bolts as they may be seized on their threads due to rust. Normally a liberal amount of penetrating oil applied to the nut or bolt will free it up.

(3) Where possible mark the installed position of the panel, especially in the cases of doors etc, to ensure correct alignment on installation.

(4) Ensure that there is no damage to the underlying structure and supports of the panel being renewed. If



Applying caulking compound to the mounting surface of a replacement panel.



**View of vehicle showing the panels correctly aligned. The gap between the panels should be even at all points.**

damage is evident it must be repaired before the replacement panel is fitted.

(5) Before installing the replacement panel, clean all mating surfaces on the vehicle and the panel and apply a suitable sealer to the mating surfaces to prevent the ingress of dirt or water.

(6) Using the surrounding undamaged panels as a guide adjust the position of the panel until the gaps between the adjoining panels are uniform.

## 7. PLASTIC BODY FILLERS

### DESCRIPTION

Plastic body fillers although not as strong as lead have the advantage of ease of application and finishing off.

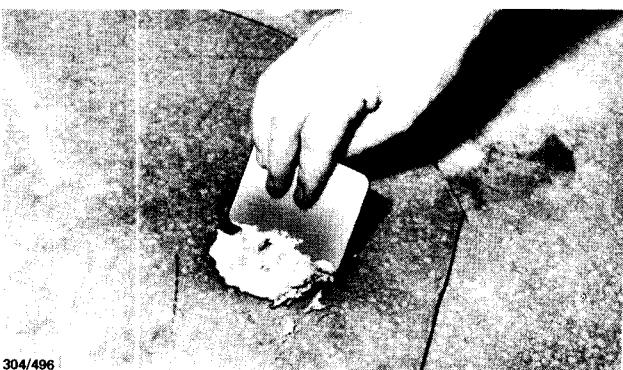
Where heat is necessary to apply lead to a metal surface, plastic body fillers are simply wiped on after the hardening agent is mixed in.

### HOW TO USE PLASTIC BODY FILLERS

(1) Ensure that the area to be filled is completely cleaned of all paint, dirt, grease and oil etc.

(2) Using a suitable clean, flat area mix the required amount of filler and hardener as per the manufacturers instructions.

(3) Using a suitable squeegee, and a small amount

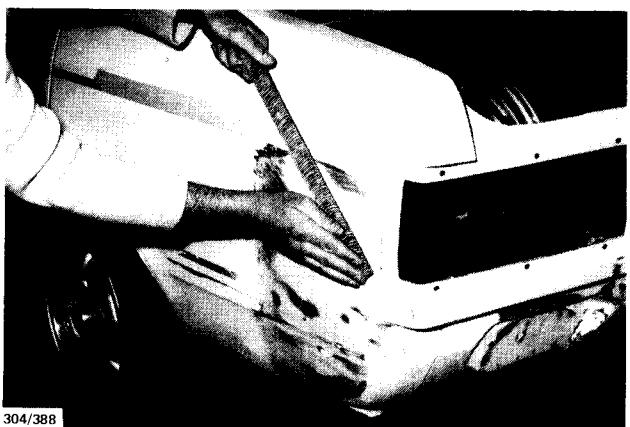


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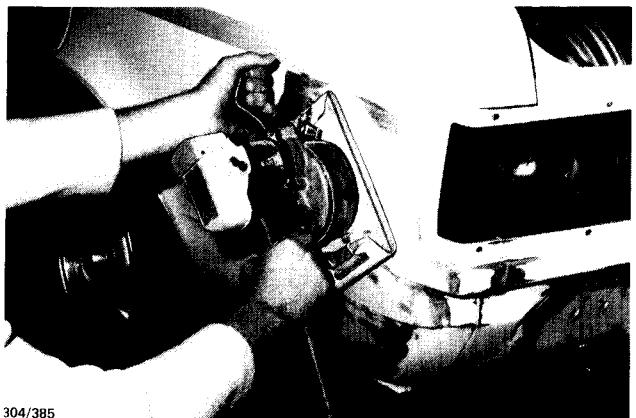
**Mixing plastic body filler on a flat pane of glass.**



**Applying the plastic body filler to the damaged area using a rubber squeegee.**



**Using the blade from a flexible body file to remove excess plastic body filler.**



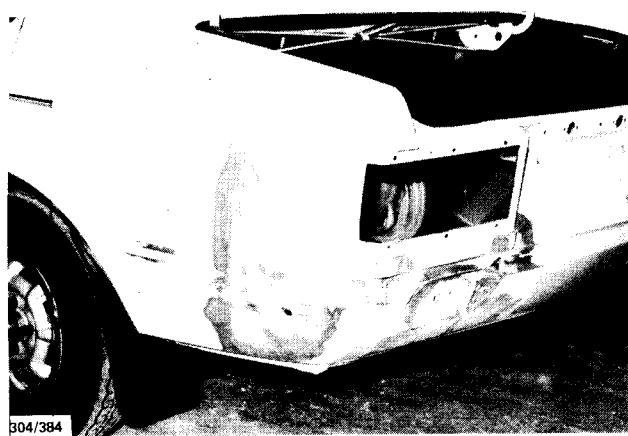
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**Smoothing the plastic body filler using an orbital sander.**

of filler at a time, apply the filler to the panel until the filler is built up slightly above the level of the surrounding panel.

*NOTE: The body filler should be applied as quickly as possible as it becomes impossible to work into indentations if it hardens too much before application.*

(4) Allow the filler to harden slightly and if necessary remove any excess filler using a cheese grater file or flexible body file blade.



**View of the repaired area prior to applying the primer/surfacer. Note the properly feathered edges.**

(5) Allow the filler to harden completely and remove any excess filler using coarse abrasive paper with a wooden block as a backing or alternatively by using a speed file or orbital sander.

*NOTE: As body filler shrinks as it hardens it may be necessary to apply a second layer if it sinks below the level of the surrounding panel.*

(6) Using 320 grade wet or dry abrasive paper with a rubber block as a backing, and using liberal amounts of water, smooth the body filler until it is level with surrounding panel.

*NOTE: The 320 grade paper can also be used to feather the edge between the repair area and the surrounding paintwork.*

*Where low spots or holes are evident in the finished filler, it will be necessary to apply another coating of filler to raise the surface to the correct level.*

## 8. FUNDAMENTALS OF SPRAY PAINTING

### PREPARING A WORK AREA

A special area should be set aside for the painting of the vehicle, ideally the area should be under cover, flat, well lit with natural light, dust free, well ventilated and large enough to permit easy access to all areas of the vehicle. Local council regulations and the effect of spray painting on neighbours should also be taken into account. A clean water supply is also desirable to assist in the wet sanding process.

### SELECTING AN AIR COMPRESSOR

To carry out satisfactory spray painting, adequate supplies of clean, moisture free compressed air is necessary. The type of compressor required for the job to be undertaken is best discussed with the supplier from whom the compressor is to be purchased or rented.

*NOTE: If purchasing an electric motor type compressor, it is recommended that a compressor with an automatic cut out switch be*

*purchased to prevent unnecessary running of the motor and compressor.*

The compressor should be drained of water before and after each use.

### PRESSURE REGULATOR/FILTER

The pressure regulator/filter is an essential piece of equipment which supplies a constant head of pressure and clean moisture free air. As most compressors are capable of a much higher pressure of air than is required the pressure regulator is used to lower the pressure available to the spray gun.

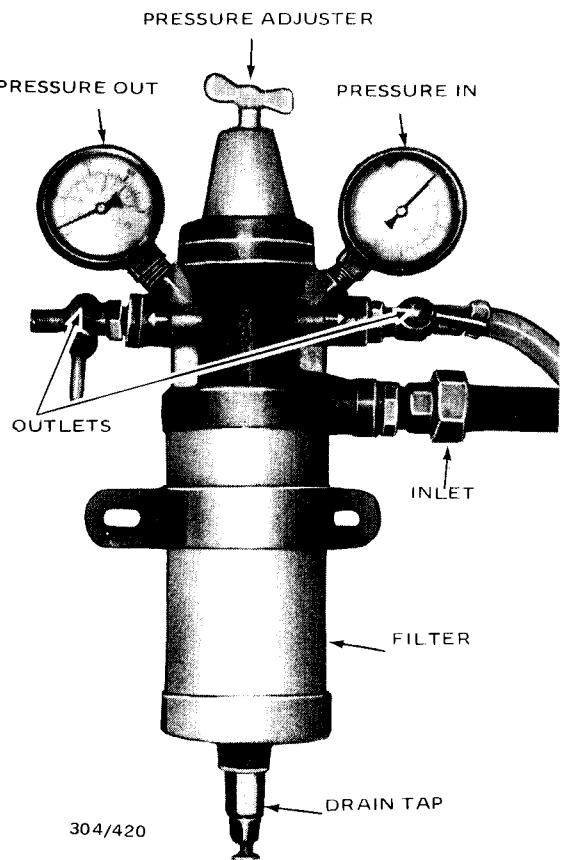
As a clean moisture free supply of air is necessary for spray painting the filter is an essential requirement. The filter should be periodically drained of water and cleaned.

### AIR HOSES

An air hose that will reach from the air compressor easily to any part of the vehicle is necessary. Ideally the hose should be reinforced nylon or rubber with an inside diameter of 8 or 9.5 mm.

The inside diameter of the hose should not be less than 8 mm as excessive pressure drop will occur.

The air hose should always be cleaned of all dirt, water and oil etc after each use. Never run over, kink or exert a sharp pull on the hose.



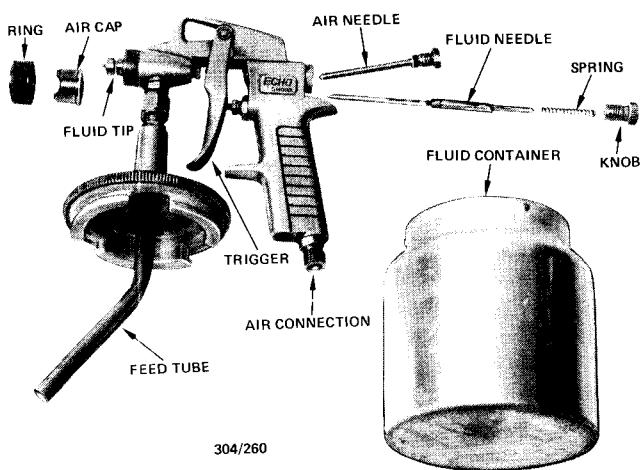
**Air pressure regulator/filter.**

## SPRAY GUNS

### Description

The automatic paint spray gun is a delicate piece of equipment and as such should be treated with care.

The spray gun uses air to atomize the paint into a sprayable mixture. The gun can be fed with paint by suction, pressure or gravity. The spray gun normally used for general spray painting is a suction feed type with an underslung one litre paint container. In this type of gun the paint is sucked from the container by the air stream which is directed by the air cap at the front of the gun.



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### Dismantled view of spray gun main components.

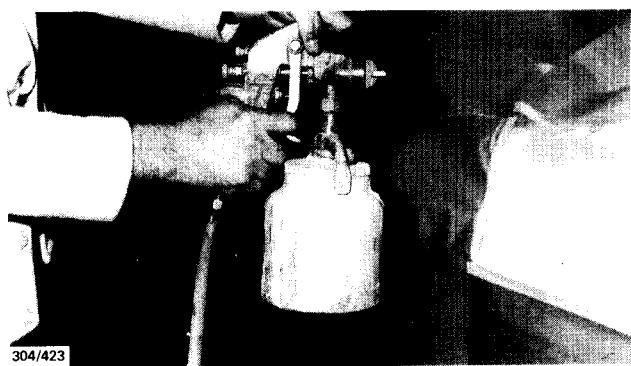
The main component parts of the spray gun are as follows:

- (1) The air cap or nozzle which has a variety of functions ie: atomizing the paint, controlling the spray width and pattern and providing the suction to lift the paint from the container.
- (2) The fluid tip or nozzle, which is located directly beneath the air cap, metres the correct amount of paint required.
- (3) The needle which is located behind and projects into the fluid tip. The needle is connected to and is controlled by the trigger. The needles function is to meter the paint flow through the gun. On some types of spray gun the needle also controls the air flow.

### Maintenance

The spray gun must be spotlessly clean if it is to function correctly, as the smallest obstruction can cause the gun to malfunction. The following cleaning procedures should be observed at all times:

- (1) After every use of the spray gun the paint container should be emptied and washed out with the correct type of solvent for the paint being used.
- (2) Place some clean solvent into the cleaned paint container, instal the container and blow the solvent through the gun until all paint is removed.
- (3) Using a solvent damp rag thoroughly clean the air cap. Press the rag up against the air cap and squeeze the



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Sometimes clogging of the spray gun can be cleared by holding a rag over the air cap and squeezing the trigger.

trigger, this will force air back through the paint passages in the gun, assisting in the cleaning process.

(4) Using the solvent damp rag thoroughly clean the exterior of the gun.

(5) Lightly apply machine oil to all the moving parts.

*NOTE: Never completely immerse the spray gun in solvents, as this will cause damage to the packing glands and sealing washers.*

*Do not use wire to clean the jets in the air cap if they become blocked as this will enlarge the jets to the detriment of the guns operation.*

### HOW TO USE A SPRAY GUN

The correct stroke of the spray gun is made by holding the gun 150 to 200 mm from the surface and at right angles. The full stroke of the gun should always be parallel to the surface thus ensuring an even build up of paint over the entire surface.

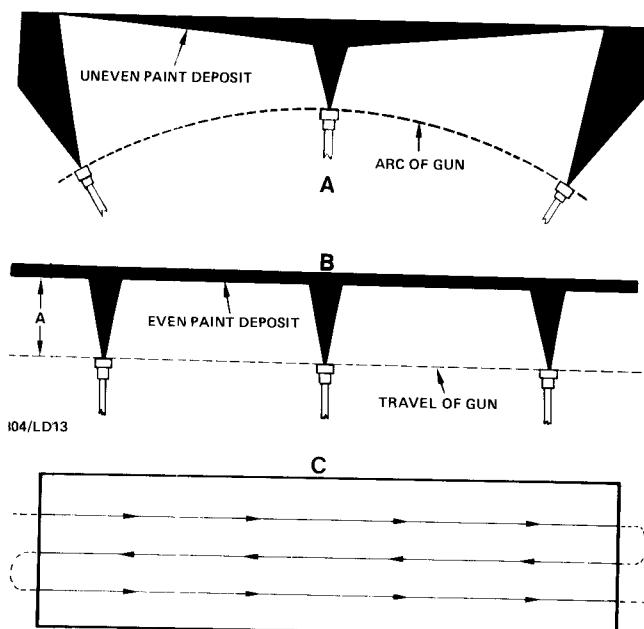
If the gun is held too close to the surface, excessive amounts of paint is deposited causing runs and sags. If the gun is held too far from the surface a dry spray and excessive overspray results.

Each stroke of the gun should overlap the preceding stroke by at least one quarter of its width, as the fan from the gun tends to thin out at the edges.



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View of the spray gun held at the incorrect angle when spraying a vertical surface.



A. Line drawing showing incorrect method of spraying a panel.  
 B. Line drawing showing correct method of spraying a panel. Dimension A = 150 to 200 mm.  
 C. Line drawing showing the correct spray gun triggering procedure. Solid lines indicate where trigger is pressed, broken lines indicate where trigger is released. Aim each new stroke at the bottom of the previous stroke.

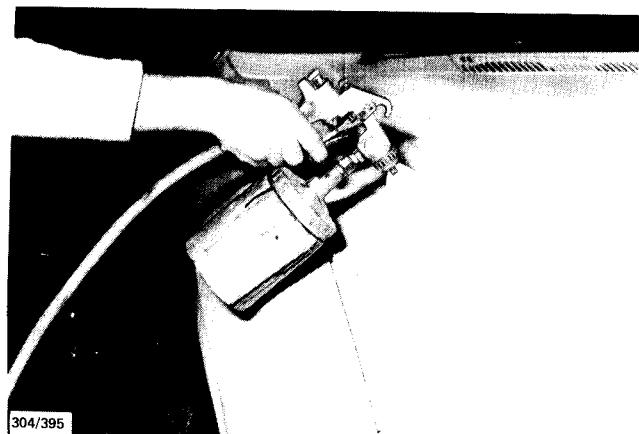
Tilting the gun up or down in relation to the surface produces an uneven spray pattern and paint deposit.

If you are satisfied that you are using the spray gun correctly but the deposit on the surface is too heavy or too light it will be necessary to adjust the fluid feed via the knob on the gun. Turn the knob slowly in the required direction until the correct spray pattern is achieved.

The trigger which controls the gun should be squeezed just after the stroke of the gun has begun and should be released just before the stroke of the gun ends. This method prevents the build up of paint at the start and the finish of each stroke.



View of the spray gun held at the correct angle when spraying a vertical surface.

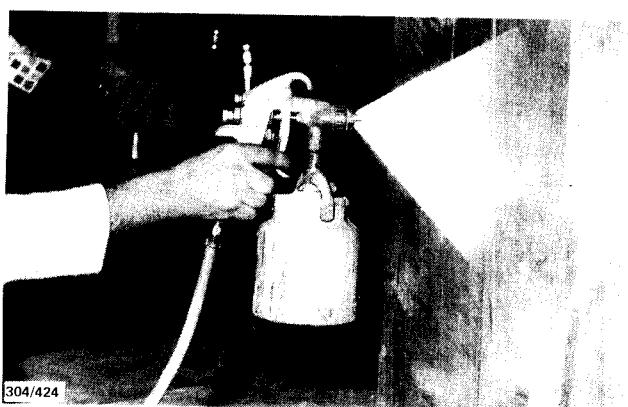


View of the spray gun held at the correct angle when spraying a horizontal surface.

When spraying horizontal surfaces hold the gun at a 45 degree angle in relation to the surface. Start at the edge closest to you and work away from the front edge. But ensure that when holding the gun at an angle paint does not leak from the fluid container seal.

Try your skill with the spray gun on an old unused panel before attempting any work on the vehicle. Any problems with technique can then be easily rectified.

A few marbles placed in the paint container will assist in keeping the paint mixed during the spraying procedures.



Checking the spray gun spray pattern and operation on a test panel. The test panel in this case is a wooden box.

## PAINTING WITH AEROSOLS

It is possible, where minor repairs are being carried out, to avoid the cost of purchasing or renting spray painting equipment by using aerosol cans to apply the primer and paint finish.

Although the use of aerosol cans is thought to be a crude method of applying paint, if they are used correctly they can supply a finished surface of comparable quality to that possible with proper spray painting equipment.

Aerosol cans are available in a range of colors matching those of most popular makes of vehicle.

### Precautions

1. Ensure that the aerosol paint is compatible with the original paint finish to which it is applied.



Using an aerosol spray can.

- (2) Ensure that the paint is thoroughly mixed before application. Agitate the can vigorously.
- (3) Do not apply the paint too thickly as aerosol paint tends to be very thin and will run or sag easily.
- (4) Blend the aerosol paint into the area surrounding the repair by at least 50 mm.
- (5) After each use of the aerosol can, invert the can and press the trigger until paint ceases to flow from the nozzle.
- (6) Allow at least two weeks drying time before compounding the painted surface to blend it into the surrounding area.
- (7) Follow the manufacturers directions fully when using aerosols. Take note of all cautions.
- (8) Do not puncture or incinerate aerosol cans, even empty ones.



In some instances a suitable mask can be made to prevent excessive overspray when using an aerosol can for spot repairs.



Some of the paint products that are available in aerosol cans.

### BRUSH TOUCHING

Brush touching is the method used to repair small scratches and chips in a vehicle's paintwork.

Touch up paint if not supplied with the vehicle can be purchased from a new car dealer, paint supplier or automotive accessories outlet. Touch up paint is normally thicker than spraying paint and if thinning is necessary the correct type of thinner must be used otherwise the paint will be rendered useless.

A good quality, thin, camel hair brush should be purchased to apply the paint.

### To Brush Touch

- (1) Clean the scratch or chip of any rust, accumulated polish or dirt.
- (2) Mix the touch up paint thoroughly, and using the brush apply several thin layers of paint to the scratch or chip until it is built up to the same level as the surrounding paintwork.
- (3) Allow the new paint to harden for at least two weeks.
- (4) After the paint has completely hardened blend it into the surrounding paintwork using a suitable cutting compound.

## 9. PREPARING FOR PAINTING

### TYPES OF PAINT

The most commonly used type of paint currently available is acrylic lacquer as it is easy to apply, durable and quick drying.

*NOTE: Acrylic lacquer must never be sprayed over nitro-cellulose lacquer or air dried enamel. Where it is necessary to apply acrylic lacquer over nitro-cellulose lacquer or air dried enamel it will be necessary to strip the old paint from the vehicle completely.*

*It will also be necessary to strip the entire paint finish from the vehicle if the paint has evidence of humidity blisters, underlying rust, cracks or perishing.*

## REMOVING EXTERIOR TRIM

Before starting any spray painting on a vehicle, it is a good policy to remove any lamps, badges, mouldings, rubbers etc from the area to be painted. It will be found that polish, dust and dirt, to which paint cannot adhere, are trapped under and around the edges of the components.

Where exterior trim items are removed from the vehicle it is a good idea to mark each component to ensure that it is installed to its original position.

## WASHING THE VEHICLE

After all the necessary exterior trim items have been removed, it is good policy to thoroughly wash the vehicle to remove any dust or dirt which may mar the finished paint surface. It is recommended that only clean water be used to wash the vehicle, but where stubborn stains persist a little detergent may be added to the water to assist in their removal.

*NOTE: Where detergent has been used to wash the vehicle ensure that all traces of the detergent are rinsed from the vehicle.*

Hosing out the dirt from the fenders is also recommended to assist in preventing the possibility of dust marring the final paint finish.

## PAINT STRIPPING

Before stripping the paint from a panel or the entire vehicle the following points should be taken into account:

(1) Any body filler which is present under the paint finish will be softened when it comes into contact with chemical strippers and should therefore be renewed.

(2) After removal of the paint, areas of poor repair or rust may become evident and should be repaired before proceeding further with the repair job.

(3) Of the four methods of stripping paint ie. sand blasting, dry scraping, mechanical sanding and chemical strippers, chemical stripper is the easiest method available to the amateur repairer.

### Masking for Paint Stripping

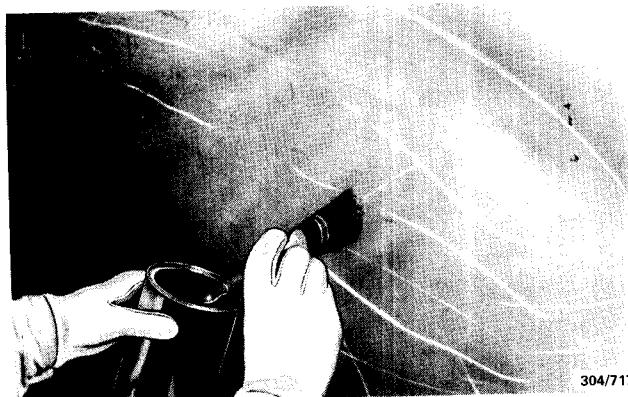
The area around the panel to be stripped or remaining exterior trim on a complete stripping job should be protected from the chemical stripper by the use of masking tape and suitable paper.

It is recommended that a number of layers of masking tape and paper be used to protect the components as the chemical stripper if left on too long will soak through the tape or paper.

The masking tape and paper should be removed and discarded immediately the stripping is completed. Any adhesive that remains after removal of the masking tape can be removed using kerosene or mineral turpentine.

### Using Chemical Stripper

(1) Place the vehicle in a shaded area and away from anything that may be damaged by splashes of stripper.



304/717  
Applying chemical paint stripper to the paint surface using a brush.

(2) Mask the areas to be protected from the stripper as previously described.

(3) Read the stripper manufacturers instructions carefully and carry out any operations that are recommended.

(4) Using a suitable brush liberally apply the stripper to the panel. Do not cover too large an area at one time as the stripper may tend to dry out.

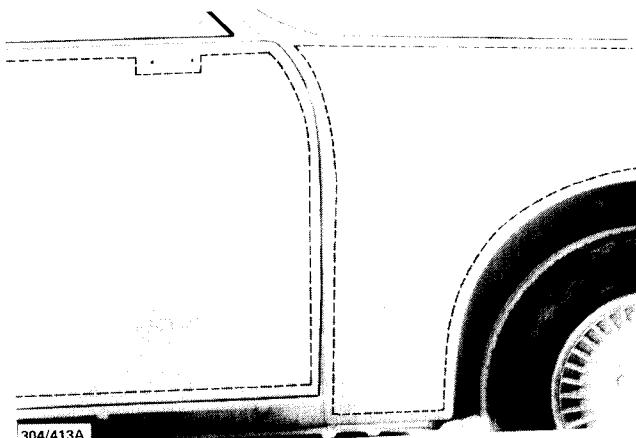
*NOTE: Wear rubber gloves, protective clothing and eye protection at all times when handling chemical stripper.*

*When stripping to the edge of a panel or around a hole allow a border of unstripped paint to remain, to lessen the risk of stripper running inside the hole or the gap between the panels.*

(5) Allow the stripper 10 minutes reaction time then apply a second coating.

(6) After allowing the second coat time to soak in, use a square edged paint scraper to remove the loosened paint.

*NOTE: Have an old tin ready that will serve as a waste container for the loosened paint and the used stripper.*



304/413A  
View of vehicle showing the correct border that should be left after using chemical paint stripper.



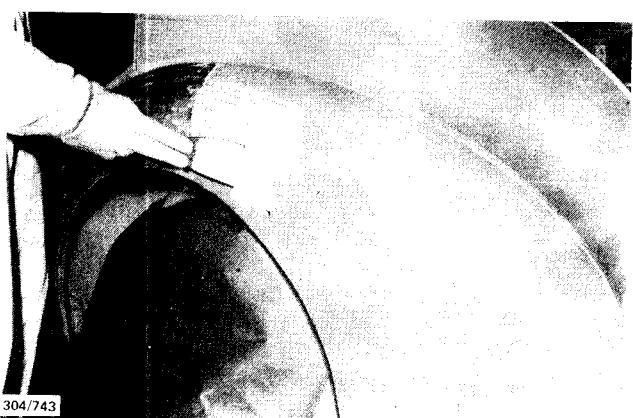
**View of panel showing the paint stripper working on the paint finish.**

(7) Move on to the next section to be stripped after the paint has been completely removed.

(8) When all the stripping has been completed, any remaining traces of paint or primer surfacer can be removed with steel wool soaked in stripper.

(9) Once all traces of paint, except the paint around the edges of the panel and holes, has been removed, thoroughly wash down the bare metal surface as recommended in the paint stripper manufacturers instructions.

*NOTE: Any traces of stripper allowed to remain on the surface will adversely affect the new paint finish.*



**Using a scraper to remove the softened paint from the panel.**

(10) To remove the paint remaining on the edges of the panel and holes, and to ensure a thoroughly cleaned surface, wet rub or dry sand the surface using 120 to 180 grade abrasive paper.

(11) Remove all masking tape and paper from the vehicle and discard.

(12) Wash the entire stripped area using a wax and grease remover as a final precautionary step to prevent contamination. Apply the wax and grease remover liberally, a small area at a time, and remove it from the surface using clean rags before it has a chance to dry.

(13) Using compressed air, blow and wipe all dust, dirt, etc. from panel joins, cracks, and door jamb areas.



**Removing any remaining paint or primer surfacer using steel wool soaked in stripper.**



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**Using heat lamps to warm the panel before painting.**

(14) Using the manufacturers instructions, treat the bare metal surface with a deoxidising agent to avoid the possibility of rust being hidden in the pores of the metal.

*NOTE: The deoxidising agent also etches the surface of the metal and leaves a rust inhibiting phosphate coating which greatly assists in primer adhesion.*

(15) Using heat lamps warm the bare metal surfaces in preparation for priming.

(16) Referring to the manufacturers instructions spray one light coat of a suitable etch primer to the entire metal area.



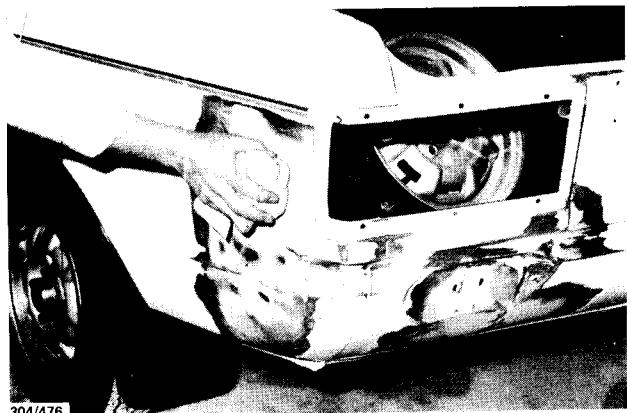
**Applying etch primer to the bare metal surface.**

**NOTE:** Etch primer should be allowed to dry for 10 to 15 minutes before applying the primer/surfacer and should never be sanded.

(17) Apply primer/surfacer to the panel and apply the paint color coats as described under the appropriate heading.

## 10. SPRAY PAINTING

At this stage the surface to be worked on should be either a bare metal surface with a coating of etch primer, a repaired surface with a proportion of bare metal, body filler and paint evident or a fully painted surface.



Cleaning down the repaired area prior to applying the primer/surfacer using wax and grease remover.

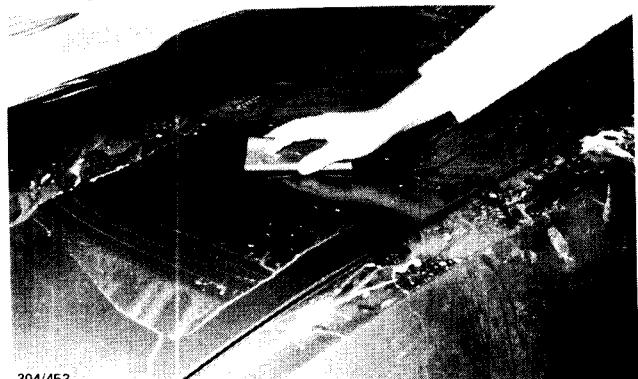
## TO PREPARE THE SURFACE FOR THE PRIMER/SURFACER

### Bare Metal Surfaces

Bare metal surfaces with a coating of etch primer do not require any further preparation before applying the primer/surfacer. Do not sand the etch primer.

### Repaired or Fully Painted Surfaces

(1) Using an orbital sander and 120 grade abrasive paper or 120 to 180 grade wet or dry paper with a rubber block as a backing and liberal amounts of water, feather back any paint edges, file marks, chips or scratches until a smooth gradual edge is achieved.



Rubbing back the old paint finish using wet or dry abrasive paper and liberal amounts of water.

(2) Wash the entire area to be painted using a wax and grease remover as a final precautionary step to prevent contamination of the new paint. Apply the wax and grease remover liberally, a small area at a time, and remove it from the surface using clean rags before it has a chance to dry.

## MASKING

### To Apply

The area around the panel to be painted or any remaining exterior trim or glass area on a complete respray should be protected from any overspray by the use of masking tape and a suitable paper.

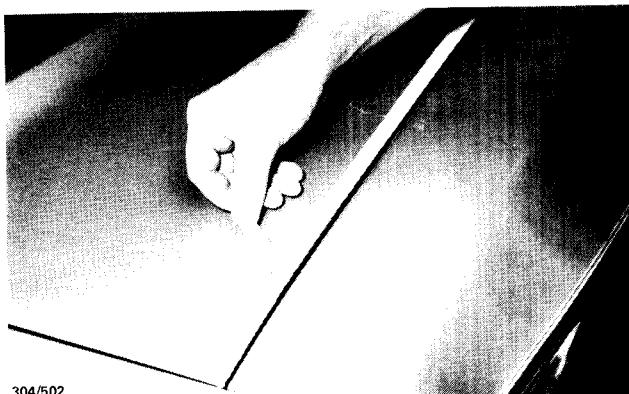
Masking tape is available in a number of widths and should always be firmly pressed into place to ensure that no overspray can contaminate the surrounding surfaces.

### To Remove

Allow the paint adequate time to dry, pull on one end of the tape and remove the tape by gently pulling the tape back over itself and away from the painted surface.

Do not allow the tape or paper to touch the freshly painted surface.

Any adhesive that remains after removal of the masking tape can be removed using kerosene or mineral turpentine.



Showing the correct method of masking tape removal.

## TO APPLY THE PRIMER/SURFACER

The correct type of primer/surfacer must be used to correspond with the type of paint that will be applied over the top of it, and where applicable, the type of paint to which it is applied. Check with your paint supplier if in doubt as to the type of primer/surfacer to use.

(1) Thin the primer/surfacer according to the manufacturers instructions.

(2) Adjust the feed pressure to the spray gun according to the spray gun manufacturers recommendations for primer/surfacer application.

(3) Apply two or three good heavy coats of the primer/surfacer to the surface and allow them to dry completely.

**NOTE:** The amount of time a primer/surfacer requires to dry completely is dependent on the type of primer/surfacer being used. Refer to



**Applying the primer/surfacer to the repaired area.**

*the primer/surfacer tin for the drying time required.*

(4) Before sanding back the primer/surfacer, it is advisable to apply a light mist coat of black paint over all areas to be sanded. The mist coat will act as a guide when sanding as it will remain in any low spots, marks or chips making these imperfections readily apparent.

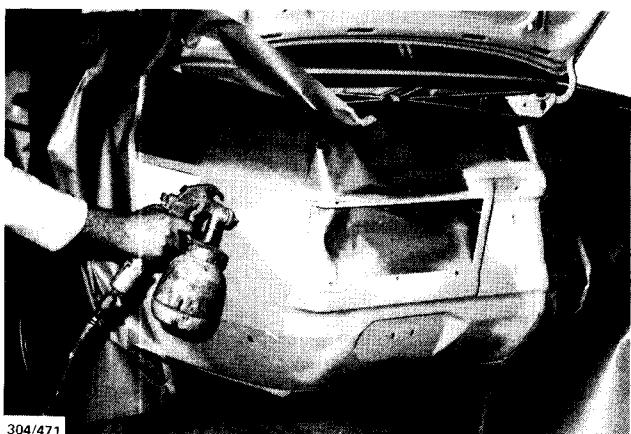
(5) Using 320 to 360 grade wet and dry or open cut paper, sand back the primer/surfacer until a smooth even finish is produced.

**NOTE:** *Do not sand through the primer/surfacer as the area will have to be reprimed.*

(6) Where any low spots, marks or chips are evident in the primer/surfacer fill the imperfections using a stop or spray putty following the putty manufacturers instructions.

(7) Allow the putty to dry, sand it back using 180 to 220 grade abrasive paper, apply a coat of primer/surfacer to the puttied areas. Allow it to dry and sand it back using the method previously described for the initial coats of primer/surfacer.

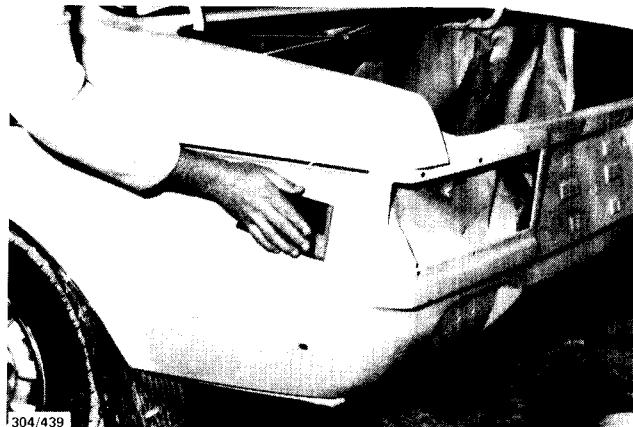
(8) Where painting over maroons or reds it is advisable to apply a few coats of bleeder sealer over the sanded primer/surfacer to prevent the pigments in the paints bleeding through and staining the new paint finish.



**Applying spray putty to the repaired area.**



**Applying stop putty using a rubber squeegee.**



**Rubbing back the primer/surfacer using wet or dry abrasive paper and liberal amounts of water.**

**NOTE:** *Do not sand bleeder sealer.*

(9) The area is now ready for the application of the color coats.

## TO APPLY THE COLOR COATS

(1) Wash the entire area to be painted using a wax and grease remover as a final precautionary step to prevent contamination of the new paint. Apply the wax and grease remover liberally, a small area at a time, and remove it from the surface using clean rags before it has a chance to dry.

**NOTE:** *The correct type of paint must be used to correspond with the type of primer/surfacer over which the paint is being applied. Check with your paint supplier if in doubt as to the type of paint to use.*

(2) Pour the paint into a larger container and thin it according to the manufacturers instructions.

**NOTE:** *Ensure that any pigment that remains in the bottom of the paint tin is removed, added to the paint and thoroughly mixed in.*

(3) Strain the paint through muslin or an old stocking to ensure that all dirt and foreign matter is removed.

(4) Spray a small amount of thinners through the



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**Straining the paint to remove all impurities.**

spray gun to remove any foreign matter and to ensure that it is functioning correctly.

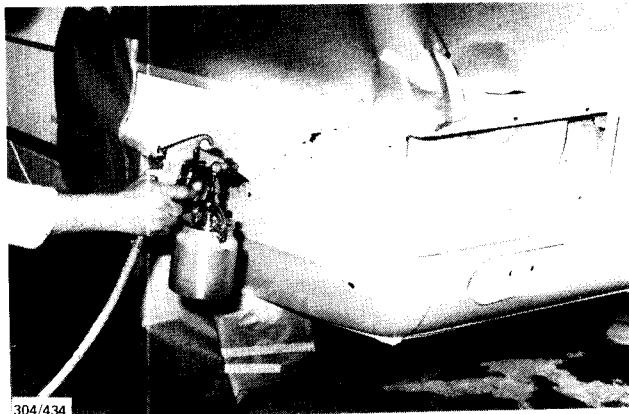
(5) Adjust the feed pressure to the spray gun according the spray gun manufacturers recommendations for the type of paint being used.

(6) Apply the color coats to the vehicle.

*NOTE: As each type of paint requires a different spraying procedure and requires a different drying time, each separate procedure is not covered in this manual. The correct procedure for the type of paint being used can be obtained by referring to the paint supplier or manufacturer.*

(7) Remove the masking tape and paper from the vehicle as previously described.

(8) After the paint has been allowed sufficient drying time finish off as described under the relevant heading.



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**Applying the final paint finish to the repaired area.**

## 11. SPRAY GUN AND SPRAY PATTERN TROUBLE SHOOTING

### FLUID LEAKING FROM NEEDLE GLAND PACKING

- (1) Gland nut loose: Tighten gland nut.
- (2) Gland packing dried out: Remove gland packing and soften with a few drops of oil.

- (3) Gland packing damaged or worn: Renew gland packing.

### FLUID LEAKING FROM FRONT OF GUN

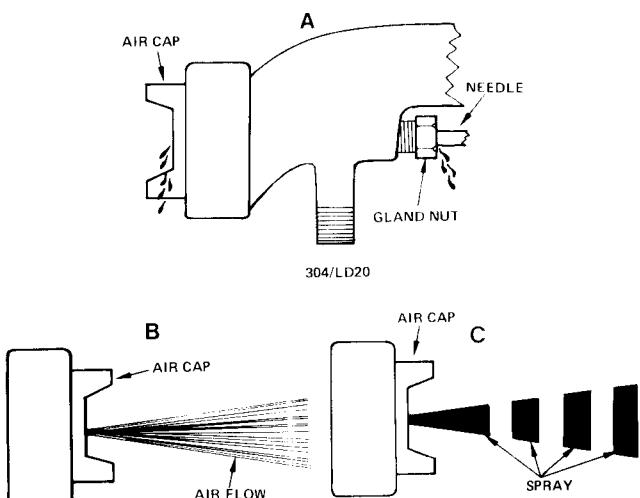
- (1) Worn or damaged fluid tip seat: Renew fluid tip.
- (2) Clogged fluid tip passage: Clean fluid tip passage.
- (3) Needle gland packing too tight: Loosen gland nut.
- (4) Needle spring broken: Renew needle spring.
- (5) Incorrect needle fitted: Instal correct needle.

### AIR LEAKING FROM FRONT OF GUN

- (1) Foreign matter on air valve or seat: Clean air valve and seat.
- (2) Air valve seat worn or damaged: Renew air valve seat.
- (3) Air valve spring broken: Renew air valve spring.
- (4) Air valve stem sticking: Lubricate air valve stem.
- (5) Air valve stem bent: Renew air valve.
- (6) Air valve gland nut too tight: Loosen gland nut until air valve moves freely.

### INTERMITTENT SPRAY

- (1) Fluid container empty: Fill container.
- (2) Spray gun held at too great an angle – fluid running away from pick up tube: Reduce angle of spray gun.
- (3) Obstructed fluid passages: Clean gun as previously described.
- (4) Loose or damaged pick up tube: Tighten or renew pick up tube.



A. Line drawing showing possible fluid leakage points from spray gun.

B. Line drawing showing possible air leakage point from front of spray gun.

C. Line drawing showing representation of intermittent spray from gun.

- (5) Loose fluid tip: Tighten fluid tip.
- (6) Worn or damaged fluid tip seat: Renew fluid tip.
- (7) Loose needle or air valve gland nuts: Tighten gland nut.
- (8) Fluid too thick: Thin fluid to correct consistency.
- (9) Clogged vent hole in fluid container lid: Remove obstruction from vent hole.
- (10) Pick up tube sitting squarely on bottom of fluid container: Carefully bend pick up tube away from bottom of fluid container.

### SPRAY GUN STARVING FOR AIR

- (1) Air hoses or lines clogged: Clean or renew air hoses or lines.
- (2) Air hoses or lines too small: Renew hoses or lines with parts of correct diameter.
- (3) Air regulator/filter clogged: Clean air regulator/filter.
- (4) Air compressor of insufficient capacity: Use air compressor of larger capacity.

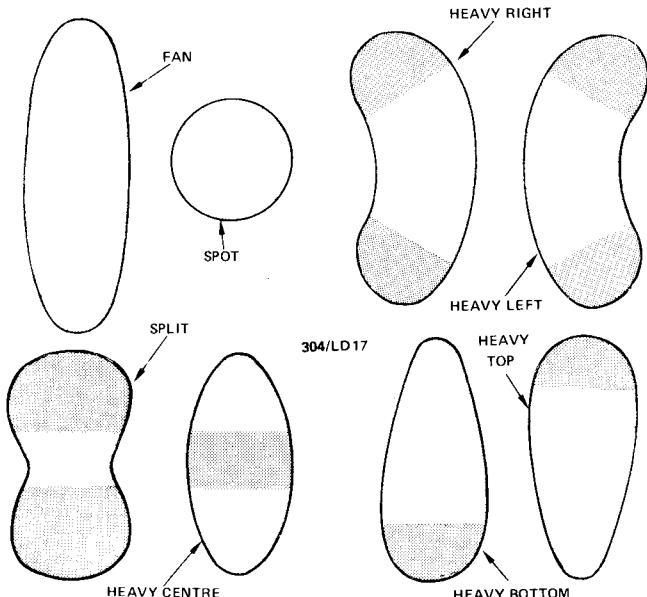
### DEFECTIVE SPRAY PATTERNS

#### Top Heavy or Bottom Heavy Pattern

- (1) Air cap jets partially blocked: Clean out air cap jets.
- (2) Top or bottom of fluid tip blocked: Clean out fluid tip passage.
- (3) Dirt on air cap or fluid tip seat: Clean air cap or fluid top seat.

#### Heavy Centre Pattern

- (1) Atomising pressure too low: Increase atomising pressure.



Line drawings showing various correct and incorrect spray patterns. The fan and spot are the correct patterns.

- (2) Fluid too thick: Thin fluid to correct consistency.
- (3) Spray gun feed pressure too high for tip size: Reduce feed pressure.
- (4) Fluid tip too large: Reduce fluid tip size.
- (5) Fan adjustment incorrect: Adjust fan.

#### Heavy Left or Right Side Pattern

- (1) Jets in left or right section of aircap partially blocked: Clean air cap jets.
- (2) Dirt in left or right section of fluid tip: Clean fluid tip.

#### Split Spray Pattern

- (1) Air flow and fluid flow incorrectly balanced: Reduce atomising pressure, adjust fluid flow and fan width.

## 12. PAINT DIFFICULTIES — CAUSES AND CURES

### INTRODUCTION

Application and drying processes can provide ample opportunities for even high quality paint materials to misbehave. Paint materials are often blamed for imperfections in the finish, when the real cause may lie in some local condition or incorrect procedure associated with the spray equipment, the method of application or contamination of the material.

It is possible to look at an unsatisfactory paint job and determine the probable cause, but it is more important to be able to locate the source of the trouble before it starts, and so avoid bad results.

The following section is devoted to normal paint faults and some of the difficulties over which you can exercise some control. Most painting problems have simple answers, and this information will help you to rectify the most common troubles and will assist in eliminating the cause before any trouble develops.

### BLEEDING

#### Appearance:

Pink, blue, black or brown stain showing through on the new finishing color.

#### Cause:

When a light color is applied over colors such as maroon or red which contain soluble dyes, or when the old surface is contaminated with bitumen, the solvents in the new finish sometimes dissolve the old color or bitumen, causing it to come to the surface, resulting in a condition which is known as 'bleeding'. Also caused by contamination of undercoats, or old color, due to overspray when bleeding colors are being used.

#### Cure:

- (a) If bleeding colors are used, clean the spraying area and equipment thoroughly to avoid contamination.

(b) To repaint over bleeding colors, seal off the old finish with high quality bleeder seal. To eliminate bitumen contamination, wash the surface thoroughly with mineral turps.

### BLUSHING

#### Appearance:

A whitish coat appearing on the surface of lacquer paints only.

#### Cause:

Blushing and the weather are closely related.

In warm, humid weather the evaporation of the solvents from the paint lowers the surrounding temperature, causing moisture to form as tiny water droplets on the surface. Water and lacquer do not mix, with the result that some of the nitrocellulose is forced out of the solution by the water, leaving the whitish cast called 'blushing'.

The use of poor quality thinner in draughts or cold areas will also promote blushing.

#### Cure:

Use a higher quality thinner or continue with the present thinner, adding 10 per cent of retarder thinner. The retarder supplies the rich solvents which are necessary to avoid blushing.

To save the job that 'blushed', apply a mist coat of thinner to which retarder has been added. It is possible to apply another coat of the finishing material doped with retarder thinner, but it will be necessary to wait until the atmosphere is drier.

Avoid spraying lacquers in draughts or damp, cold areas.

### CHALKING OF LACQUERS

Chalking is a natural failure of pigmented finishes because of the gradual breaking up of the paint film under weathering and exposure to the sun's rays. It results in a gradual loss of gloss and powdering of the surface.

When this condition is encountered, rub and polish the surface to remove 'dead' pigments and expose the 'live' paint film beneath.

### COMPOUNDING TOO EARLY

#### Appearance:

Dull, dirty looking finish.

#### Cause:

If the lacquer is too soft when rubbed, scratching is excessive, and the compound is imbedded in the paint, cutting down the normal gloss and often giving the appearance of an off shade color. This becomes particularly evident on black, where a grey hazy tone is developed.

#### Cure:

Compound only after the paint has hardened sufficiently. Allow at least 4 hours or preferably overnight drying before compounding the paint finish. If the paint

film is already flat allow to dry for 10 days and recompound to restore lustre.

### CRAZING, CRACKING OR CHECKING

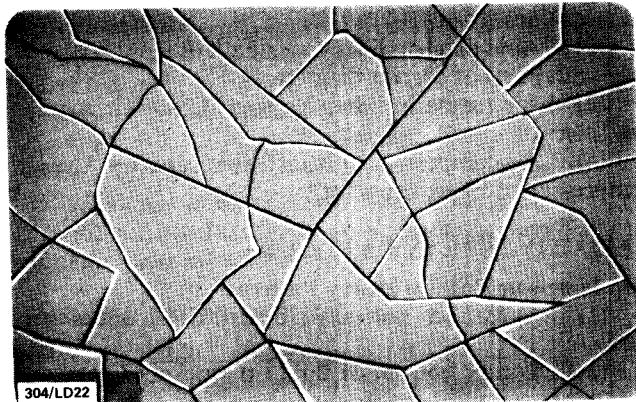
#### Appearance:

Development of fine irregular lines in the surface of the paint.

#### Cause:

These conditions, each a degree of the other, result when the top coats are applied before the undercoats are dry. The undercoats contract while drying and pull the top coat, causing it to craze, crack or check.

Also caused by too heavy coats resulting in non uniform drying throughout the paint.



Crazing, cracking or checking.

#### Cure:

To avoid this condition, always let undercoats dry thoroughly before spraying color coats. Weather conditions will alter drying times, so do not blindly follow a standard drying time. Do not 'pile on' coats.

### HANDS ON METAL

No matter how clean the hands may seem, there is always some dirt, grease, oil or perspiration which will cause blistering and poor adhesion. Keep bare hands off the surfaces to be painted.

In motor vehicle assembly plants the vehicle body is never directly touched with human hands after being chemically cleaned, the operators wear cotton gloves. This is good practice for all painters to follow.

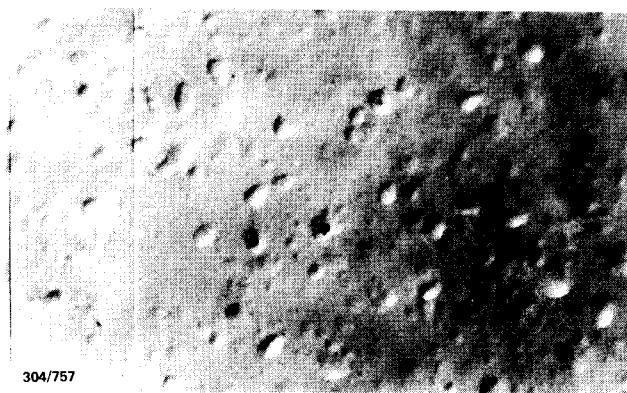
### HUMIDITY BLISTERING

#### Appearance:

Fine pimply blisters which occur in conditions of extreme humidity and high temperatures. Most common in tropical areas. These blisters will often 'settle back' when atmospheric humidity reduces.

#### Cause:

Weakness in adhesion of finish to undercoat, alternatively poor adhesion of undercoat to metal. No paint is impervious to moisture which, under extreme conditions



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**Blistering.**

will permeate the paint as a liquid, and later emerge as a vapour. Any weakness in the paint system will allow the moisture to condense and form a globule which becomes a blister.

**Cure:**

When the blisters do not break, moisture will evaporate of its own accord, and the paint film will resume its original appearance. Broken blisters must be sanded back to either the undercoat or metal, wherever the blister started, and repainted.

**LIFTING****Appearance:**

Swelling of the paint finish in sections generally followed by sinking back, leaving dull streaks or patches.

**Cause:**

- (a) Application of paint finish over a surface from which wax, grease, polish or other foreign matter has not been completely removed.
- (b) Improper time between coats allowing solvents to feed on soft primers or undercoats.
- (c) Heavy initial finishing coats.

**Cure:**

- (a) Always clean the old surface with a wax and grease remover to remove wax, grease, etc., especially from abrasive paper scratches, before painting.
- (b) Allow undercoats time to dry thoroughly. Follow the directions and avoid excessively heavy applications which may prevent thorough drying.
- (c) Except where specified, the first coats of the paint finish should be light coats which seal off the undercoats.

**ORANGE PEEL****Appearance:**

Rough, wavy finish, like the peel of an orange.

**Cause:**

- Improper atomisation.
- (b) Faulty handling of spray gun.
- (c) Insufficiently thinned material.

- (d) Poor quality thinner.
- (e) Wrong grade of thinner.

**Cure:**

- (a) Ensure correct atomisation of materials.
- (b) To avoid a poor spraying technique, use the arm in full long strokes, paralleling the surface with as little wrist action as possible. Hold the gun at right angles to and 150 to 200 mm from the surface.
- (c), (d), (e) Reduce the paint with the recommended thinner only, according to the directions.

**OVERSPRAY — DRY SPRAY****Appearance:**

Dusty appearance on paint finish, giving sandy dotted effect.

**Cause:**

It is usually found where the paint finish forms a centre line on roof, bonnet and luggage compartment lid surfaces. If the left side of the vehicle is painted first, overspray appears to the left of the centre line; when the right side is sprayed first, overspray appears to the right of the centre line. At this point, the gun is held at an angle and further from the surface than at other points of the stroke.

Also caused by excessive air pressure or thinner being too fast evaporating.

**Cure:**

Spray side of car on which overspray appears with a wet mist coat. A mist coat is made by adding several parts of thinner to the color left in the paint container, or it may be a coat of quality thinner.

Use slow thinner with synthetic enamel. Always point the gun straight at the surface, moving it at right angles to the line of work.

**PINHOLING****Appearance:**

Characterised by appearance of minute holes in the paint film.

**Cause:**

- (a) Moisture in air lines and hoses.
- (b) Trapped solvents caused by excessive application and quick surface drying.
- (c) Insufficient atomisation or breaking up of material.
- (d) Fast evaporating thinners and excessive coats.
- (e) High humidity and cool draughts.

**Cure:**

- (a) The drain valve on the air compressor and the air regulator/filter should be opened daily to allow the drainage of collected moisture.
- (b) Do not apply the materials too heavily, but spray in uniform, normal coats to allow proper evaporation of solvents. Use recommended thinners only.
- (c) Increase the pressure of the spray gun for proper

atomisation so that the overspray on the test panel shows the finest possible texture.

(d) A combination of a fast evaporating thinner and heavy coats should be avoided.

(e) When the humidity is high, avoid cool drying areas.

### POOR ADHESION

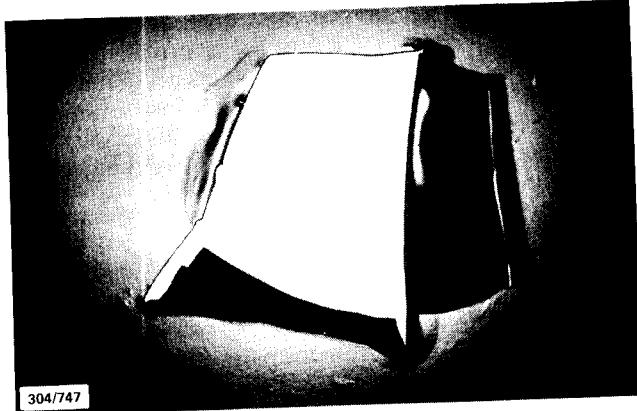
**Appearance:** Evident as peeling or easy removal of the paint finish.

**Cause:**

- (a) Improper surface preparation.
- (b) Incorrect undercoats.

**Cure:**

- (a) Thoroughly clean the old finish with a wax and grease remover to remove grease, wax, polish and other foreign matter. Keep the surface clean before painting.



Poor adhesion-peeling.

- (b) Use only those undercoats that are recommended for the particular paint finish being used.

*NOTE: When painting bare metal surfaces always treat the metal with a high quality de-oxidising agent.*

### POOR HIDING

The inability of a pigmented or colored finish to completely cover or hide the color of the original surface is usually referred to as 'poor hiding'.

There is a natural tendency for pigmented paints to settle and the pigment cakes in the bottom of the container. This is especially true of products which have had thinner added to them.

If the paint is taken from the top of a paint container, without stirring, it will be lacking in pigment content. Poor hiding will result.

The answer is to stir all materials thoroughly. Do not allow thinned paints to stand any longer than is necessary before using.

Another cause of poor hiding is faulty application. Paint thickness and hiding ability are closely related. In

many cases poor hiding results from too thin a paint film and non uniformity of thickness.

A third cause of poor hiding is the addition of excessive amounts of thinner.

### ROUGH, DIRTY FINISH

**Appearance:**

Inclusion of dirt and dust in the paint finish

**Cause:**

Applying finish over dusty surface.

**Cure:**

Ensure that the surface to be painted is clean and completely free from dust.

### RUNS AND SAGS

**Appearance:**

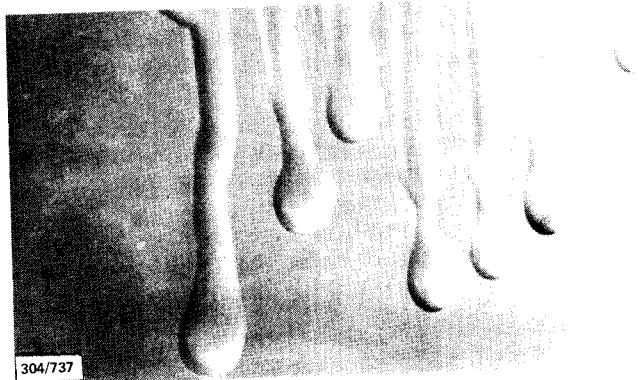
Apparent as running or sagging paint finish resulting from too much or too thin paint applied to surface.

**Cause:**

- (a) Too much thinner.
- (b) Too heavy coats.
- (c) Too wet coats.

**Cure:**

- (a) Thin paint as per manufacturers instructions.



Runs and sags.

- (b) Reduce paint flow from spray gun.

- (c) Do not hold gun too close and move at a constant speed.

### RUST UNDER PAINT FILM

**Appearance:**

Fine lumps or blisters growing under the paint finish.

**Cause:**

Presence of rust on the surface before painting. Paint will not adhere to a rusty surface.

**Cure:**

Ensure that all areas of rust are properly repaired or treated before applying paint finish.



**Shrinking and splitting of primer/surfacer.**

### SHRINKING AND SPLITTING OF PRIMER/SURFACER

#### Appearance:

Fine cracks in the undercoat when dry.

#### Causes:

- (a) Improper surface cleaning.
- (b) Improper feather edging.
- (c) Excessive heavy coats.
- (d) Insufficient drying time between coats.
- (e) Fanning with air to force the drying time.
- (f) Applying on cold surface.

#### Cure:

- (a) Ensure that the surface to be painted is cleaned thoroughly.
- (b) Feather edge the old finish about 50 to 100 mm back from the edge of the spot.
- (c) Apply in medium wet coats.
- (d) Allow sufficient time for coats to dry.
- (e) Do not fan with air to force the drying as it causes surface drying only and traps thinner which penetrates scratches in the old paint finish.
- (f) In cold weather ensure that the vehicle, primer/surfacer and the painting area are approximately the same temperature.

### SHRINKING AND SPLITTING OF PUTTY

#### Appearance:

Cracks in puttied areas.

#### Cause:

Because putties usually dry quickly on the surface, they may remain soft underneath when applied too heavily and ultimately shrink and split.

#### Cure:

Apply the putty in several light coats with adequate drying time between coats.

### SINKING

#### Appearance:

Flat spots over puttied areas.

#### Cause:

Putty is different in porosity to normal primer/surfacers and paints, and unless it is sealed off to give uniform porosity with the remainder of the surface, the finish will sink over the puttied areas.

#### Cure:

Always apply putty before the last coat of primer/surfacer and sand back level with the surrounding surface. This will produce uniform porosity. If putty is applied after the primer/surfacer, always take the precaution of spot coating the finish over the puttied areas before painting completely.

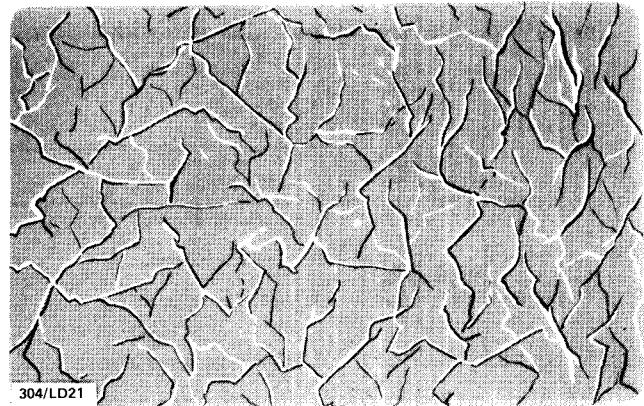
### WRINKLING

#### Appearance:

Wrinkles appearing in the paint finish.

#### Cause:

Too rapid surface drying can cause wrinkling. This condition retards the drying of the paint below the surface. As the paint below the surface dries it tends to shrink and thus wrinkle the dry material on top.



**Wrinkling.**

#### Cure:

Avoid spraying heavy coats and spraying in draughty or too hot or cold conditions.

### 13. FINISHING OFF (EXCEPT ENAMEL FINISHES)

#### HAND COMPOUNDING

- (1) Using a 200 to 250 mm square of clean, soft cheesecloth formed into a pad. Dip the pad into a suitable hand rubbing compound, taking care not to apply too much at one time, rub the paint using brisk strokes.

*NOTE: Take care not to apply too much pressure on edges or contours as it is possible to cut through the top coats and expose the primer/surfacer underneath.*

*It is recommended that only an area 450 mm by 450 mm be rubbed at one time until all the compound is removed or the desired finish is achieved.*

(2) Wipe over the compounded area with a clean, soft cloth to remove any excess compound.

(3) Compound all areas of new paint and, if necessary, any surrounding areas of old paint to obtain an even finish.

(4) Polish the entire vehicle to provide a protective coating for all the painted surfaces.

(5) Instal any exterior trim items to the vehicle that were removed to facilitate the repair job.

#### MACHINE COMPOUNDING

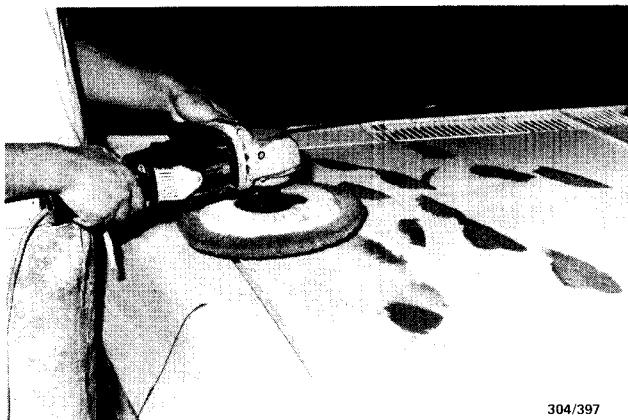
(1) Thin the compound slightly with clean water and wipe or brush it onto a 600 mm by 600 mm area of the paintwork.

(2) Using a polishing machine fitted with a lamb-swool pad, polish the compound until it is removed.

(3) Repeat the above operations until the desired finish is obtained.

*NOTE: Take care not to apply too much pressure on edges or contours as it is possible to cut through the top coat and expose the primer/surfacer underneath.*

(4) Wipe over the compounded area with a clean,



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**Machine compounding the paint finish.**

soft cloth to remove any excess compound.

(5) Compound all areas of new paint and, if necessary, any surrounding areas of old paint to obtain an even finish.

(6) Polish the entire vehicle to provide a protective coating for all painted surfaces.

(7) Instal any exterior trim items to the vehicle that were removed to facilitate the repair job.