SECTION BRM
BODY REPAIR

CONTENTS

FUNDAMENTALS

SERVICE INFORMATION 5

SHEET METAL WORK 5

SHEET METAL WORK TOOLS 5
SHEET METAL WORK TOOLS : Sheet Metal Work Tools 5
SHEET METAL WORK TOOLS : Hammers 5
SHEET METAL WORK TOOLS : Dollies 7
SHEET METAL WORK TOOLS : How to Use Hammer and Dolly 10
SHEET METAL WORK TOOLS : Spoons 13
SHEET METAL WORK TOOLS : Scribing Chisels 15
SHEET METAL WORK TOOLS : Types and Uses of Tinman's Shears 17
SHEET METAL WORK TOOLS : Tools for Pulling 18

SHRINKING THE SHEET METAL 21
SHRINKING THE SHEET METAL : Shrinking The Sheet Metal 21
SHRINKING THE SHEET METAL : Shrinking Methods 21
SHRINKING THE SHEET METAL : How to Heat Sheet Metal 23

CORRECTING A DEFORMED PANEL 24
CORRECTING A DEFORMED PANEL : Determining Panel Damage 24
CORRECTING A DEFORMED PANEL : Basic Types of Damage 25
CORRECTING A DEFORMED PANEL : Examination of Panel Damage 25
CORRECTING A DEFORMED PANEL : Elastic VS. Plastic Deformation 27
CORRECTING A DEFORMED PANEL : Basic Repair Procedure 27

COLORED SHEET METAL WORK 30
COLORED SHEET METAL WORK : Colored Sheet Metal Work 31
COLORED SHEET METAL WORK : Confirmation of The Panel 31
COLORED SHEET METAL WORK : Selection of Repair Tools 32
COLORED SHEET METAL WORK : Panel Repair Methods 32
COLORED SHEET METAL WORK : Polishing of Panel Surface and Anti-corrosive Treatment 34
COLORED SHEET METAL WORK : Examination of Panel 34

BODY WELDING AND PRECAUTIONS 35

OUTLINE OF WELDING 35
OUTLINE OF WELDING : Features of Welding 35
OUTLINE OF WELDING : Welding of Automovile Body 35

ELECTRIC RESISTANCE SPOT WELDING 36
ELECTRIC RESISTANCE SPOT WELDING : Principles of Spot Welding 36
ELECTRIC RESISTANCE SPOT WELDING : Features of Spot Welding 36
ELECTRIC RESISTANCE SPOT WELDING : Construction of Spot Welder 37
ELECTRIC RESISTANCE SPOT WELDING : Cooling Methods 37
ELECTRIC RESISTANCE SPOT WELDING : Spot Welding Gun 37
ELECTRIC RESISTANCE SPOT WELDING : Mult-functional Type Spot Welder 38
ELECTRIC RESISTANCE SPOT WELDING : Process of Spot Welding 38
ELECTRIC RESISTANCE SPOT WELDING : Condition of the Panel 39
ELECTRIC RESISTANCE SPOT WELDING : Precautions when Performing Spot Welding 40
ELECTRIC RESISTANCE SPOT WELDING : Inspection of Welded Portion 42

ARC WELDING 43
ARC WELDING : Arc Welding 43

ARC WELDING : Principles of MIG and MAG Arc Welding 43
ARC WELDING : Features of MIG and MAG Welding 44
ARC WELDING : Structure of MIG and MAG Welding Machine 44
ARC WELDING : Condition of Panel to be Welded ... 45
ARC WELDING : Inspection of Welded Portions ... 45
ARC WELDING : Types of MIG and MAG Welding ... 47

SAFETY AND HEALTH 49

PRECAUTIONS FOR OPERATION 49
PRECAUTIONS FOR OPERATION : Precautions for Operation 49
PRECAUTIONS FOR OPERATION : Protectors ... 49
PRECAUTIONS FOR OPERATION : Safety Stand 49
PRECAUTIONS FOR OPERATION : Inflammables 49
PRECAUTIONS FOR OPERATION : Working Environment 49
PRECAUTIONS FOR OPERATION : Handling of Welding Equipment 49

WORKING WITH BODY STRAIGHTENING EQUIPMENT 51
WORKING WITH BODY STRAIGHTENING EQUIPMENT : Use of Protectors 51
WORKING WITH BODY STRAIGHTENING EQUIPMENT : Precautions while Working 51
WORKING WITH BODY STRAIGHTENING EQUIPMENT : Protection of Vehicle 52

WORKING WITH GRINDING THE BODY FILLER (PUTTY) 52
WORKING WITH GRINDING THE BODY FILLER (PUTTY) : Danger from Dust 52
WORKING WITH GRINDING THE BODY FILLER (PUTTY) : Precautions during Dust Generating Work 52
WORKING WITH GRINDING THE BODY FILLER (PUTTY) : Protector and Equipment 52
WORKING WITH GRINDING THE BODY FILLER (PUTTY) : Precautions during Air Blow 53

PAINT SAFETY PRECAUTIONS 53
PAINT SAFETY PRECAUTIONS : Paint Safety Precautions 53

REPAIRING PROCEDURES AND PRECAUTIONS 54

FUNDAMENTALS OF BODY REPAIR 54
FUNDAMENTALS OF BODY REPAIR : Fundamentals of Body Repair 54

DAMAGE DIAGNOSIS 54
DAMAGE DIAGNOSIS : Damage Diagnosis 55
DAMAGE DIAGNOSIS : Determining Various Conditions of the Collision 55
DAMAGE DIAGNOSIS : External Appearance 55
DAMAGE DIAGNOSIS : Key Points in Choosing Repair Methods 56
DAMAGE DIAGNOSIS : Parts to be Replaced 56

CHECKING DAMAGE 57
CHECKING DAMAGE : Checking Damage 57
CHECKING DAMAGE : Centering Gauge 57
CHECKING DAMAGE : Tracking Gauge and Steel Tape 58

BODY STRAIGHTENING EQUIPMENT 59
BODY STRAIGHTENING EQUIPMENT : Comparison of Pulling Methods 59
BODY STRAIGHTENING EQUIPMENT : Clamps... 59
BODY STRAIGHTENING EQUIPMENT : Hooks and Other Tools 61
BODY STRAIGHTENING EQUIPMENT : High Intensity Cabin Structure 61

REPAIR TECHNIQUES USING BODY STRAIGHTENING EQUIPMENT 62
REPAIR TECHNIQUES USING BODY STRAIGHTENING EQUIPMENT : Securing the Vehicle 62
REPAIR TECHNIQUES USING BODY STRAIGHTENING EQUIPMENT : Securing and Pulling 64

REPAIR PROCEDURE FOR PULLING 65
REPAIR PROCEDURE FOR PULLING : Repair Sequence 65
REPAIR PROCEDURE FOR PULLING : Key Points in Actual Repair Work 66

REPLACEMENT OF PANEL 68
REPLACEMENT OF PANEL : Replacement of Panel 68
REPLACEMENT OF PANEL : Door Hemming 69
REPLACEMENT OF PANEL : Adjustment Fitting of Front Fender 71
REPLACEMENT OF PANEL : Adjustment Fitting of Door Assembly 72

PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) 72
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Partial Replacement of Panel (Welded Panel) 72
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Welded Panel Replacement Procedure... 72
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Rough Cutting of Panel 73
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Cutting Off Welded Portions 74
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Precautions for High Strength Steel (HSS) 77

PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Prohibition for Ultra High Strength Steel (UHSS) 79
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Rear Fender Hemming Process 79
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Welding Method for Stud Bolt and Nut 80
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Preparation for Service Panel Installation 81
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Anti-corrosive Treatment 83

USE OF BODY FILLER (PUTTY) AND GRINDING... 84
USE OF BODY FILLER (PUTTY) AND GRINDING : Use of Body Filler (Putty) and Grinding 84
USE OF BODY FILLER (PUTTY) AND GRINDING : Types of Filler and Putty 84
USE OF BODY FILLER (PUTTY) AND GRINDING : Procedure for Applying Body Filler 85
USE OF BODY FILLER (PUTTY) AND GRINDING : Drying the Body Filler 88
USE OF BODY FILLER (PUTTY) AND GRINDING : Grinding the Filled Area 88
USE OF BODY FILLER (PUTTY) AND GRINDING : Sandpaper Grits 90
USE OF BODY FILLER (PUTTY) AND GRINDING : Grinding Power of Air Sander 90

REPAIR OF RUST AND CORROSION 90
REPAIR OF RUST AND CORROSION : Repair of Rust and Corrosion 91
REPAIR OF RUST AND CORROSION : Removal of Rust Limited to the Skin Panel Surface 91
REPAIR OF RUST AND CORROSION : Repair of Corroded Panel 91

ALUMINUM REPAIR 96

SHEET METAL WORK (ALUMINUM) 96
SHEET METAL WORK (ALUMINUM) : Sheet Metal Work (Aluminum) 96
SHEET METAL WORK (ALUMINUM) : Sanding 96
SHEET METAL WORK (ALUMINUM) : Hammering 96
SHEET METAL WORK (ALUMINUM) : Heating Repair 96
SHEET METAL WORK (ALUMINUM) : Shrinking 96
SHEET METAL WORK (ALUMINUM) : Precautions during Assembly 97

WELDING (ALUMINUM) 97
WELDING (ALUMINUM) : Welding (Aluminum) 97
WELDING (ALUMINUM) : Comparision of Chemical and Physical Properties between Aluminum and Iron 98
WELDING (ALUMINUM) : Filler Metal 98
WELDING (ALUMINUM) : TIG Welding 98
WELDING (ALUMINUM) : MIG Welding 98
WELDING (ALUMINUM) : MIG Welding Method 100
WELDING (ALUMINUM) : Precautions during Welding 102

BODY STRAIGHTENING (ALUMINUM) 103
BODY STRAIGHTENING (ALUMINUM) : Securing the Vehicle 103
BODY STRAIGHTENING (ALUMINUM) : Frame Straightening 104

REPAIR INFORMATION

VEHICLE INFORMATION 105

BODY EXTERIOR PAINT COLOR 105
Body Exterior Paint Color 105

PRECAUTION 106

PRECAUTIONS 106
Precautions for Body Repair 106
Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER" 106

REPAIRING HIGH STRENGTH STEEL 107
High Strength Steel (HSS) 107
Handling of Ultra High Strength Steel Plate Parts 109

LOCATION OF PLASTIC PARTS 110
Precautions for Plastics 110
Location of Plastic Parts 111

PREPARATION 113

REPAIRING MATERIAL 113
Foam Repair 113

BODY COMPONENT PARTS 114
Underbody Component Parts 114
Body Component Parts 116

REMOVAL AND INSTALLATION 119

CORROSION PROTECTION 119
Description 119
Anti-corrosive Wax 119
Undercoating 120
Stone Guard Coat 121
Body Sealing 122

BODY CONSTRUCTION 126
Body Construction 126
Rear Fender Hemming Process 127

REPLACEMENT OPERATIONS 129
Precautions for Body Repair 129
Description 129
Hoodledge 131
Hoodledge Reinforcement 132
Radiator Core Support Side 134
Strut Housing 135
Front Side Member Outer 135
Front Side Member Inner 136

Front Side Member (Partial Replacement) 138
Front Pillar 138
Center Pillar 140
Rear Fender 143
Rear Panel 144
Rear Floor Rear 144
Rear Side Member Extension 145

SERVICE DATA AND SPECIFICATIONS (SDS) 147

BODY ALIGNMENT 147
Body Center Marks 147
Description 148
Engine Compartment 148
Underbody 150
Passenger Compartment 153
Rear Body 155

SERVICE INFORMATION

SHEET METAL WORK

SHEET METAL WORK TOOLS

SHEET METAL WORK TOOLS : Sheet Metal Work Tools

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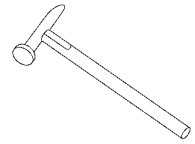
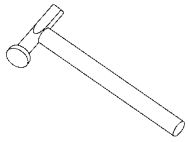
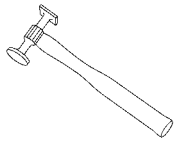
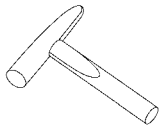
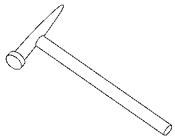
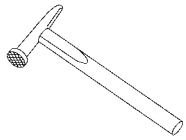
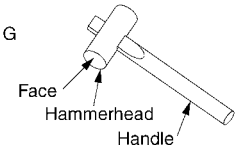
This section explains various tools used in body repair work.

SHEET METAL WORK TOOLS : Hammers

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A hammer is used to correct dents, projections or other deformations. Various shapes have been designed according to their purposes.

(1) TYPES AND FEATURES OF HAMMERS

A 	A	Cross peen hammer	For shaping the panel together with dollies and spoons
B 	B	Straight peen hammer	For shaping the panel together with dollies and spoons
C 	C	Bumping hammer	For shaping the panel together with dollies and spoons
D 	D	Roughing hammer	For rough-shaping the panel in combination with straightening equipment, or when great force is required
E 	E	Pick hammer	For correcting small dents
F 	F	Shrinking hammer	For shrinking stretched panels
G 	G	Wooden hammer	For shrinking or correcting the panel without stretching

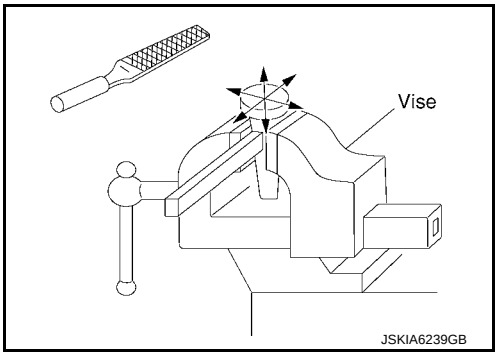
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(2) SELECTION AND MAINTENANCE OF HAMMERS

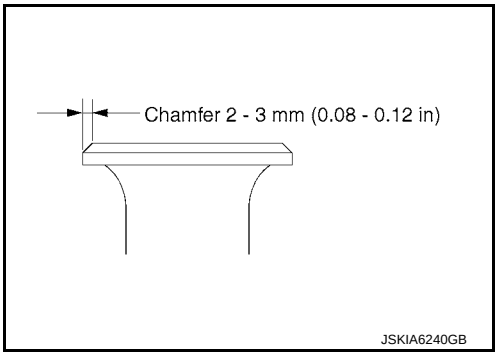
It is necessary to choose lighter or heavier hammers according to application or purpose.
Hammer weight should be selected according to the user's physical strength.
Hammer maintenance is important. In particular, the hammer face must always be kept clean. A distorted or damaged hammer face will lead to distorted panels.

Accordingly, hammers for sheet metal work must not be used to hit other objects such as a chisel. Do not mix sheet metal hammers with ordinary hammers.
Repairing the face of a sheet metal hammer is explained below.

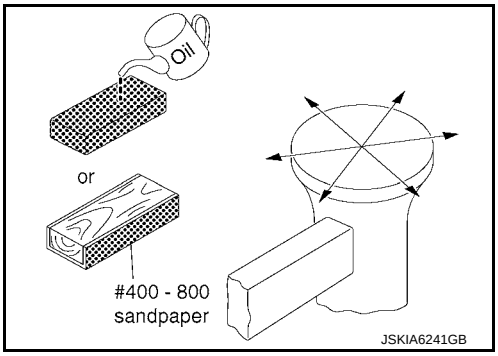
(a) Clamp the hammer in a vise with the hammer face up.
If the hammer face is deformed, use a hand file to smooth it.
(b) File the face in all directions.Do not file in only one direction.



(c) Chamfer the edge of the face to prevent it from nicking or distoring the sheet metal.



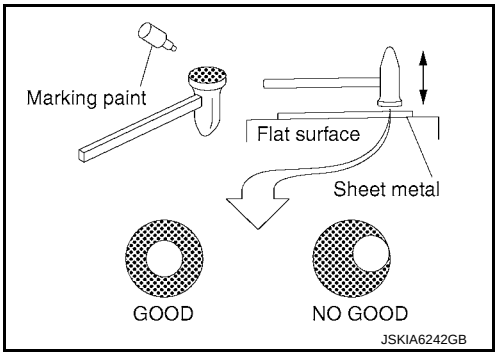
(d) After smoothing the hammer face, polish it with an oil stone or #400 - #800 abrasive paper wrapped around a wooden block. Polish the face in all directions.



(e) To check the finish, apply marking paint to the hammer face. Hit a piece of flat sheet metal on a flat surface.

GOOD : The paint comes off the center to the face.

NO GOOD : The paint comes off at a section other than the center or the face. Grind the surface again.

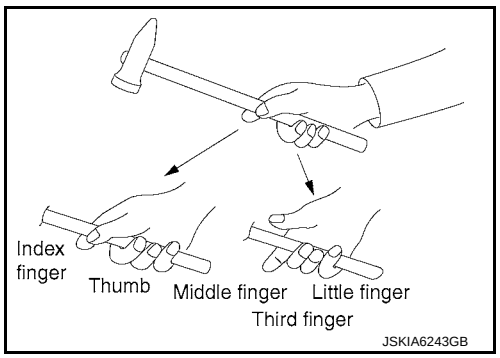


(3) HOLDING AND HITTING WITH THE HAMMER

(a) Holding the hammer

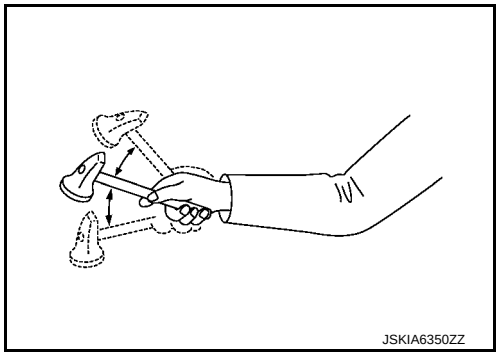
- Hold the hammer handle tightly with the middle, third and little fingers so that it will not slip when it is swung.

- Hold the sides of the hammer handle lightly with the thumb and index finger to prevent sideways movement.

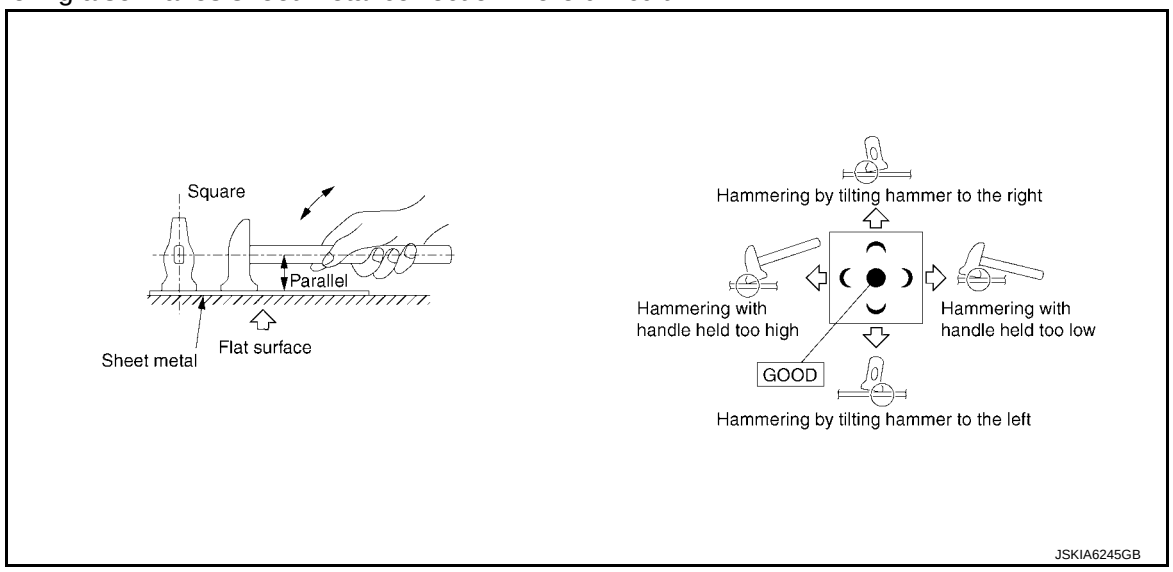


(b) Hammering

- For rough straightening work, strike strongly.
  For ordinary correcting work, swing the hammer using the wrist. In this case, the arm serves as a guide to determine the hammer direction.



- The hammer face should be flush with the panel surface when hitting. If the hammer edge strikes the surface, it will nick the panel.
- Hammering should be approximately 100 hits a minute, and should be kept constant. An irregular hammering rhythm will lead to an uneven hammering force. Sheet metal will stretch when it is hammered. Irregular hammering also makes sheet metal correction more difficult.



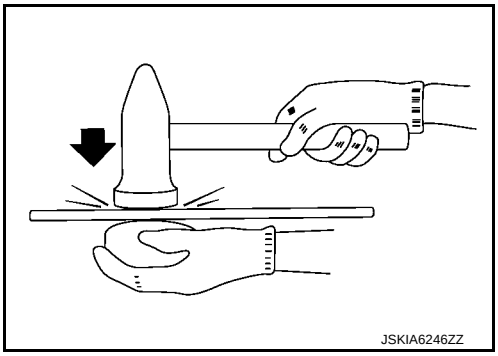
SHEET METAL WORK TOOLS : Dollies

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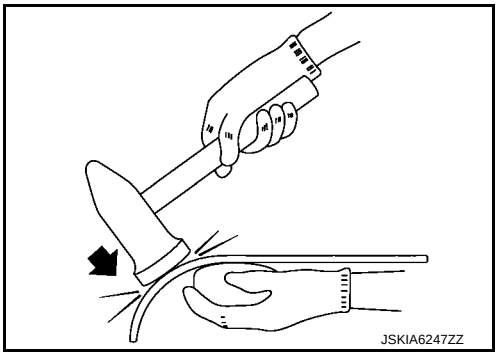
Dollies are used in combination with a hammer. They are a 1 kg - 2 kg (2 lb - 4 lb) steel blocks, heavier than a hammer, with various curves and planes.

(1) USE OF DOLLIES

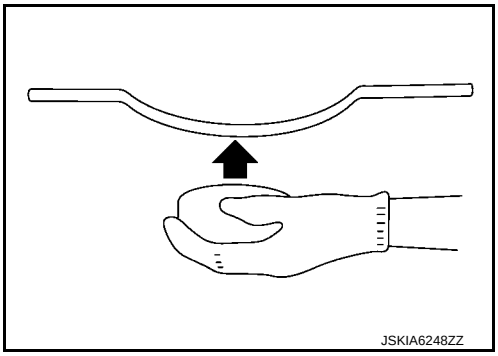
(a) Place the dolly on the underside of the deformed sheet metal. Strike the deformed section of the sheet metal with the hammer to stretch it.


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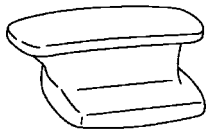
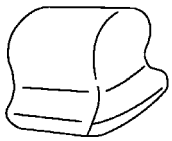
(b) Move the hammer and dolly as necessary, and direct the hammer blows so as to bend the sheet metal.

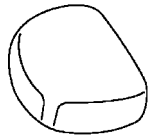
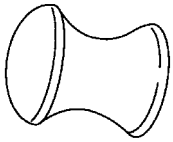
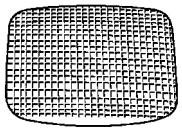

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(c) If ordinary hammering is impossible due to limited space, substitute a dolly for the hammer, and strike the dented portion with the dolly.


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(2) TYPES AND FEATURES OF DOLLIES

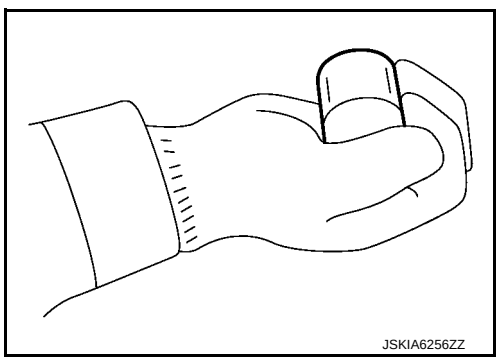
 JSKIA6249ZZ	General purpose dolly	This is also called a rail dolly. It has both wide and narrow curved faces.
 JSKIA6250ZZ	Utility dolly	This type of dolly features various curved surfaces and has wide applicability to automobile body repair work. It can be handled easily in narrow spaces.

 JSKIA6251ZZ	Heel dolly	One side is flat and the other side is curved slightly. This is suitable for correcting flat and slightly curved surfaces.
 JSKIA6252ZZ	Toe dolly	This dolly is formed by two flat surfaces and a connecting curved surface. It can be used in narrow places.
 JSKIA6253ZZ	Round dolly	Both sides are curved. This dolly is used for repairing small dents.
 JSKIA6254ZZ	Wedge dolly	This dolly has a curved surface which changes gradually from sharp to gentle. Its sharp end can be inserted into narrow portions.
 JSKIA6255ZZ	Shrinking dolly	The surface is like a file. This dolly is used in combination with a shrinking hammer.

(3) SELECTION AND MAINTENANCE OF DOLLIES

Ideally, a dolly whose curved surface just fits the curvature of the panel should be used. However, this is often difficult. In most cases, a dolly whose curvature is slightly smaller than that of the panel should be selected. Generally speaking, four types of dollies (general purpose, utility, heel and toe dollies) are sufficient for ordinary panel work. However a special dolly can be designed for unique shaping.

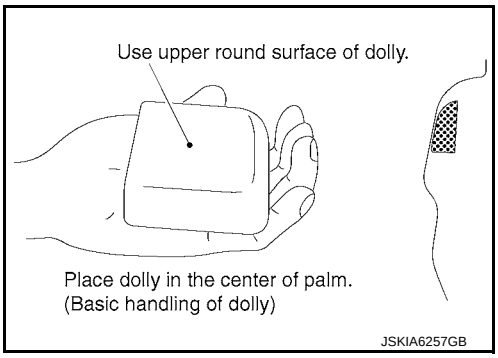
The size and weight of the dolly must be easy to handle.
The maintenance procedures and cautions described for the hammer also apply to the dolly.
The entire surface of the dolly must be free from damage.


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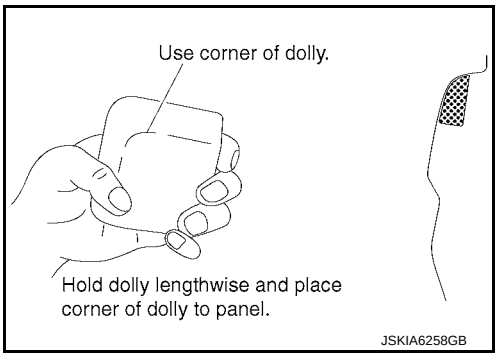
(4) HOW TO HOLD THE DOLLY

Basic handling of the dolly.

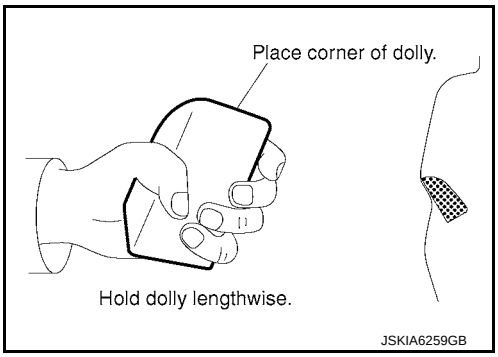
(a) TOP:
Place the dolly in the palm of your hand.
Holding it lightly, place the curved surface against the curved surface of the panel.



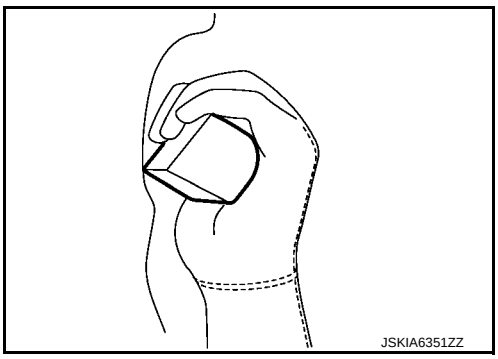
(b) CORNER:
Hold the dolly lengthwise, and place the corner in the sharply bent portion of the panel.



(c) EDGE:
Hold the dolly so that the edge faces upward.
Place this edge to the press line of the panel.



(d) CORRECTING THE PRESS LINE:
To correct a concave press line in a narrow space on the back of the panel, use a dolly as shown in the figure and strike the press line with it.

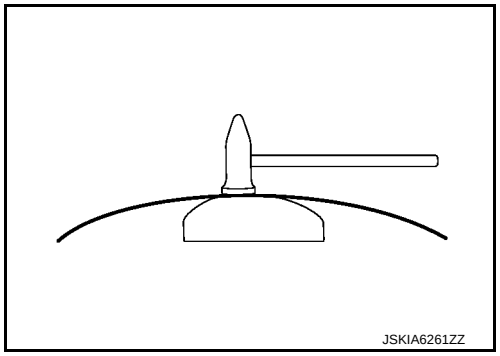


SHEET METAL WORK TOOLS : How to Use Hammer and Dolly

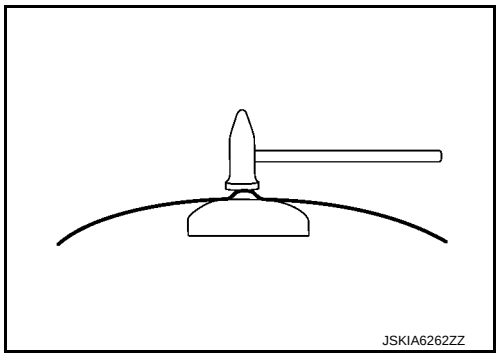
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(1) HAMMER-ON-DOLLY

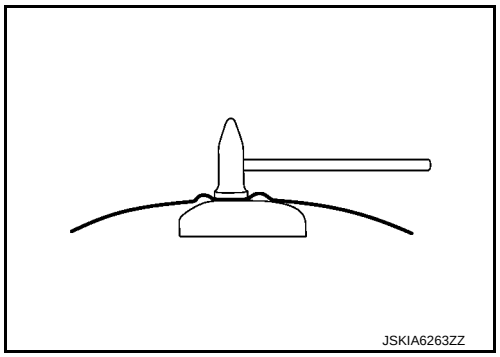
This is also known as dinging on the dolly. The dolly is held directly under the area being struck with the hammer. Hammering smoothes the dented metal between the dolly and hammer. This method causes the sheet metal to stretch.


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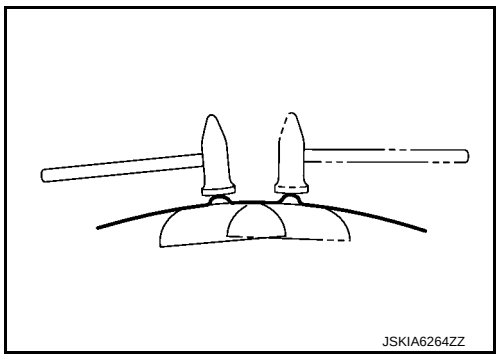
Hammering on a dolly is most effective for repairing shallow dents.
(a) The hammer strikes the sheet metal, causing the dolly to bounce against the metal surface. Thus the damaged portion is worked out from both inside and outside.


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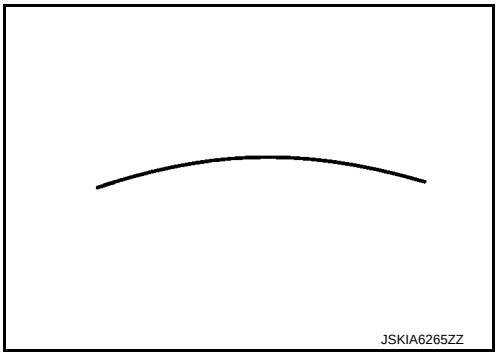
(b) The sheet metal stretches between the hammer and dolly, and deformation is distributed around the strike area.


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(c) Continuously move the dolly under the shifting deformation so that it can be struck properly.


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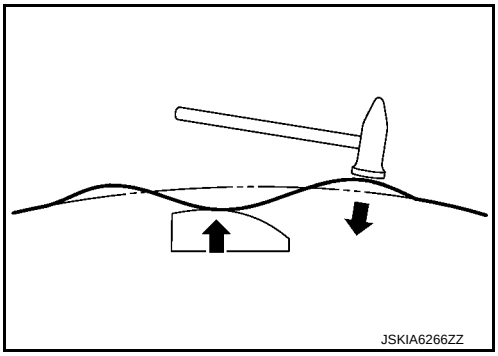
(d) The sheet metal gradually stretches and returns to its original shape.



(2) HAMMER-OFF-DOLLY

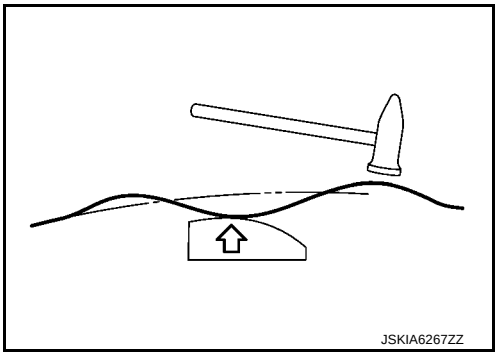
This is also known as dinging off the dolly.

Place the dolly directly under a dent, and hammer against the edge of the dent. The hammer drives one area downward while the reaction of the dolly drives the adjacent area upward.

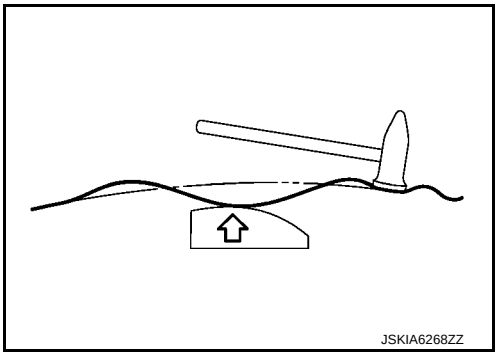


An example of the hammer-off-dolly operation is given below.

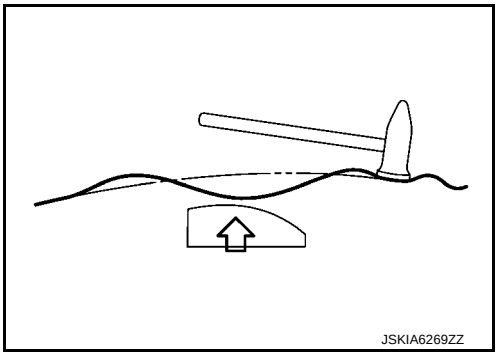
(a) Place the dolly under the deepest dent, and hammer the highest portion of the top surface.



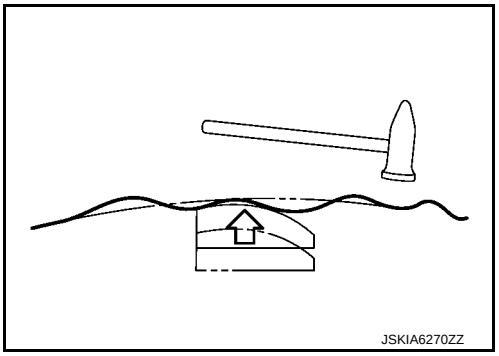
(b) The raised portion of the surface lowers as it is struck with the hammer.



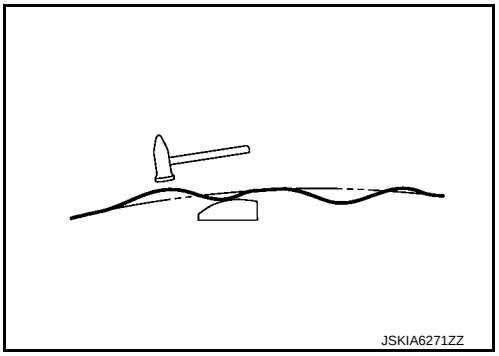
(c) Hammer blows are transmitted to the dolly, creating a reaction force.


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(d) This reaction force pushes the dent.


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(e) Repeat steps (a) - (d) until the surface is smooth.


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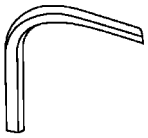
SHEET METAL WORK TOOLS : Spoons

INFOID:0000000014642466

Spoons are made of steel, and one or both ends are flat. Spoons are used as dollies in narrow spaces or as pry bars.

(1) TYPES AND FEATURES OF SPOONS

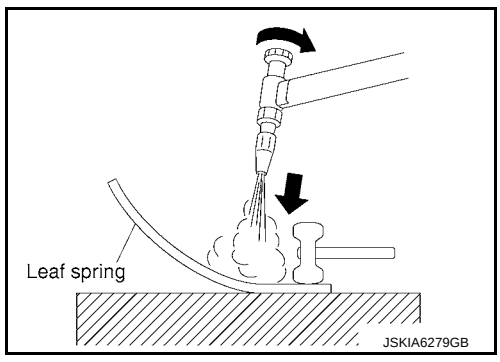
 JSKIA6273ZZ	General purpose spoon	This spoon has a gently curved surface and sharply curved ends. It is widely used in automobile body repair work.
 JSKIA6274ZZ	Long spoon	This spoon has a long handle and thin, rigid faces. It is used primarily for prying.

 JSKIA6275ZZ	Curved spoon	The handle of this spoon is comparatively short. It has a wide curved blade. This spoon is used for smoothing.
 JSKIA6276ZZ	Flat spoon	This spoon has a short handle and a wide, flat blade. When the spoon is placed on the panel and hammered, the force disperses over a wide area.
 JSKIA6277ZZ	High crown spoon	This spoon has a wide hooked blade. It is used for repairing narrow body panel spaces such as inside of outer sill panel.
 JSKIA6278ZZ	Sickle-shaped spoon	This spoon has a wide, gently curved surface with a thin end. It can be inserted into very narrow gaps between panels.

(2) SELECTION AND MAINTENANCE OF SPOONS

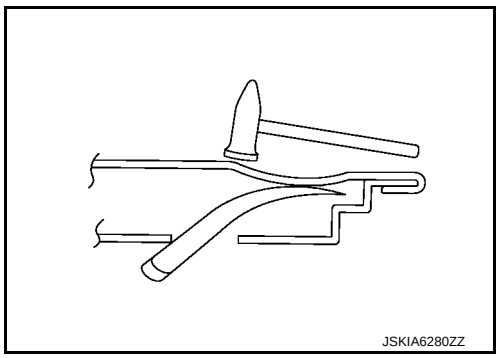
Select spoons suitable for the particular panel shape and internal structure. Spoons can be made from leaf springs.

Cut the leaf spring to the desired shape. Heat it with a gas torch and shape it into a spoon by bending or stretching with a hammer. Then grind and polish. (See Hammer Maintenance, refer to BRM-5, "SHEET METAL WORK TOOLS : Hammers".)
The precautions described for the hammer and dolly also apply to spoons. Do not damage the surface which comes into direct contact with the panel during repair work.

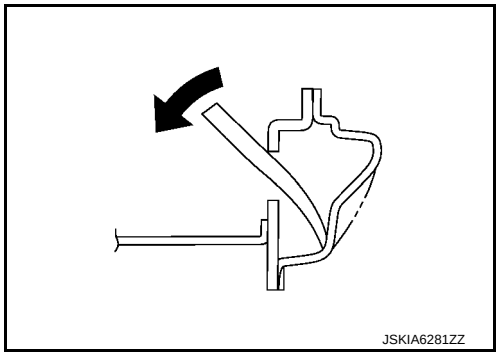


(3) HOW TO USE SPOONS

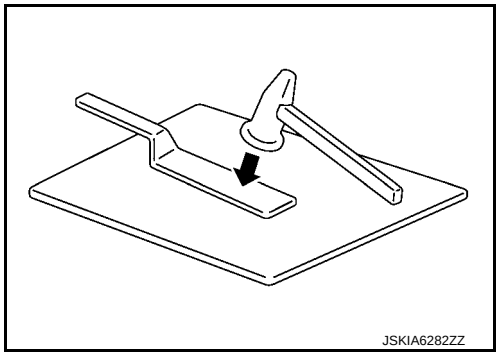
(a) Insert the spoon into tight spaces such as inside of door, and use as a dolly.


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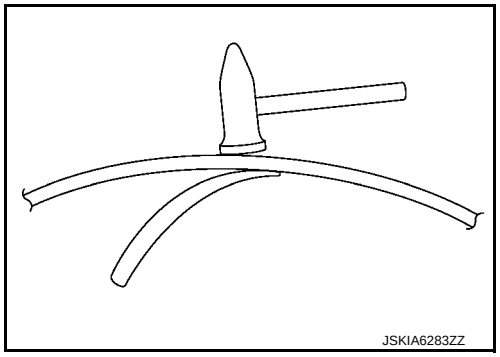
(b) Place a spoon between two panels and pry out the concave portion.


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(c) Hammer directly on the spoon to disperse the force of the hammer blows.


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(d) The figure to shows an example of incorrect spoon usage. There is no fulcrum point for the spoon.
If a spoon is used in this way, insufficient force is applied to the mating face, and the spoon cannot act as a dolly.

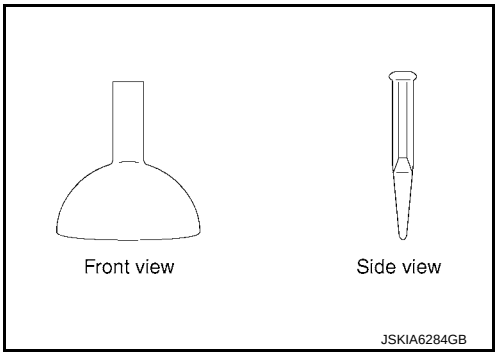

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SHEET METAL WORK TOOLS : Scribing Chisels

INFOID:0000000014642467

Chisels are generally used to cut sheet metal.
They are also used in body repair work. There are numerous types of chisels. This section, however, describes scribing chisels used exclusively for bending sheet metal or for shaping panel press lines.

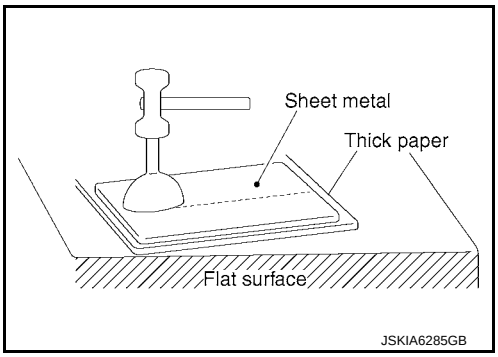
This type of chisel must have a smoothly rounded edge as shown in the figure. If the edge is sharp, the body panel will be nicked.



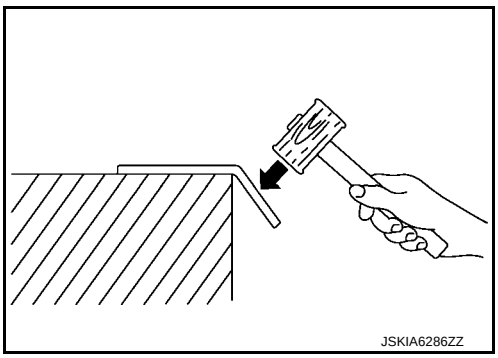
HOW TO USE SCRIBING CHISELS

(a) For bending sheet metal

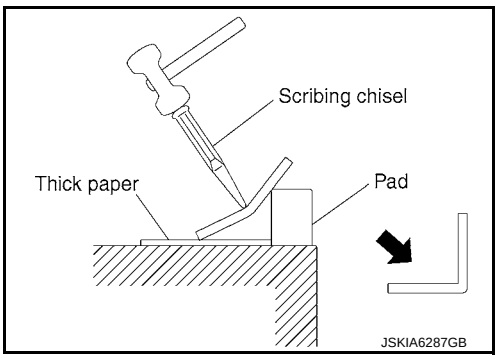
- First scribe a line on the sheet metal.
  Place thick paper or cardboard under the sheet metal.
  Place the scribing chisel on the line and hammer it.



- Place the sheet metal on a flat, angled surface scribed-side down, and bend the sheet metal with a wooden hammer.

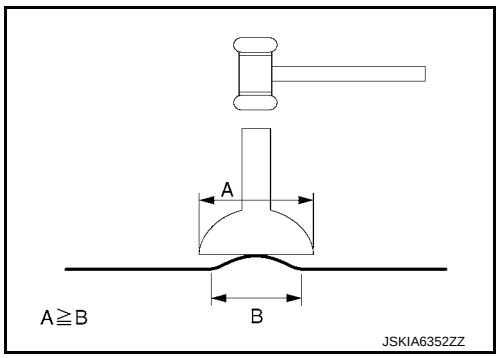


- Using a hammer and the scribing chisel, neatly bend the sheet metal squarely. Do not bend all at once.
  Bend the sheet metal gradually by gently hammering against the chisel head.

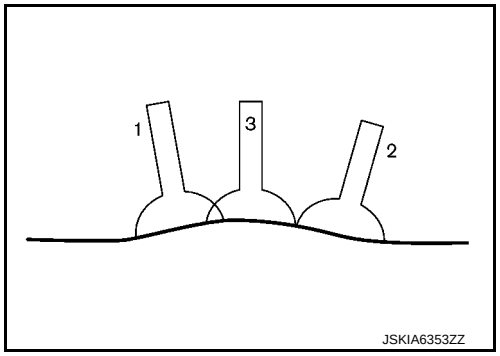


(b) Shaping the press line

- If the dent in the press line is smaller than the width of the chisel, apply the chisel to the center of the dent. Hammer to flatten. Hammer gently so that the dent can be removed gradually.



- If the dent is larger than the width of the chisel, do not strike the dent in the center. Apply the chisel at the edges of the dent.

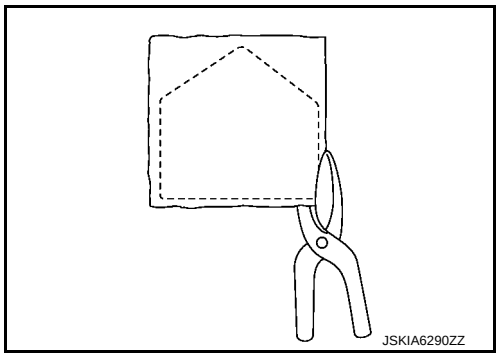


SHEET METAL WORK TOOLS : Types and Uses of Tinman's Shears

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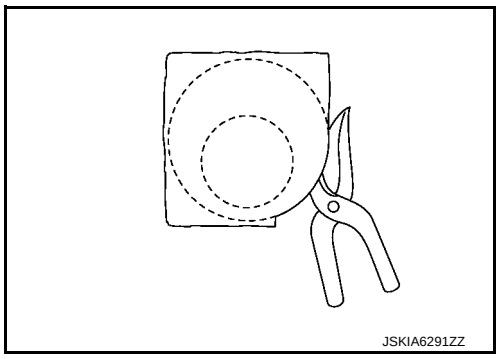
(1) STRAIGHT BLADE SHEARS

For cutting straight lines.



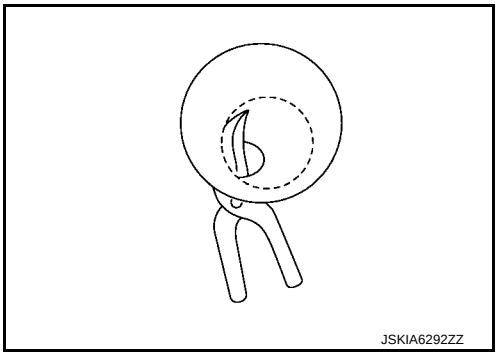
(2) CURVED BLADE SHEARS

The blades are smoothly curved. Suitable for straight or curved cutting.



(3) SCOOPED BLADE SHEARS

The entire blade is bent to one side. Suitable for cutting along a sharply curved line.



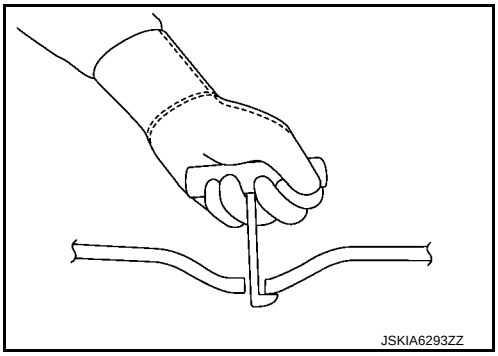
SHEET METAL WORK TOOLS : Tools for Pulling

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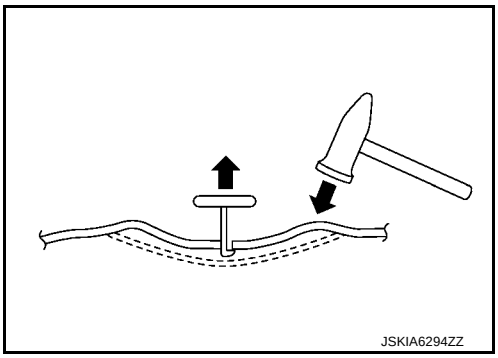
If it is impossible to gain access to the damaged area, dents can be pulled out and repaired.

(1) HAND HOOK

Small holes are drilled in the dented portion, and a hand hook is inserted into the hole. The dented panel is pulled out with the hook. This method is used to repair small panel dents.

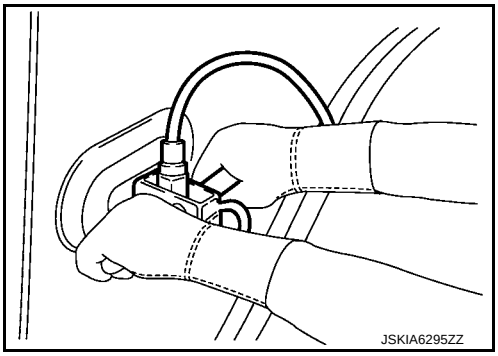


When using a hand hook, fit the end snugly against the panel. Do not pry up or use too much force. Pull the hook lightly while tapping with a hammer at the edge of the dent.
The drilled hole must be refilled with body putty after completing the work.



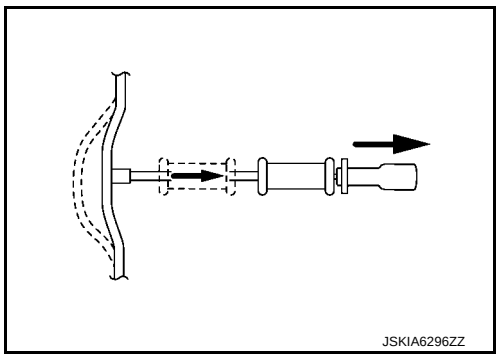
(2) VACUUM PULLER

The vacuum puller is suitable for pulling out large dents if the dented surface is comparatively smooth.

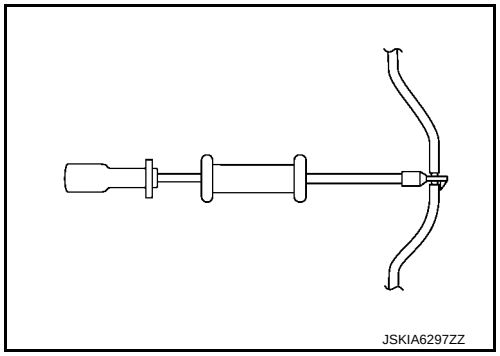


(3) SLIDING HAMMER

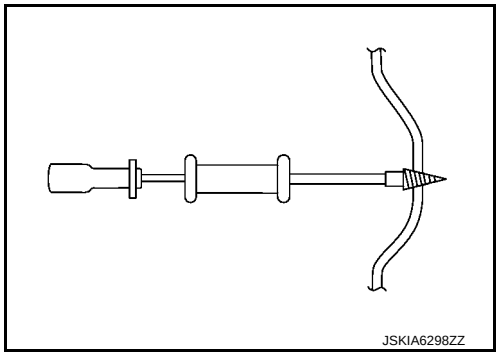
The sliding hammer is used for repairing large, deep dents. Since it provides greater force than an ordinary hammer, it is used to repair dents in thick panels.


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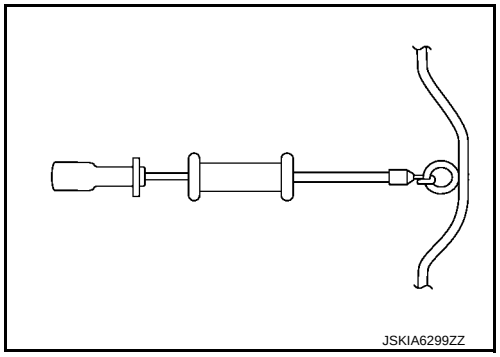
(a) A hook similar to the hand hook is attached to the end of the sliding hammer. Pulling holes are drilled in the panel. A limited force is allowed for pulling. The panel must be pulled carefully to avoid tearing.


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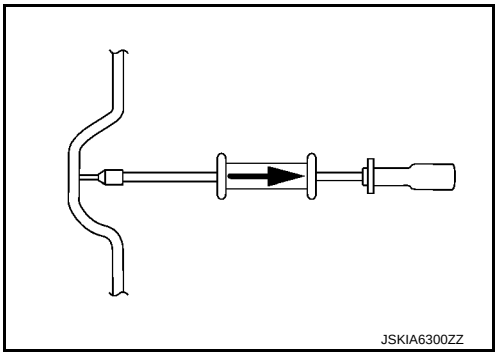
(b) A tapping screw is attached to the end of the sliding hammer. It is then screwed into the panel. A greater pulling force is possible than with the hook.


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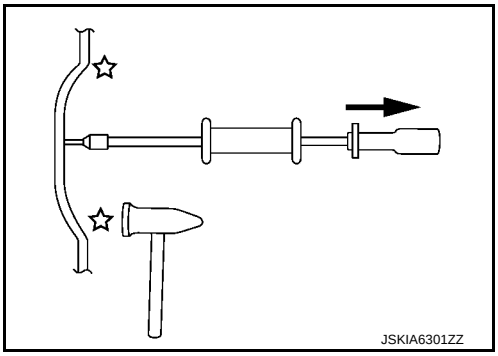
(c) Instead of a hole, a metal pin or washer is welded to the panel. Great force can be used for pulling.


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(d) When the dent is deep and narrow, pull it with a single blow.

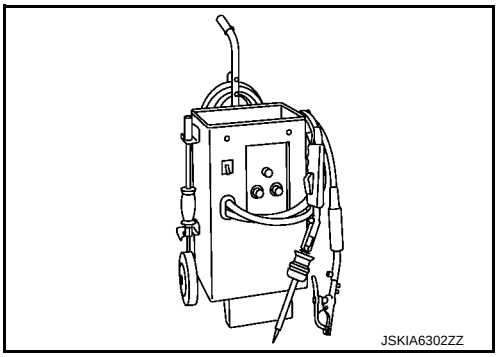


(e) When the panel dent is shallow and wide, hold the end of the sliding handle. Repair the dent by gradually tapping the edge of the dent.

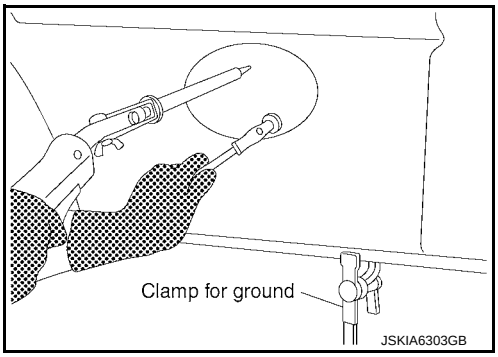


(4) STUD WELDER (BODY REPAIR STATION)

A pin or washer is welded directly to the body panel dent without drilling. The panel dent area is then pulled outward with the sliding hammer. Because no drilling is required, panel strength is unaffected. Corrosion problems are also reduced.

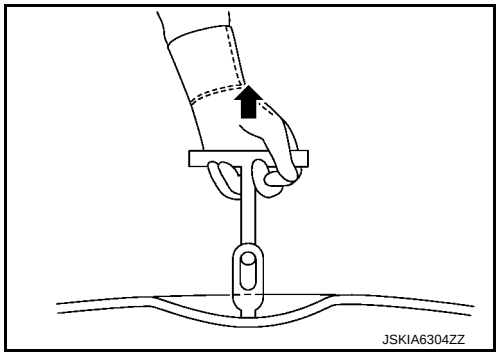


Because the stud welder welds pins directly, the paint must be removed from the dent surrounding area and the area where body ground is established.
As shown in the figure, the ground can be established at the flange area or in the dent surrounding area using a magnet.

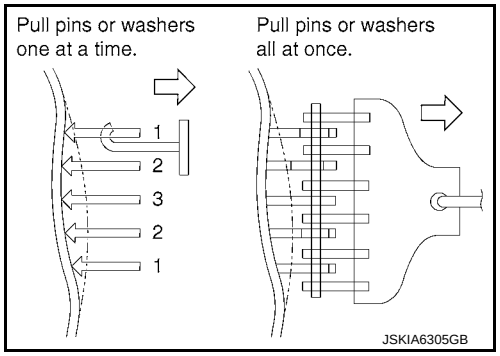


(5) WELDED PIN OR WASHER

A pin or washer is welded to the dent without drilling. It is then pulled to repair the dent.

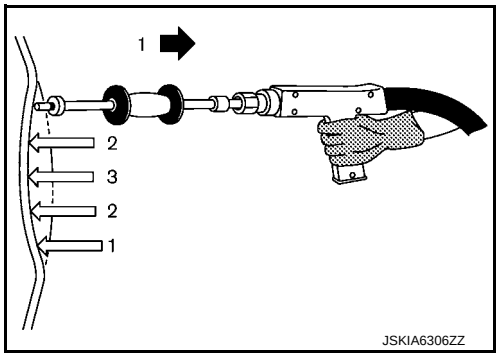


Several pins or washers are welded to the dent. They are then pulled together or separately to repair the dent.



(6) SPOT HAMMER WELDING

The sliding hammer tips are welded to the dent.
They are then pulled separately to repair the dent.
After the tips are pulled, they are twisted to separate them from the panel.



SHRINKING THE SHEET METAL

SHRINKING THE SHEET METAL : Shrinking The Sheet Metal

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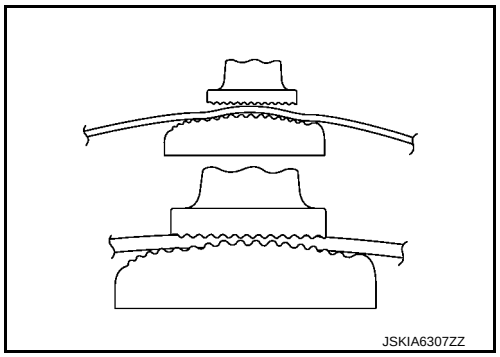
Plastic deformation may cause reduced panel thickness and the panel may stretch. Even when it is repaired using a hammer and dolly, the panel tends to bulge, losing its original shape.
In such cases, it must be shrunk to its original shape. This is called shrinking the sheet metal.

SHRINKING THE SHEET METAL : Shrinking Methods

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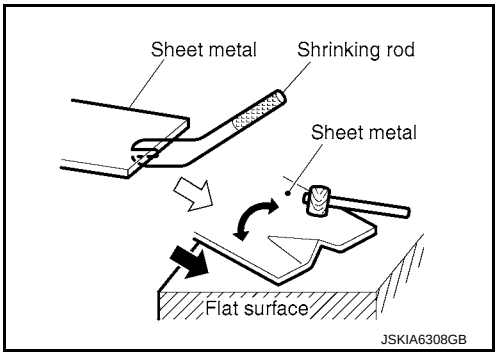
(1) HAMMER AND DOLLY

A shrinking hammer and shrinking dolly are used by the hammer-on-dolly method. Many tiny dents are formed on the panel surface. This method is suitable for shrinking comparatively small areas of panel deformation.



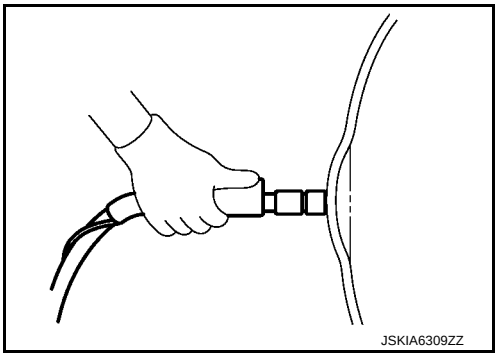
(2) SHRINKING ROD

This method is used to shrink stretched sheet metal edges. The sheet metal is inserted into the shrinking rod slit and bent in a “V” shape. The convex area of the sheet metal is then worked flat with a wooden hammer.
Hammer blows should begin at the edge and should gradually move outward to shrink the sheet metal.



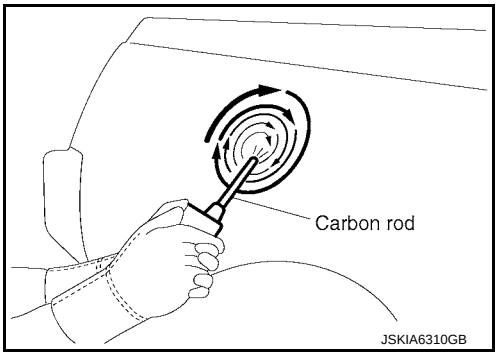
(3) ELECTRIC WELDING MACHINE

The body panel is connected to the negative power supply terminal and the tip is connected to the positive terminal. Then, an electric current is supplied to heat the panel. The shrinking principle is the same as that of gas welding. This method features no hammering and greater workability than gas welding and is suitable for repairing local panel deformations.



(4) CARBON ROD

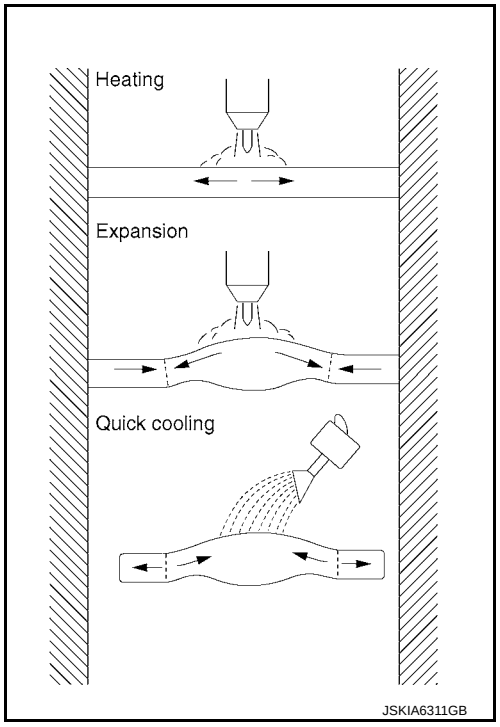
The panel is connected to the negative power supply terminal and a carbon rod is connected to the positive terminal. The panel is heated so that heat is conducted from the outside to the center of the dent. Wet rags are then applied to cool it quickly, thus shrinking the panel. This method is suitable for repairing wide, shallow panel deformations.



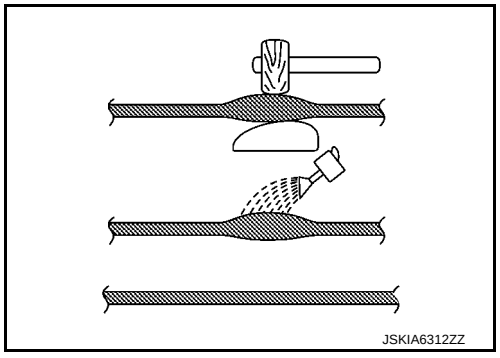
(5) GAS WELDING (OXY-ACETYLENE TORCH)

(a) Heating and expansion

As the sheet metal is heated with a gas welding torch, it stretches. However, stretching is restricted in the unheated surrounding portion. As a result, the heated portion bulges.



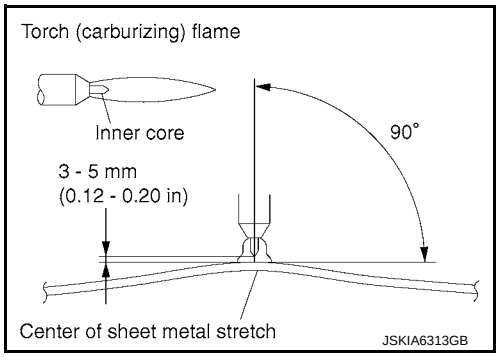
(b) Sudden cooling
When the bulge is cooled suddenly, it shrinks.
This shrinking is accelerated by tapping with a wooden hammer.



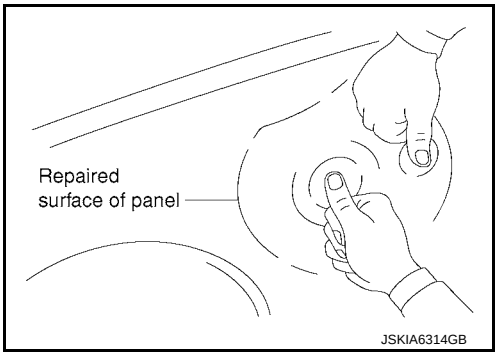
SHRINKING THE SHEET METAL : How to Heat Sheet Metal

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- Use a carburizing flame when shrinking sheet metal with a gas welding torch.
- Hold the torch at a right angle to the center of the sheet metal.
- Maintain a distance of 3 mm - 5 mm (0.12 in - 0.20 in) between the inner core and sheet metal.
- Heat the sheet metal to approximately 800°C (1,472°F) (until the heated portion turns red). Increase the temperature if sheet metal stretching is insufficient.

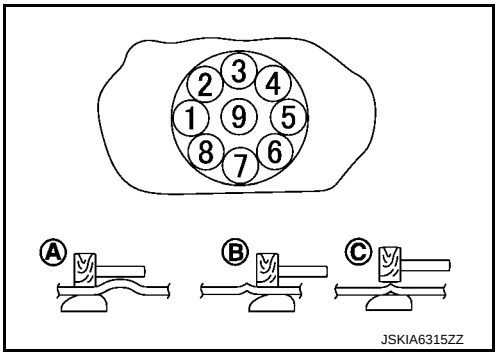


- Locate the stretched portion of the panel.
  Press the surface being repaired in several places.
  The point where the largest elastic dent is formed is the center, where the stretch is the maximum. The highest portion of the panel being repaired can also be considered the most stretched portion.



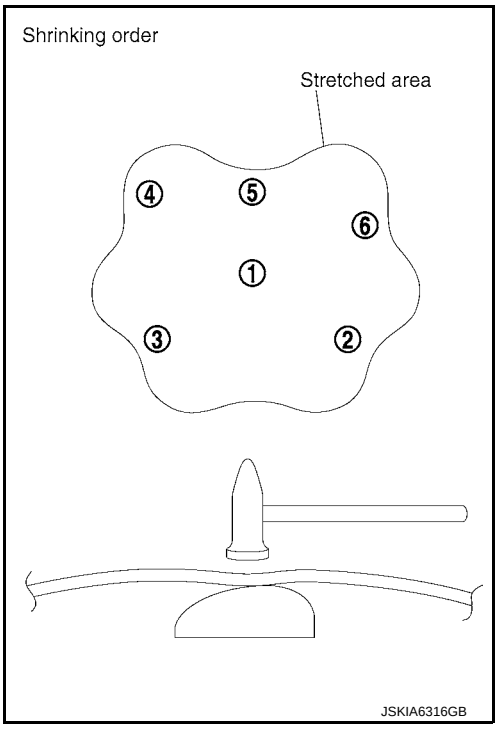
- The area heated with a welding torch must be approximately 3 mm - 5 mm (0.12 in - 0.20 in) in diameter if the panel shape is complex, and approximately 6 mm - 15 mm (0.24 in - 0.59 in) in diameter if it is flat.
- Small stretch
- Apply a dolly to the back of the heated panel. Tap the panel with a wooden hammer using the hammer-ondolly method in the sequence shown in the figure.

  (A) and (B) → 1 - 8
  (C) → 9



- Excessive stretch
  Shrink the panel, starting with the most stretched portion, and proceed toward the edge of the dent so that the dent surface is lower than the original surface.

  Using a gas welding torch makes the panel concave.
  To correct this, strike the concave portion using the hammer-on-dolly method to stretch the panel bit by bit until the original surface is restored.



- Apply wet cloths to the shrunken portion of the panel to cool it quickly.

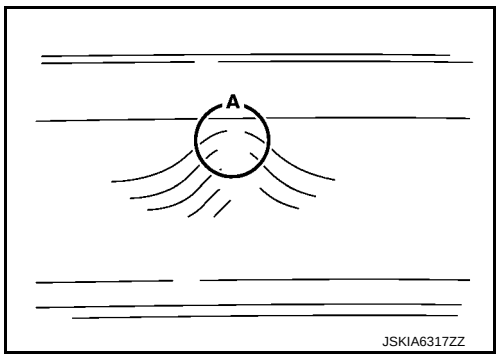
CORRECTING A DEFORMED PANEL

CORRECTING A DEFORMED PANEL : Determining Panel Damage

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Panel damage must be examined carefully to select the most suitable repair method.

(A) In the figure is the plastic deformed area and the surrounding portions are elastic deformed areas.
Correction of (A) will automatically remove the elastic deformation.



Removing the cause of the dent can simplify the entire repair operation. Plastic deformation can be recognized by sharp bending, a nick, or cracked or peeled paint.

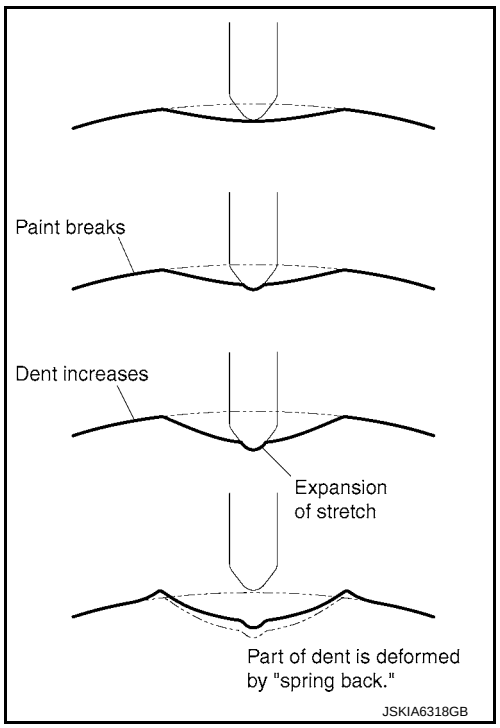
SHEET METAL DEFORMATION ANALYSIS

(a) When external force is applied, sheet metal deformation begins. Elastic deformation is generated around the point where the external force is applied.

(b) As the external force increases, areas surrounding the dent yield to the pressure, and local cracking or small breaks in the paint occur. This indicates plastic deformation.

(c) If the external force continues to increase, breaks around the dent enlarge, and the sheet metal at the center of the dent stretches.

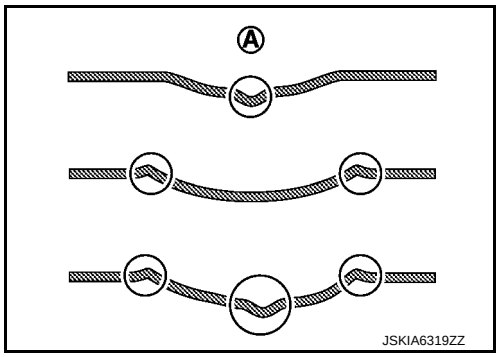
(d) When the external force is removed, the “spring back” causes the plastic deformed portion of the dent to swell above the original surface.



CORRECTING A DEFORMED PANEL : Basic Types of Damage

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- Plastic deformation forms at the center of portion (A) of the dent. The surrounding area remains in elastic deformation.
- Plastic deformation occurs at one or several portions around the dent. Other areas remain in elastic deformation.
- Both plastic and elastic deformation are generated throughout the damaged panel.



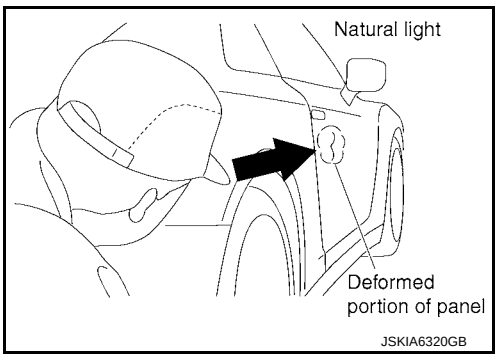
CORRECTING A DEFORMED PANEL : Examination of Panel Damage

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It is difficult to find minor deformation or panel irregularity, particularly, at the final stage of repair. This section explains how to determine if a vehicle has minor panel deformation.

(1) VISUAL CHECK

Check the affected portion of the panel by carefully examining the deformation in the light reflected on the surface.

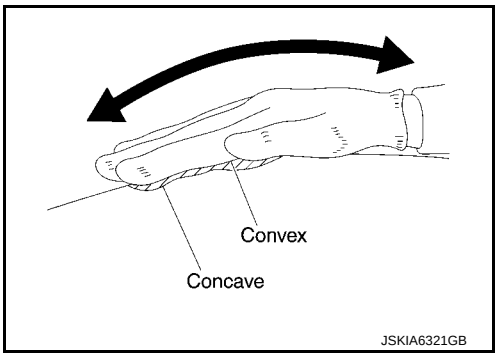


(2) TOUCH CHECK

Lightly place a hand on the surface of the panel and move it forward/backward and right/left to judge by touch with the palm of a hand. Slide and move a hand from an undamaged surface to a damaged part, all the way to the undamaged surface on the other side.

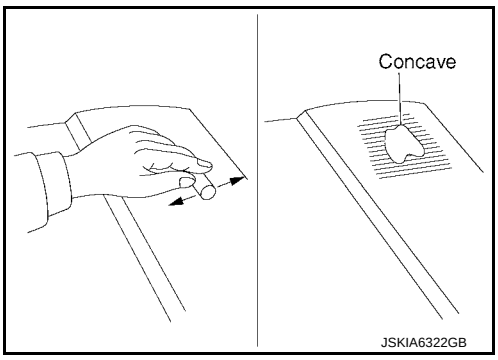
NOTE:

Wearing work gloves makes it easier to tell the difference.

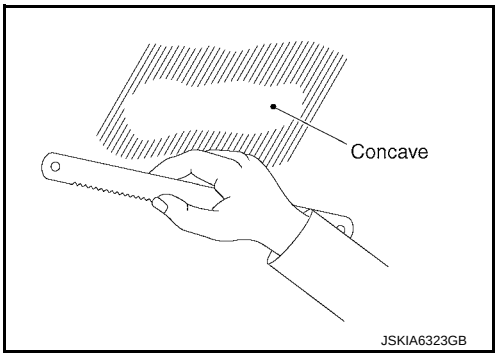


(3) CHECK WITH TOOLS

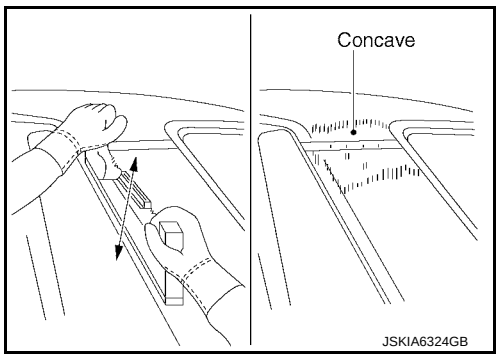
- Use of chalk: Rub the panel surface with a piece of chalk held lengthwise.
  Dents or concave areas in the panel will remain uncolored.



- Use of hacksaw blade: Scrape the panel surface with the blade teeth.
  Dents or concave areas will not be scratched.



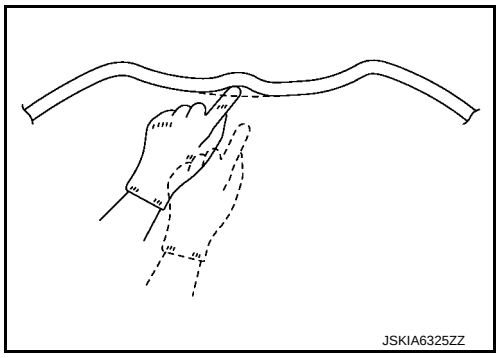
- Use of body file: Scrape a body file lightly on the panel.
  Dents or concave areas will not be scratched.
  The body file should not be used for grinding.
  Thickness and strength of the panel will be reduced.



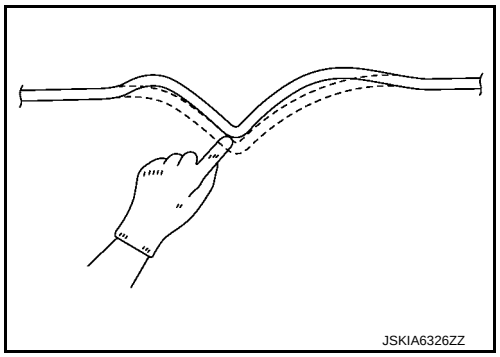
CORRECTING A DEFORMED PANEL : Elastic VS. Plastic Deformation

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- Elastic deformation: If pressed, the deformed portion will move or further deform.



- Plastic deformation: If pressed, the deformed portion will remain unchanged, and other portions will move.

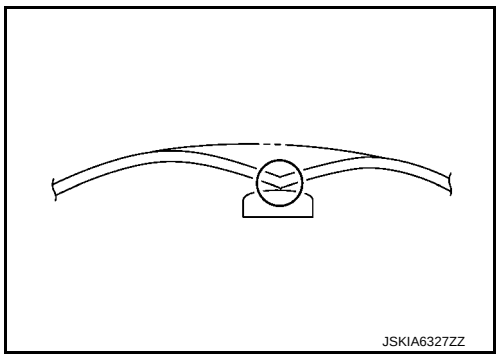


CORRECTING A DEFORMED PANEL : Basic Repair Procedure

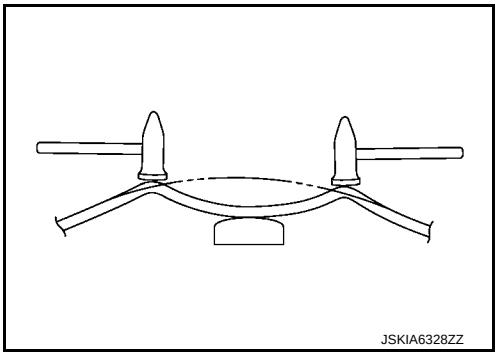
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(1) WHEN PLASTIC DEFORMATION OCCURS AT THE CENTER OF THE DAMAGED PORTION

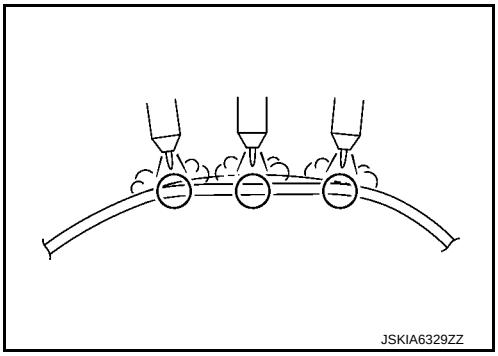
(a) Using a hammer or dolly, strike the lowest portion of the dent from behind until it becomes flat.



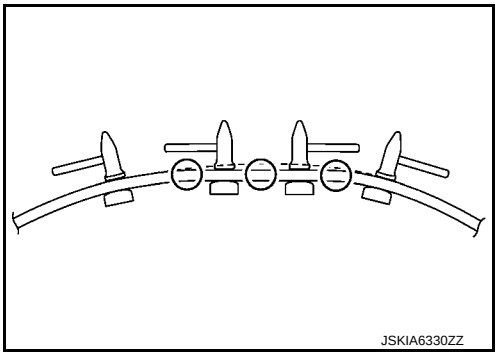
(b) Using the hammer-off-dolly method as shown in the figure, raise the concave portion and lower the convex portion.
Then smooth the surface a little lower than the original. Using a wooden hammer and dolly, correct the irregularities in the panel.


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(c) Existence of plastic deformation can be determined by the stretched panel. The original surface can be restored by shrinking that portion with a gas welding torch.


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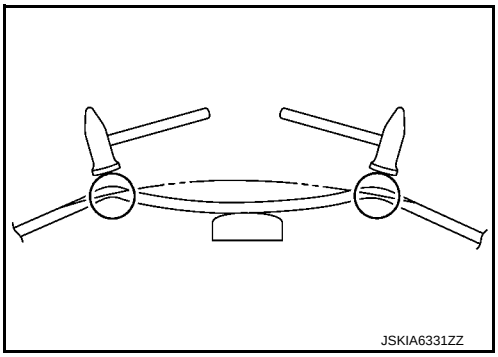
(d) Use a hammer and dolly by the hammer-on-dolly method. Stretch the panel while striking the outer area of the damaged portion. The entire panel surface should be formed somewhat higher than the original surface. Note that, in this case, the stretched portion of the panel must not be hit with the hammer.


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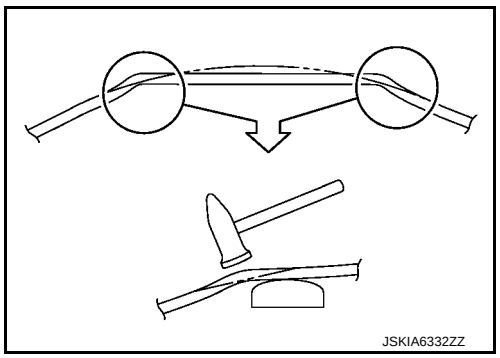
If the concave portion is shallow and if the working face of the wooden hammer matches it, the repair work can be completed quickly by directly shrinking the portion with a gas welding torch.

(2) WHEN PLASTIC DEFORMATION EXISTS AROUND THE DAMAGED PORTION

(a) Apply the dolly to the elastic deformation area behind the panel. Hit the plastic deformation area with a hammer so that the elastic deformation area is lower than the original surface.

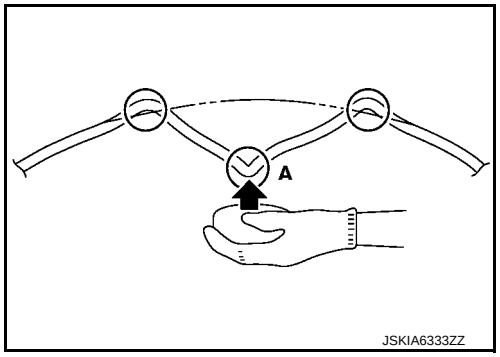

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(b) Repair the plastic deformed portion using the hammer-off-dolly method. If a shrinking hammer is available, the stretched portion can be easily shrunk.

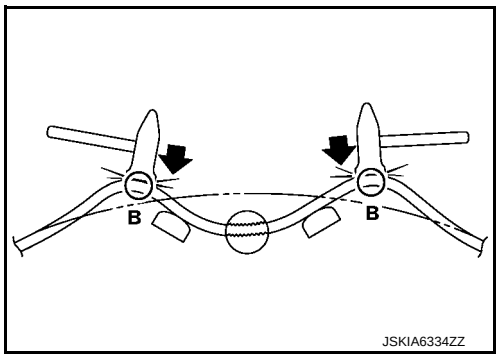


(3) WHEN PLASTIC DEFORMATION EXISTS AT THE CENTER AND AROUND THE DAMAGED PORTION

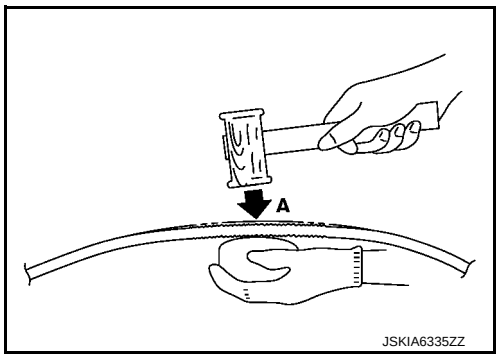
(a) Using a hammer and dolly, flatten the lowest portion (A) where the plastic deformation exists, so that the flattened surface is not higher than the original surface.



(b) Flatten the highest points (B) where plastic deformation exists.

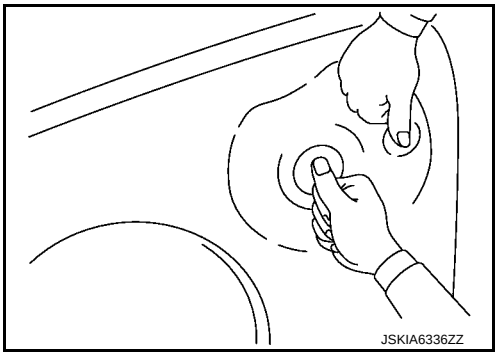


(c) Flatten portion (A) so that the panel surface is not higher than the original surface.
Correct irregularities using a wooden hammer and dolly. If the panel has been stretched, repair by shrinking.

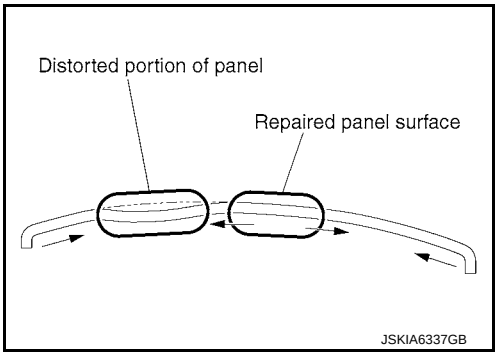


(4) CORRECTING PANEL DISTORTION

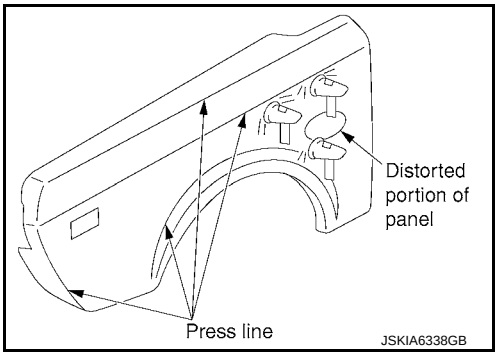
(a) Panel distortion occurs when panel damage is repaired. The panel is deformed within the range of elastic deformation. If pressed with a finger, the deformed area bends inward and outward. Panel irregularities occurring over a wide range other than the repaired portion may also indicate panel distortion.



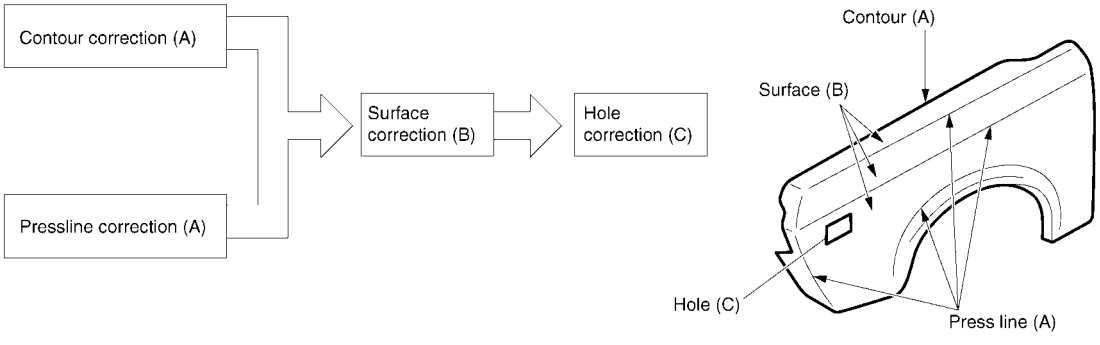
(b) Cause of panel distortion
Expansion stress due to damage repair is confined inside the panel because the outer area is bent and work hardened. Thus, it does not allow the panel to expand. The stress is released in the form of panel distortion.



(c) How to correct panel distortion
Panel distortion can be removed by shrinking the stretched portion or by stretching the side of the press line using the hammer-on-dolly method.



The front fender repair procedure is explained below:



When repairing the body panel, paint and anti-corrosive wax must be thoroughly removed from the damaged area by sanding.

COLORED SHEET METAL WORK

COLORED SHEET METAL WORK : Colored Sheet Metal Work

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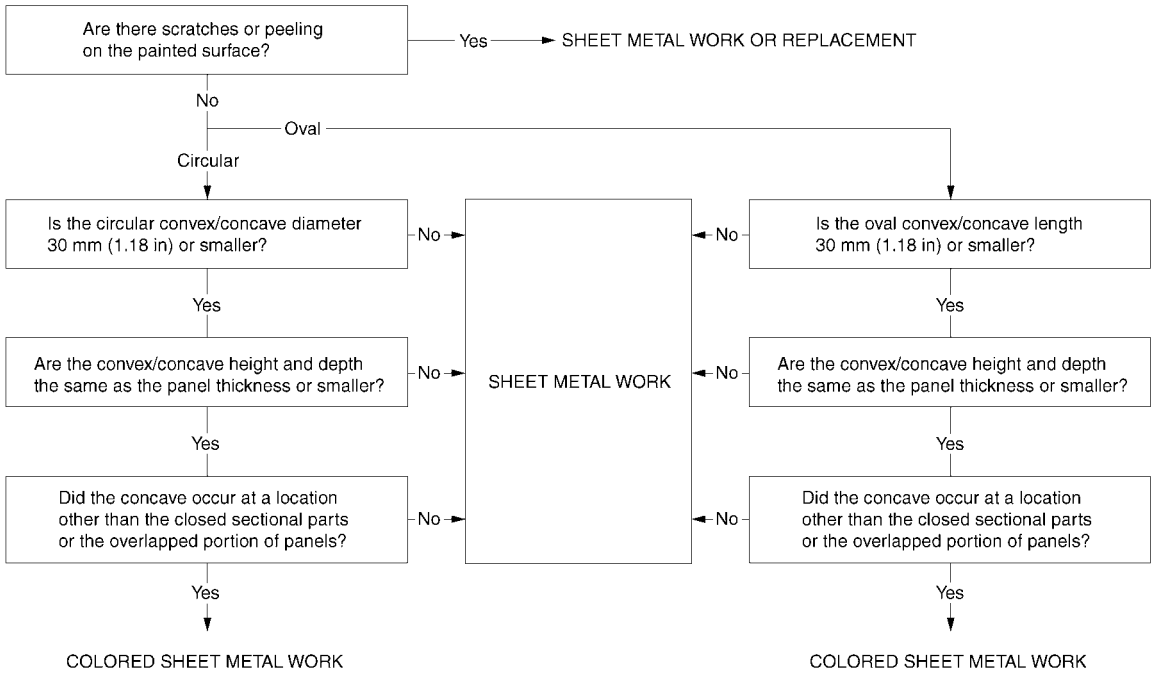
Colored sheet metal work is one type of panel repair technique. This technique is used to repair irregularities on painted outer panels without damaging the painted surface.

COLORED SHEET METAL WORK : Confirmation of The Panel

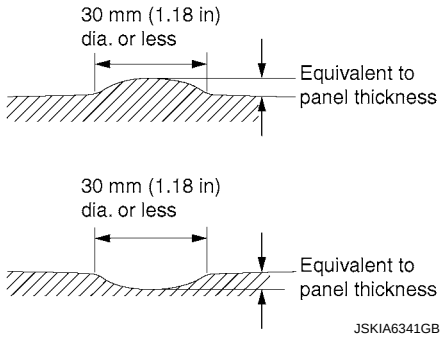
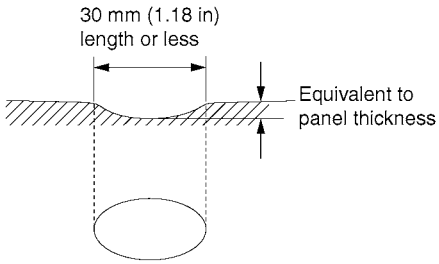
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It is not possible to correct all convex/concave portions in colored sheet metal work.
Whether or not the parts need to be removed/installed, and tools that can be inserted must be checked for each repair location.
When checking the convex/concave location, determine whether or not the colored sheet metal work is possible. It is also important to determine the most suitable repair method.

COLORED SHEET METAL WORK FLOWCHART



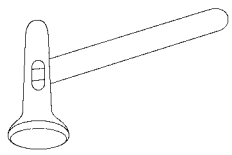
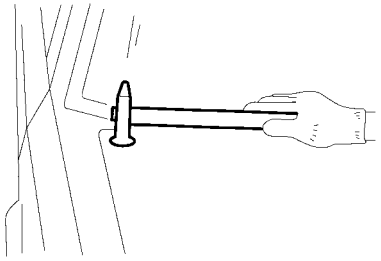
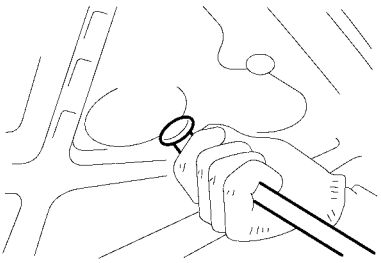
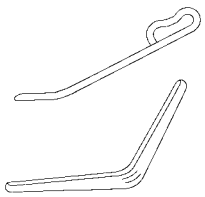
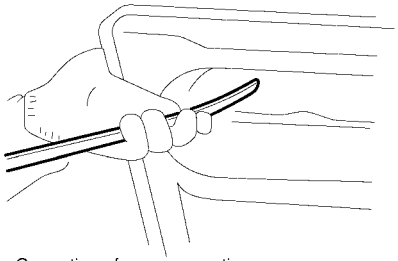
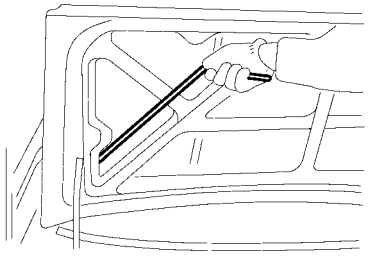
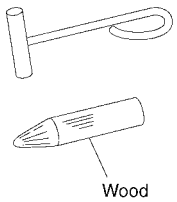
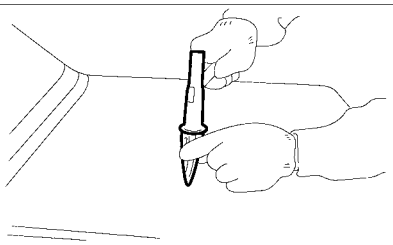
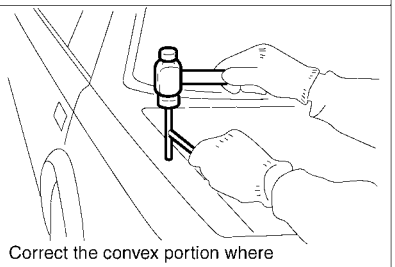
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Example of circular convex/concave	Example of oval convex/concave
	

COLORED SHEET METAL WORK : Selection of Repair Tools

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Tools for colored sheet metal work are hammers, spoons, dollies and punches. Some popular hand tools for colored sheet metal work and application examples are described below.

Hand tool	Usage example	
Hammer 	 Hammer the convex portion where elasticity of panel is not felt.	 Correct by directly pressing the concave portion.
Spoon 	 Correction of concave portion when no fulcrum point is available.	 Correct by inserting a spoon between inner panel and outer panel.
Punch Make by yourself. 	 Correction of the center portion of trunk lid and other sections having elasticity.	 Correct the convex portion where no elasticity is felt, such as upper portion of rear fender.

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Choose suitable tools to repair the panel.

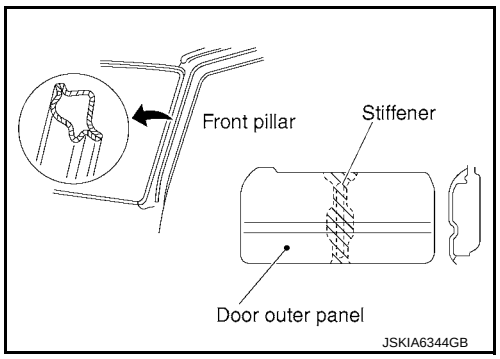
COLORED SHEET METAL WORK : Panel Repair Methods

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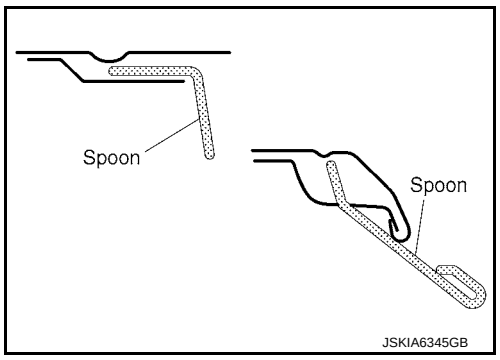
(1) CORRECTION OF CONCAVE PANEL WITH SPOONS

Convex panels can be repaired with a hammer and punch. Concave panels can be repaired with a spoon if the following conditions are satisfied:

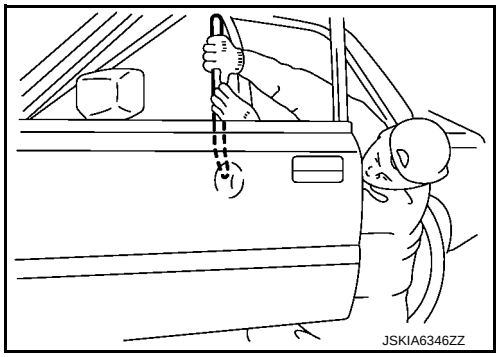
- The spoon must be able to be inserted behind the concave panel. A closed construction portion or mating panel cannot be repaired.



- Use of lever action should be allowed.
  If the surrounding portion of panel can be used to support a spoon as a lever, the concave area can be repaired. Otherwise, corrective force cannot be transmitted to the desired portion.

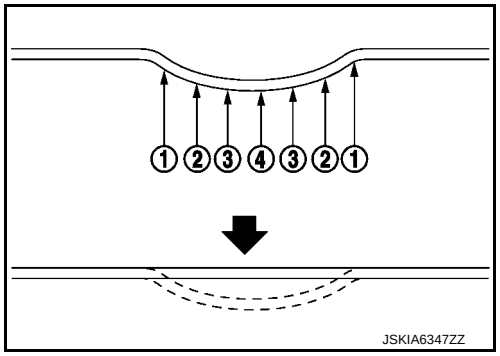


- The concave portion should be visible from outside.
  This work is performed visually, and dents in concealed areas cannot be repaired.

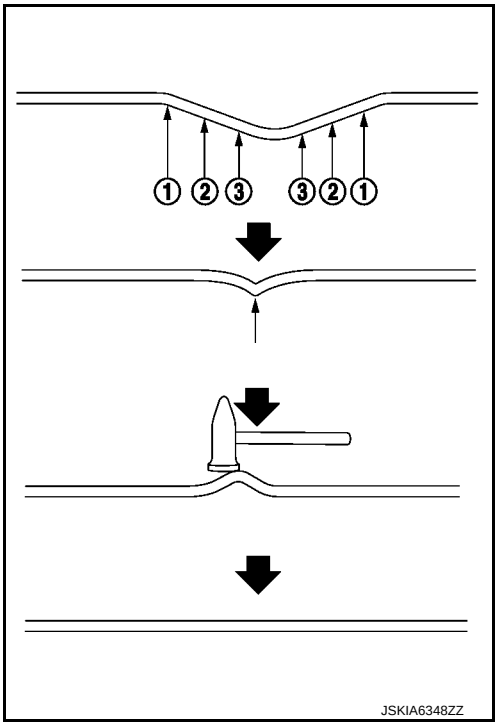


(2) KEY POINTS IN COLORED SHEET METAL REPAIR WORK

- Repairing a smoothly rounded concave section:
  Raise the concave portion little by little, beginning with the outside.



- Repairing a concave section bent sharply at the center:
  First, raise the concave portion 60% - 70%, beginning with the outside. Next, raise the sharply bent portion slightly higher than the surrounding panel surface.
  Then flatten the high point by tapping with a hammer.



- Do not attempt to correct panel deformation all at once.
  Use the step-by-step repair method, such as roughing → smoothing → finishing.
- After repairing, visually check the repaired portion from all directions.

COLORED SHEET METAL WORK : Polishing of Panel Surface and Anti-corrosive Treatment

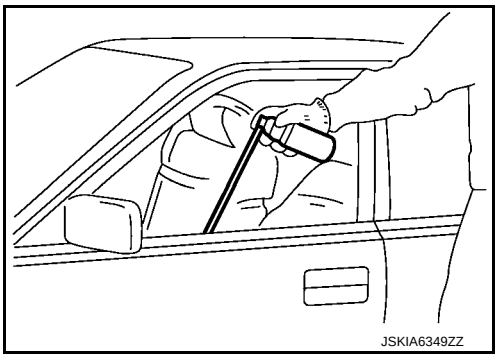
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(1) POLISH-FINISHING OF CORRECTED SURFACE

If the painted surface is scratched during repair, polish with compound to remove scratches.

(2) ANTI-CORROSIVE TREATMENT OF BACK OF PANEL

The spoons may cause scratches. Apply anti-corrosive wax to the back of panel.



COLORED SHEET METAL WORK : Examination of Panel

INFOID:0000000014642483

Irregularities in the panel must be examined carefully to see whether or not they can be repaired, and also to determine the most suitable repair method.
Refer to BRM-25, "CORRECTING A DEFORMED PANEL : Examination of Panel Damage".

BODY WELDING AND PRECAUTIONS

OUTLINE OF WELDING

OUTLINE OF WELDING : Features of Welding

INFOID:0000000014642484

- No restrictions on the shape of joint
- Reduction in weight compared to using of bolts or rivets
- Great strength
- Airtight and watertight
- High working efficiency
- Some welding processes require higher welding skills.
- The welded parts can be separated only by breaking the weld. (Except when brazing)

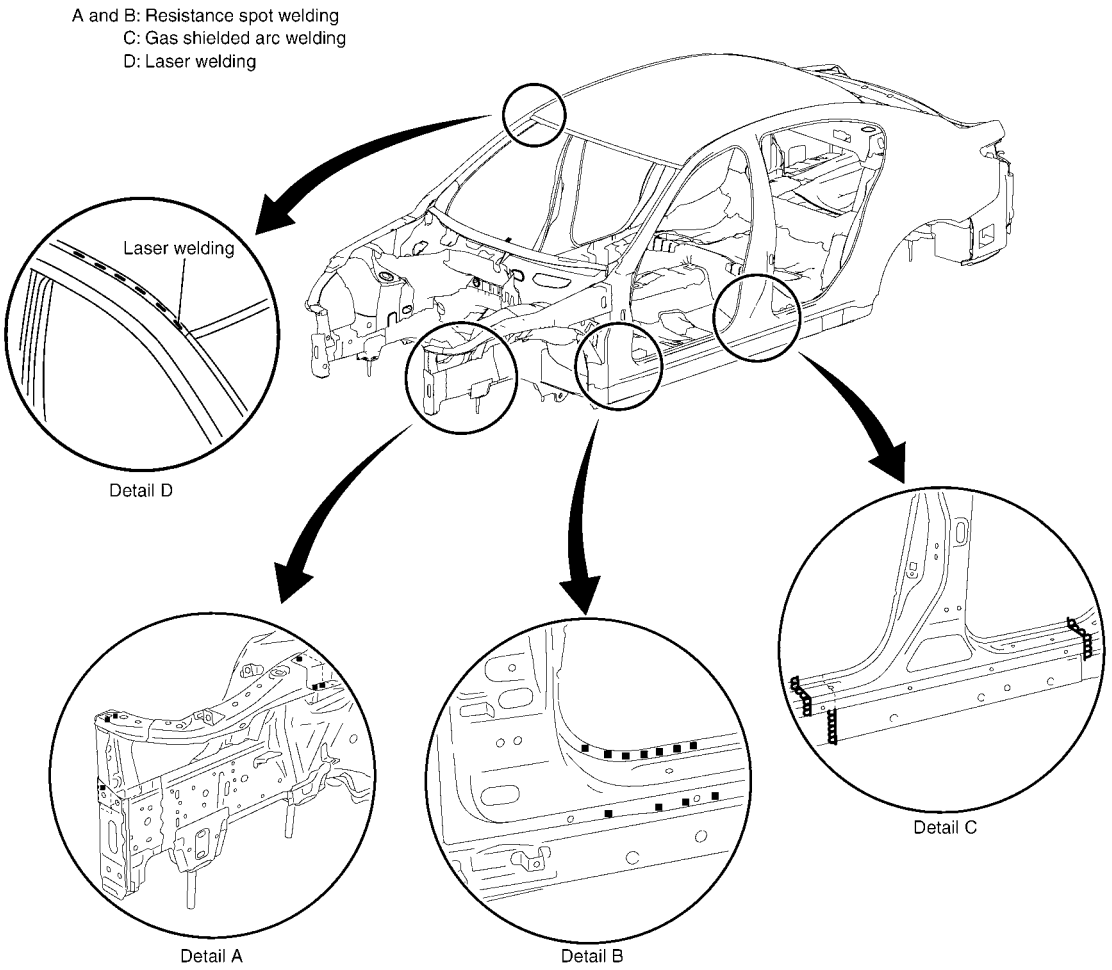
OUTLINE OF WELDING : Welding of Automovile Body

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The automobile body is fabricated by welding 0.6 mm - 1.4 mm (0.024 in - 0.055 in) thick sheet steel. Spot welding is most suitable in terms of cost, quality and working efficiency. On the automobile production line, spot welding is widely used, except for some special areas which cannot use this procedure. Today, spot welding is mostly performed by robots.
In addition to spot welding CO_2 arc welding and brazing are also used.
Soldering is not used in the automobile production line. Brazing is used on the roof joints, front pillar and rear pillar, and on the sealing surface of the center pillar.

Automobile assembly line welding processes are shown below.

Automobile assembly line welding processes are shown below.



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ELECTRIC RESISTANCE SPOT WELDING

ELECTRIC RESISTANCE SPOT WELDING : Principles of Spot Welding

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Resistance spot welding is a kind of electric resistance welding. It is classified as pressure welding. Two or three sheets of metal are overlapped and pressed, and current is passed through the mating surfaces. As the current flows, the metals melt due to Joule heat at the mating surfaces and are joined by the pressure.

ELECTRIC RESISTANCE SPOT WELDING : Features of Spot Welding

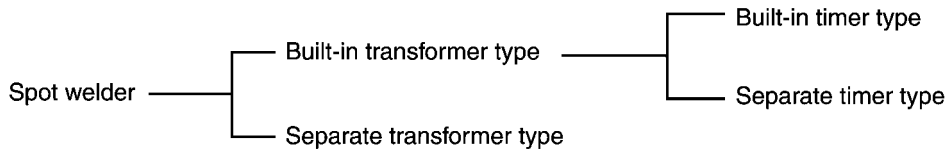
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- Short welding time and high efficiency compared to other welding processes
- Minimum thermal strain due to partial heating
- No need to finish the welded surface
- Less rust formation compared to other welding processes due to application of conductive sealer
- Great welding skill is not needed. Uniform weld strength can be obtained regardless of worker's skill
- Heavy welding machine is required to produce high current
- Most suitable for welding thin sheet metals
- The condition of the weld is difficult to check from the outside
- Paint must be removed from the surfaces to be welded

ELECTRIC RESISTANCE SPOT WELDING : Construction of Spot Welder

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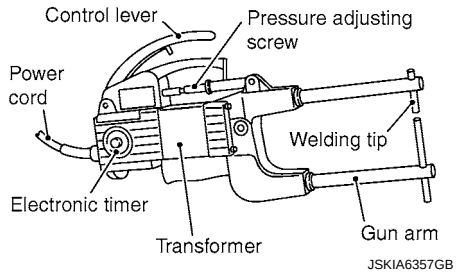
The spot welding machine consists of a transformer unit which supplies the voltage and current required for welding, a timer unit which controls the current passing time, and a welding gun.



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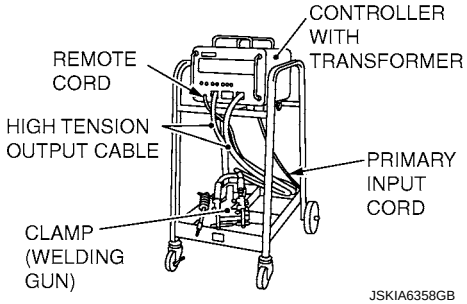
The separate transformer type includes a multi-functional type for welding of pins and washers.

BUILT-IN TRANSFORMER TYPE SPOT WELDER



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SEPARATE TRANSFORMER TYPE SPOT WELDER



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ELECTRIC RESISTANCE SPOT WELDING : Cooling Methods

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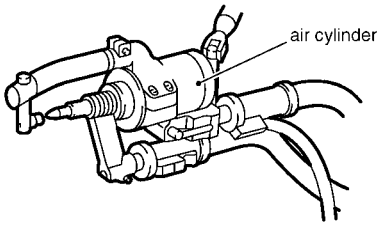
1. Air cooling: Forced air cooling with fan
2. Water cooling: Cooling by circulating the water

ELECTRIC RESISTANCE SPOT WELDING : Spot Welding Gun

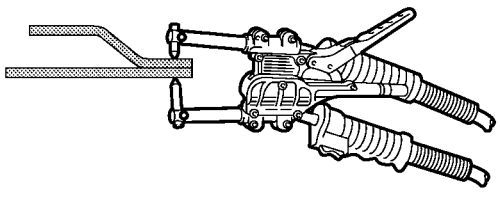
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(1) TYPES OF CLAMP

Air clamp type
Panels are pressurized with compressed air pressure.
The welding pressure can be adjusted by adjusting air pressure.



Manual clamp type
Panels are pressurized manually.
This type of gun is lightweight.

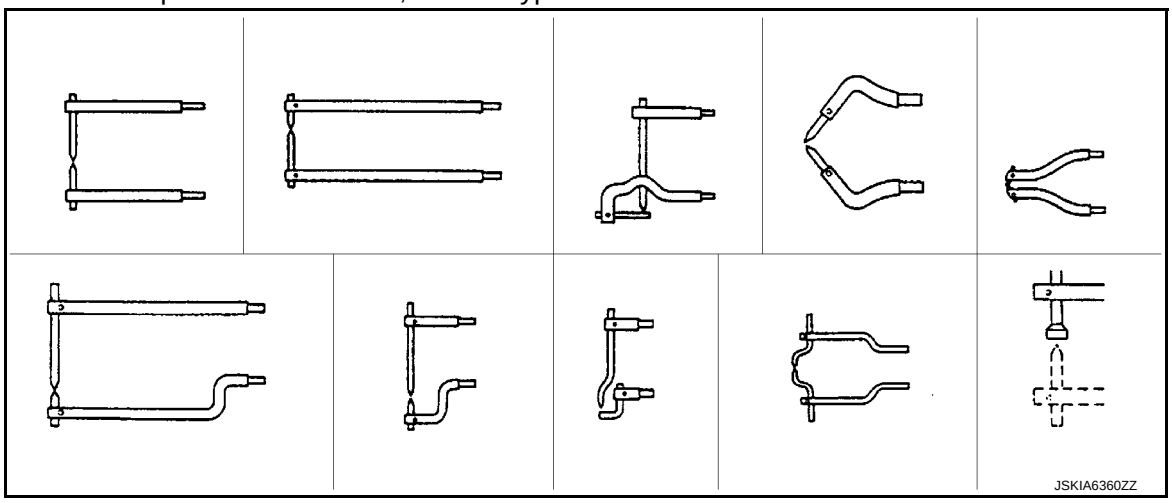


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(2) ATTACHMENT ARM

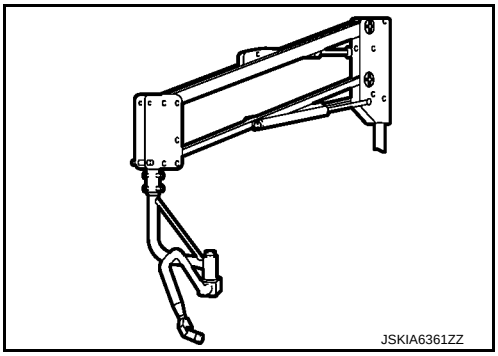
- In spot welding, 2 or 3 panels to be welded must be clamped directly at electrodes. Therefore, the disadvantage of spot welding is that there are some points at which welding cannot be performed.

• In order to make up for this weakness, various types of attachment arms have been created.



(3) HANGING UNIT

• The weight of guns, arms and cables has been reduced to minimize the burdens on workers.
• Depending on the unit type, the cable can simply be hung, or the gun can be hung with a cylinder.

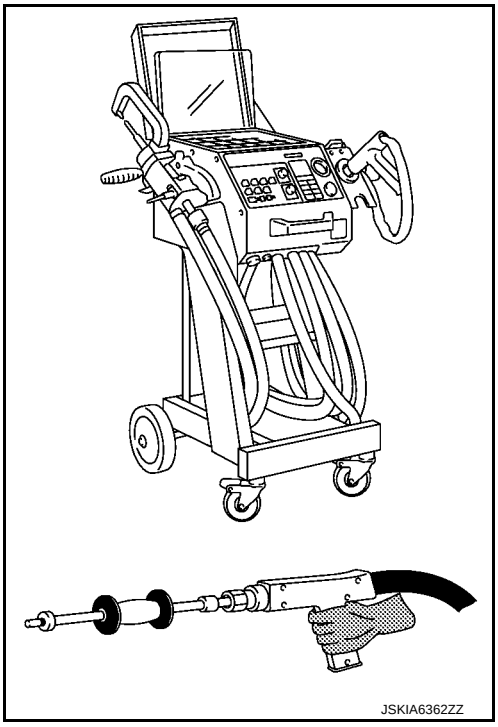


ELECTRIC RESISTANCE SPOT WELDING : Mult-functional Type Spot Welder

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In addition to the ordinary spot welding function, sheet metal can be pulled with the sliding hammer.
Major functions:

• Both sided spot welding
• One sided spot welding (Pre tack welding)
• Spot hammer welding
• Nuts and bolts welding
• Carbon shrinking
• Contact shrinking
• Washer and pin or stud welding



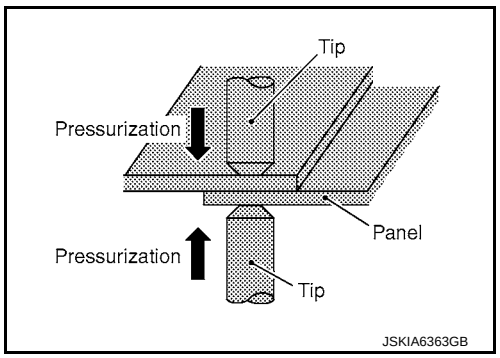
ELECTRIC RESISTANCE SPOT WELDING : Process of Spot Welding

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It takes 3 processes, “pressurization”, “energization”, and “retention”, to complete the spot welding.

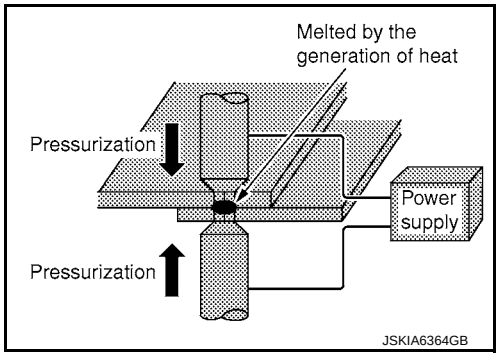
(1) PRESSURIZATION

- The welding points of overlapped panels are pressurized with the tip (electrode) for close contact.
- With the panels contacting closely, the current can run intensively.



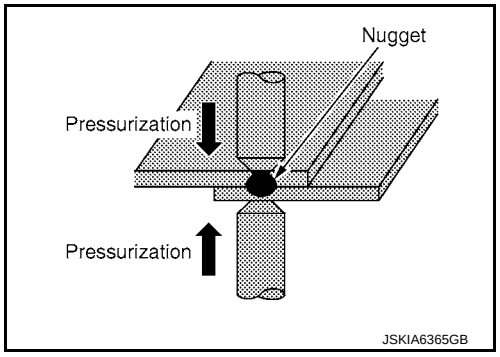
(2) ENERGIZATION

- With the panels being pressurized, heavy current is applied.
- Joule heat is generated at panel mating areas, and the temperature rises sharply.
- The panel mating areas are melted and fused together by welding pressure.



(3) RETENTION

- Even after the current is turned off, pressure is still applied until the welded point cools down.
- The nugget system becomes delicate by pressurization, resulting in better mechanical properties.
- Therefore, the retention process must not be omitted.



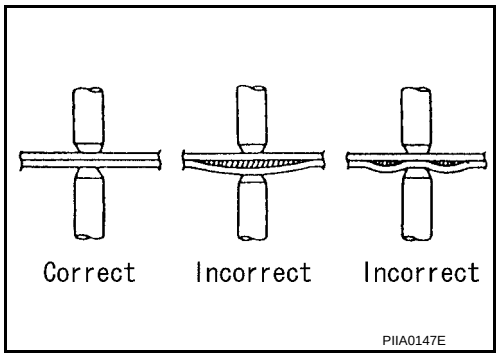
ELECTRIC RESISTANCE SPOT WELDING : Condition of the Panel

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Before beginning, thoroughly check the panel and make any necessary corrections.

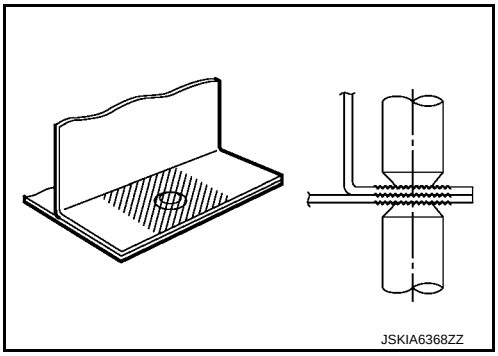
(1) CLEARANCE BETWEEN WELDING SURFACES

Gaps between the surfaces to be welded cause poor current flow. Even if welding could be done without removing such gaps, the welded area would be smaller, resulting in poor strength.
Flatten the two surfaces to remove the gaps, and clamp them tightly before welding.



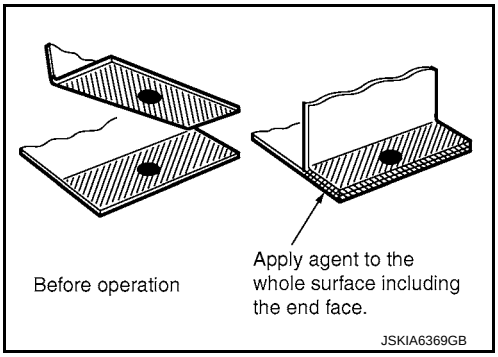
(2) PANEL SURFACES TO BE WELDED

Paint, rust, dust, or any other contamination on the panel surfaces to be welded cause insufficient current flow and poor results.
Remove such foreign matter from the surfaces to be welded by sanding or wiping clean.
Do not remove electrodeposited coatings.



(3) CORROSION PREVENTS PROPER WELDING OF PANEL SURFACES.

Coat the surfaces to be welded with an anticorrosion agent that has high conductivity.
It is important to evenly apply the agent to the panel including the end face.
Perform the spot welding before the anticorrosion agent gets dry, as the agent has generally low conductivity.
Because the wet agent can move from the welding portion due to the welding pressure, that leads to the good quality of spot welding by high conductivity.

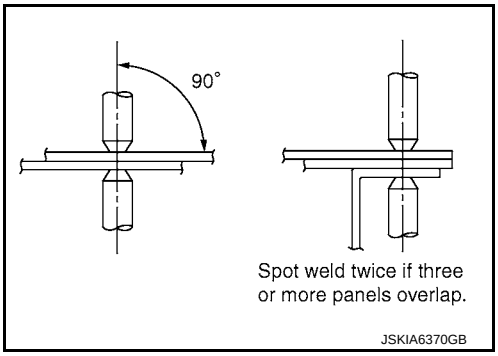


ELECTRIC RESISTANCE SPOT WELDING : Precautions when Performing Spot Welding

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(1) SELECTION OF SPOT WELDING MACHINE

Use the direct welding method whenever possible.
(When direct welding cannot be applied, use MIG/MAG plug welding.)



(2) APPLICATION OF ELECTRODE TIPS

Apply electrodes at right angles to the panel. If they are not applied properly, the current density will be low, resulting in poor welding strength.

(3) LAP WELDING OF MORE THAN TWO PANELS

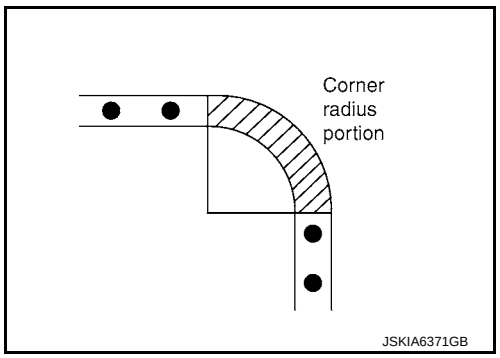
Where three or more panels overlap, spot welding should be done twice.

(4) NUMBER OF SPOT WELDING POINTS

Generally, the capacity of repair shop spot welding machines is smaller than that of factory welding machines. Accordingly, the number of points of spot welding should be increased by 20% - 30%.

(5) WELDING CORNERS

Do not weld the curved corner. Welding this portion results in stress concentration, which leads to cracks.
Examples:
- Upper corner of front and center pillars
- Front upper portion of rear fender
- Corner portion of front and rear windows

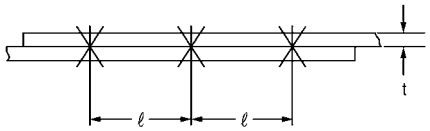


(6) MINIMUM WELDING PITCH

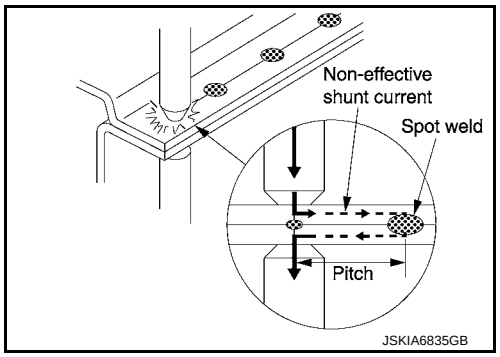
The minimum welding pitch varies with the thickness of panels to be welded. In general, observe the values in the following table.

Unit: mm (in)

Thickness (t)	Minimum pitch (ℓ)
0.6 (0.024)	10 (0.39)
0.8 (0.031)	12 (0.47)
1.0 (0.039)	18 (0.71)
1.2 (0.047)	20 (0.79)
1.6 (0.063)	27 (1.06)
1.8 (0.071)	31 (1.22)

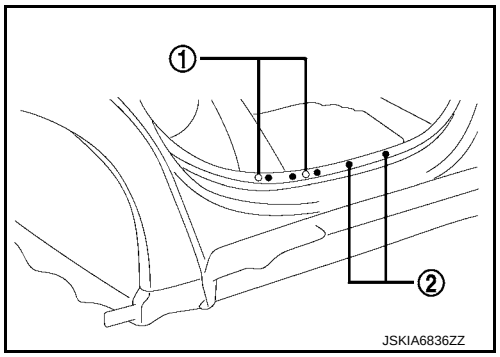


NOTE:
The excessively small pitch allows the current to flow through surrounding portions, resulting in poor welding strength.



Avoid welding over previously welded areas.

① **Old Spot Locations**
② **New Spot Locations**

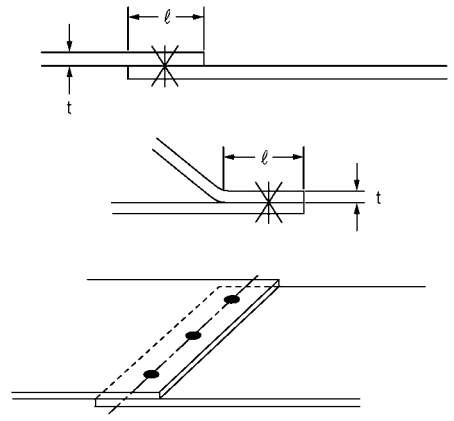


(7) MINIMUM LAP OF PANELS

Observe the following values for the lap distance of panels. Too short of a lap distance results in reduced strength and also in a strained panel.

Unit: mm (in)

Thickness (t)	Minimum pitch (ℓ)
0.6 (0.024)	11 (0.43)
0.8 (0.031)	11 (0.43)
1.0 (0.039)	12 (0.47)
1.2 (0.047)	14 (0.55)
1.6 (0.063)	16 (0.63)
1.8 (0.071)	17 (0.67)

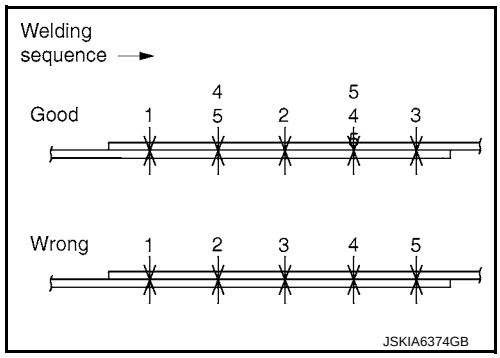


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NOTE:
Be sure to spot weld at the center of the overlapped portion.

(8) SPOTTING SEQUENCE

Do not spot weld continuously in one direction only. This causes weak welding due to the shunt effect of the current. If the welding tips become red-hot, stop welding and cool the tips.



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ELECTRIC RESISTANCE SPOT WELDING : Inspection of Welded Portion

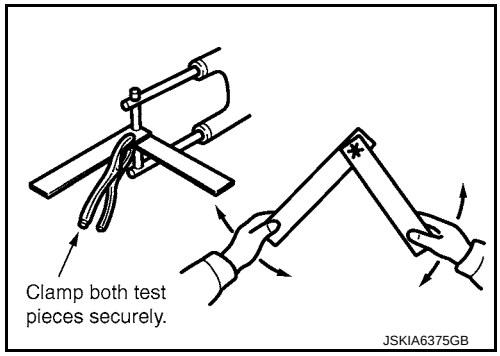
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Spot welded portions can be checked by the destructive inspections explained below. They can be easily adopted when welding. Before and after welding, you should perform these destructive inspections to check the strength of the welded portions.
The welding spots should be equally spaced and arranged at the center of the flange to be welded.

(1) CHECK BY USING TEST PIECE (Confirmation before operation)

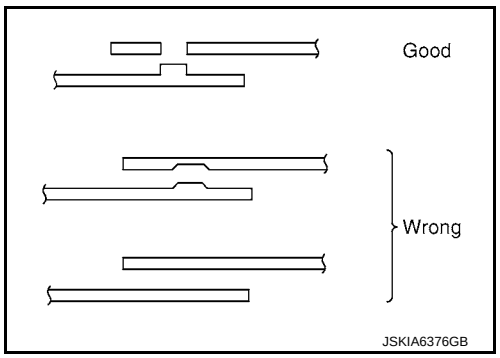
NOTE:
Clamp both test pieces together so that they will not slip or move during welding.

(a) Weld together test pieces with the same thickness as the panel to be welded.
Break the weld by twisting, and examine the break.



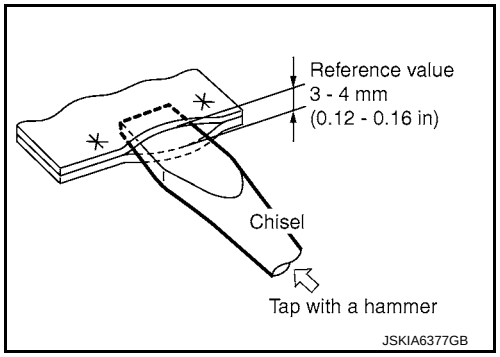
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(b) With this test, a hole should be made on one test piece by tearing at the welded portion. If no hole is formed, it indicates that the welding conditions are incorrect. Adjust the pressure, welding current, current passing time and other conditions, and repeat test until the best result is obtained.



(2) CHECK BY USING CHISEL AND HAMMER (Confirmation after welding)

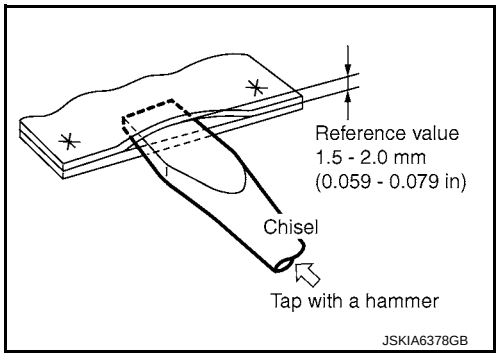
(a) Insert a chisel tip between the welded panels, and tap the end until a clearance 3 mm - 4 mm (0.12 in - 0.16 in) [when the panel thickness is 0.8 mm - 1.0 mm (0.031 in - 0.039 in)] is formed between the panels. If the welded portions do not separate, it indicates that the welding has been done properly.



This clearance varies with the location of the welded spots, length of the flange, panel thickness, welding pitch, and other factors. Note that the value shown above is only for reference.

(b) If the thickness of the panels is different, the clearance must be limited to 1.5 mm - 2.0 mm (0.059 in - 0.079 in). Further opening of the panels can become a destructive test.

(c) Be sure to repair the deformed portion of the panel after inspection.



ARC WELDING

ARC WELDING : Arc Welding

INFOID:0000000014642496

Arc welding uses the heat of an electric arc to join two pieces of metal by fusing both the metal and the electrode. For auto repair, MIG (Metal Inert Gas) and MAG (Metal Active Gas) are the types of arc welding most often used.

ARC WELDING : Principles of MIG and MAG Arc Welding

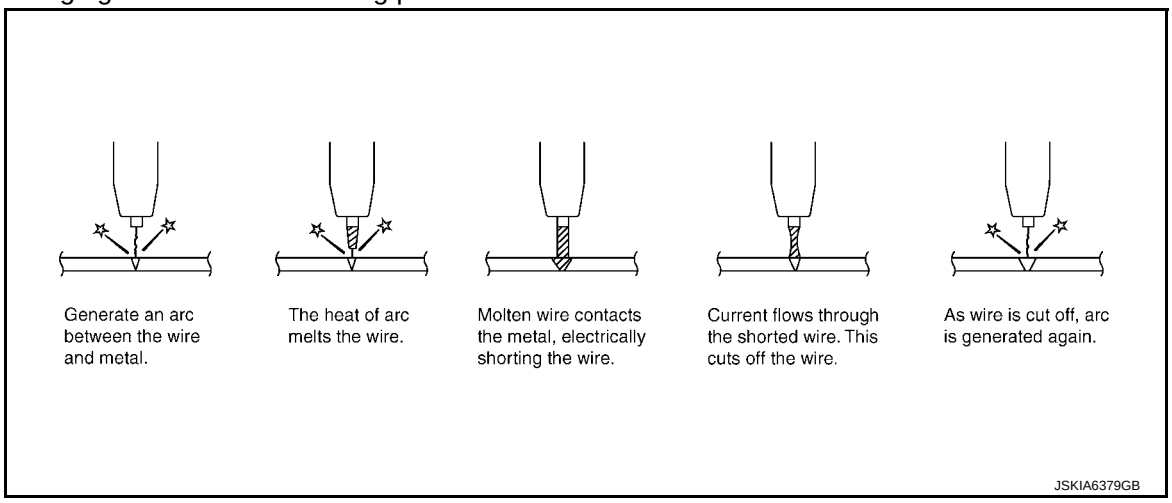
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The welding electrode consists of a wire wound on a reel. This welding wire is fed by an electronically controlled motor.

The welding zone is shielded from the atmosphere by injecting a shielding gas. This prevents oxidation and nitriding so that greater weld strength and a good weld bead can be obtained. The shielding gas is argon, CO_2, or a mixture of both.

MIG arc welding uses argon gas as a shield. If CO_2 is used, the method is called MAG arc welding. Use of argon gas permits most metals, including aluminum, copper, stainless steel, titanium, to be welded.

The following figure shows the welding procedure.



ARC WELDING : Features of MIG and MAG Welding

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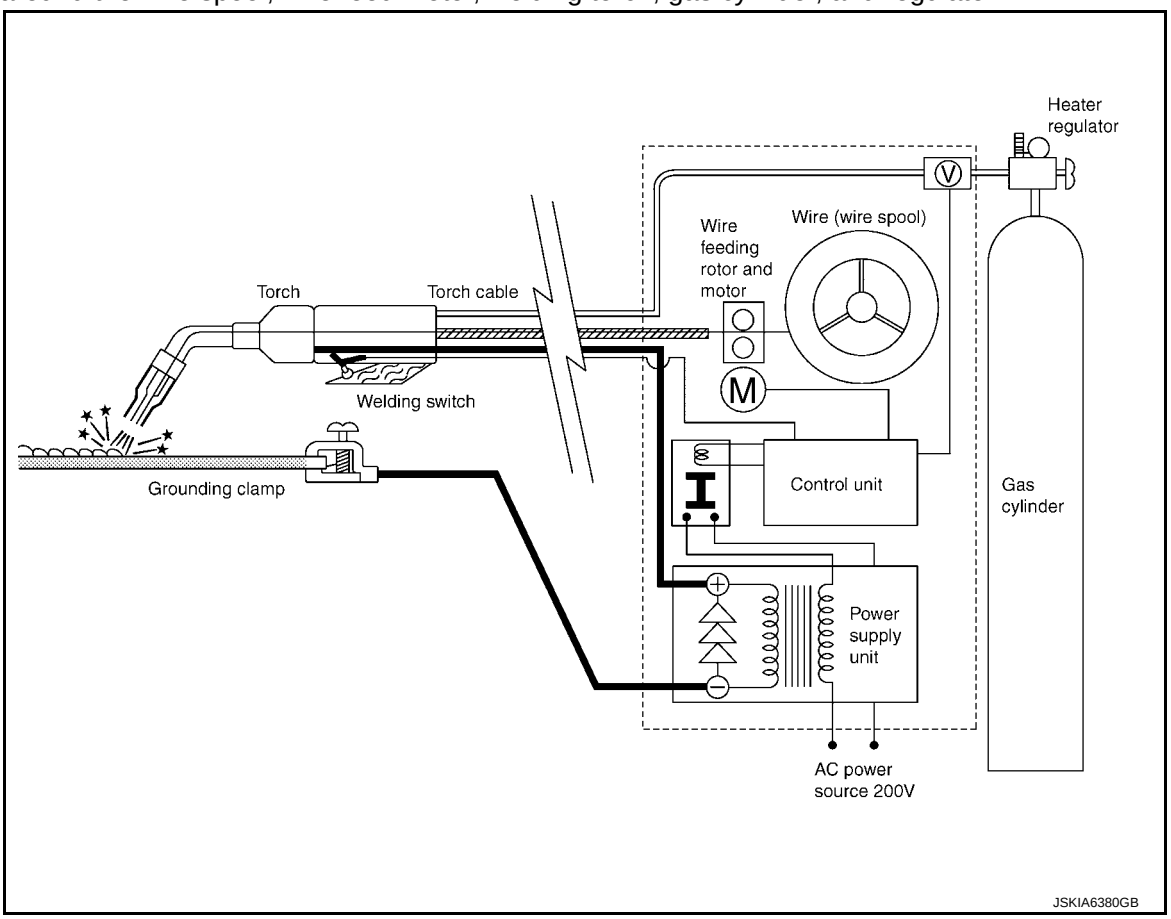
- Less slag
- Less thermal strain
- Comparatively easy to master
- Greater weld strength than gas or spot welding
- Suitable for thin sheet metal
- Less influence of welding position to the strength of weld
- Not suitable for windy locations

ARC WELDING : Structure of MIG and MAG Welding Machine

INFOID:0000000014642499

The welding machine consists of a power supply unit composed of a transformer and rectifier which converts the source voltage to welding voltage and rectifies the current. A controller which controls the voltage, current

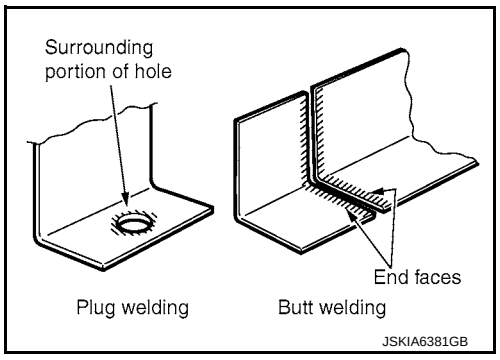
and welding wire feed speed corresponding to the thickness of the welding panel. Welding wire which is wound around the wire spool, wire feed motor, welding torch, gas cylinder, and regulator.



ARC WELDING : Condition of Panel to be Welded

INFOID:0000000014642500

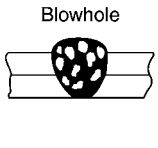
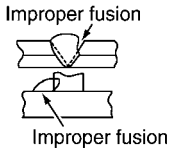
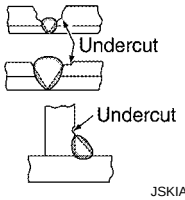
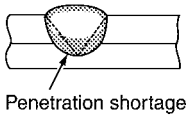
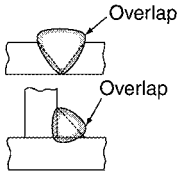
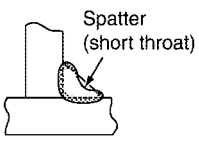
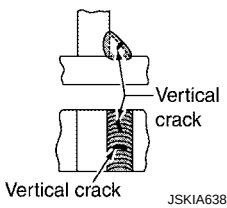
Paint, rust, or oils on the surface of the panel cause blowholes and spatter when the panel is welded. Thoroughly remove any foreign matter with a belt sander or wire brush.
Do not remove electrodeposited coatings.



ARC WELDING : Inspection of Welded Portions

INFOID:0000000014642501

Refer to the inspection method for spot welding. Refer to BRM-42, "ELECTRIC RESISTANCE SPOT WELDING : Inspection of Welded Portion".
Sample defects and welding conditions of MIG, MAG welding.

Defect	Check points	Remarks
 JSKIA6382GB	• Is correct wire selected? • Is gas sealed properly? • Is weld joint surface clean? • Is weld zone quickly cooled?	A hole is made when gas is trapped in the weld metal.
 JSKIA6383GB	• Is torch feed operated properly? • Is voltage low? • Is the area to be welded clean?	This is an unfused condition between weld metals or between deposited metals.
 JSKIA6384GB	• Is current too great? • Is torch feed too fast? • Is torch angle correct?	• Undercut is a condition where the overmelted metal has made grooves or an indentation. • Metal's section is made thinner, and therefore the weld zone's strength is severely lowered.
 JSKIA6385GB	• Is current too little? • Is wire feed out of order? • Is extrude extension too long? • Is groove face too small?	This is a condition where there is poor deposition made under the panel.
 JSKIA6386GB	• Is torch feed too slow? • Is current too little?	• Overlap is apt to occur in fillet weld rather than in butt weld. • Overlap causes stress concentration and results in premature corrosion.
 JSKIA6387GB	• Is current too great? • Is correct wire selected?	Spatter is prone to occur in fillet weld.
 JSKIA6388GB	Are there any stains on welded surface (paint, oil, rust)?	Cracks usually occur on top surface only.

ARC WELDING : Types of MIG and MAG Welding

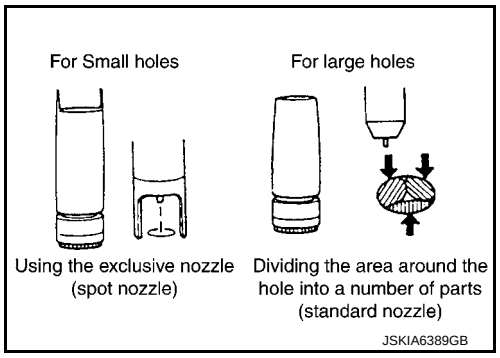
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(1) CONTINUOUS WELDING

This welding process is suitable for sheet steel 2 mm (0.08 in) thick or over. If applied to thinner panels, it will cause melt-through.

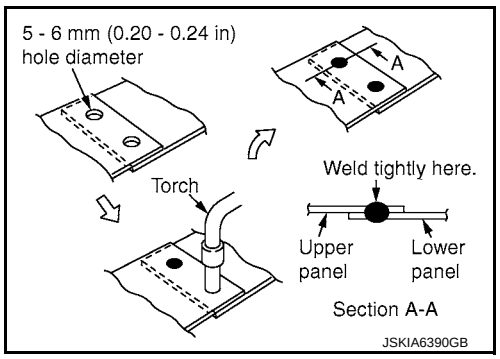
(2) SPOT WELDING

Replace the torch nozzle with a spot welding nozzle.
Grind the surfaces to be welded and press tightly together.



(3) PLUG WELDING

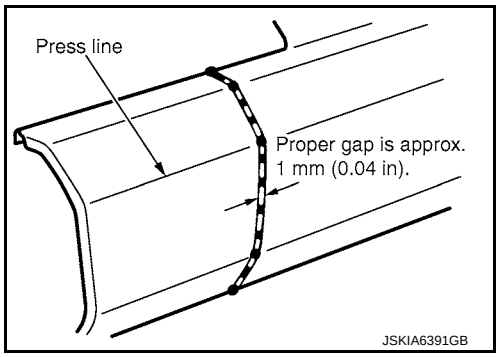
(a) Make a hole 5 mm - 6 mm (0.20 in - 0.24 in) in diameter in the upper of the two panels to be welded. Keep the upper panel and lower panel tightly together.
(b) Apply the torch at a right angle to the panel and quickly fill the hole with the molten metal. Intermittent welding generates oxide film, causing blowholes. If this occurs, remove the oxide film with a wire brush or belt sander.
(c) Weld the upper and lower panels together tightly.



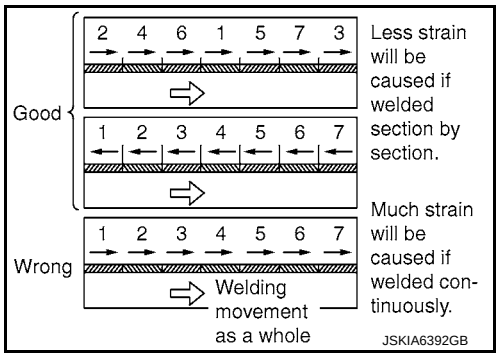
(4) INTERMITTENT (STEP) WELDING

This method is suitable for thin or rusted panels to prevent thermal deformation and melt-through. In body repair, it is used as butt welding on partial panel replacements.

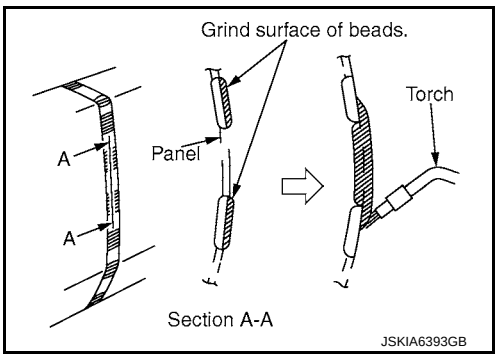
- Before step welding, tack weld the panels to be welded to prevent strain and to align panel surfaces.
  To do this, point weld and then fill in the spaces with short welding beads.



- Long weld line will cause strain. Use the method as shown in the figure to reduce strain.



- To fill the spaces between intermittently placed beads, grind the beads using a sander, then fill with molten metal. If this is done without grinding the surface of the beads, blowholes may result.



SAFETY AND HEALTH
PRECAUTIONS FOR OPERATION

PRECAUTIONS FOR OPERATION : Precautions for Operation

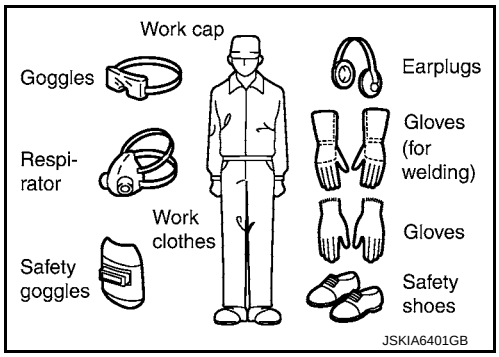
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In body repair, great importance is attached to quality, efficiency and cost. Consideration for workers' safety and health should, however, be deemed as the most important item. In reality, it is essential that measures be established to prevent accidents and to make the work environment safer and healthier.

PRECAUTIONS FOR OPERATION : Protectors

INFOID:0000000014642504

- While working, suitable work clothes, a work cap and safety shoes must be worn. To prevent burns, a long sleeve shirt and trousers must also be worn and must not be taken off under any circumstances.
- Keep work clothes clean. Do not keep a lighter or other flammable materials in pockets.
- During oxygen and acetylene gas welding, to protect eyes wear goggles according to the quantity of infrared rays.
- During arc welding, to protect eyes wear a safety goggles with a shading plate according to the quantity of ultraviolet rays.
- Gloves, apron, foot covers, earplugs and arm covers should be used to prevent burns.



PRECAUTIONS FOR OPERATION : Safety Stand

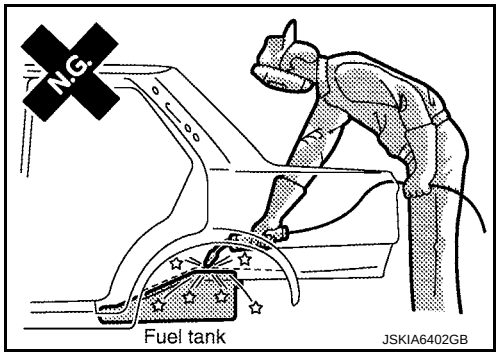
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After jacking up a vehicle body, be sure to support it with the safety stand. For the supporting positions, refer to “Lifting Points” in the Service Manual for each model.

PRECAUTIONS FOR OPERATION : Inflammables

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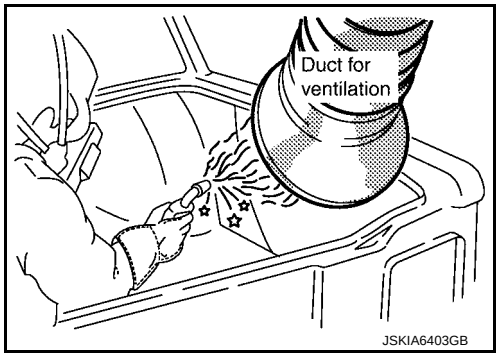
- Before starting repair work, be sure to disconnect the negative terminal of the battery.
- When welding parts near the fuel tank fuel filler, be sure to remove the fuel tank. Plug the filler port of the tank.
- Plug the fuel pipe and brake pipes to avoid leakage when removing connectors from the pipes.



PRECAUTIONS FOR OPERATION : Working Environment

INFOID:0000000014642507

- Pay attention to ventilation and the health of workers.
- Paint and sealant may generate poisonous gases when heated by fire. To prevent this, do not use a gas welder for cutting off damaged portions.
- Use an air saw or an air chisel.
- Use a belt sander or rotary wire brush for removing paint from the panel.

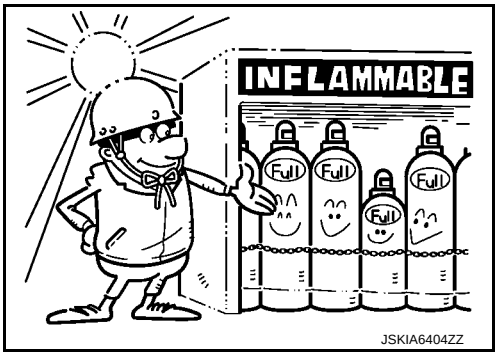


PRECAUTIONS FOR OPERATION : Handling of Welding Equipment

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(1) STORAGE OF GAS CYLINDERS

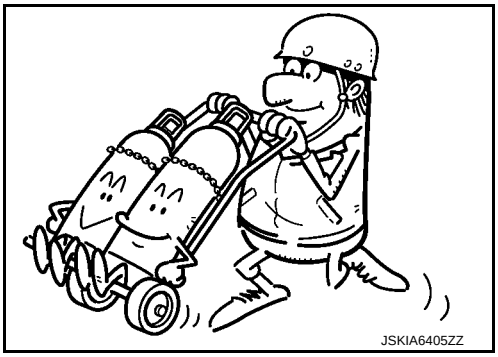
- In a well ventilated area, post a “No Fire” sign.
- Avoid the direct rays of the sun. Maintain temperature below 40°C (104°F).
- Inflammable gas cylinders and oxygen cylinders must not be stored in the same place.
- Acetylene cylinders must be stored upright. Check that they cannot fall down.



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(2) MOVEMENT AND TRANSPORTATION OF CYLINDERS

- Be sure to properly close the valve and securely install the cap.
- Do not drag or roll the cylinder.
- Use a cylinder transportation cart.
- When moving, tilt the cylinder slightly and roll it carefully on the bottom edge with one hand while supporting its cap with the other hand.


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(3) USE OF CYLINDERS

- The cylinder valve must be kept clean and free from oil.
- After opening the cylinder, leave the open-end wrench attached to the valve so it can be turned off quickly in an emergency.
- When the cylinder is replaced, open the valve of the new cylinder slightly and remove dust from around the valve seat.
- To check the cylinder for leakage, apply soapy water.
- The valve should be fully open for oxygen and open 1.5 turns or so for acetylene.
- To prevent the cylinder from falling down, ensure that it is properly secured.
- And never give a shock to the cylinder.

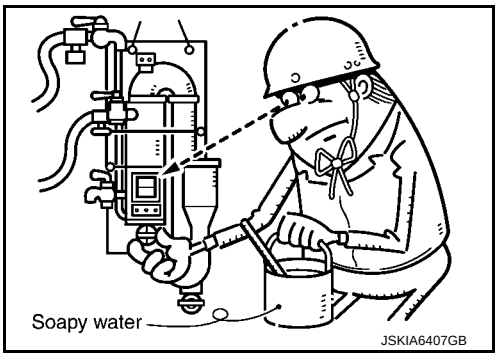

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(4) HANDLING OF THE PRESSURE REGULATOR

- Always handle the pressure regulator with care and avoid impact.
- Inspect the regulator periodically (at least once a year).
- After use, purge the gas, and set the gauge to “0” (except the indoor type pressure regulator).

(5) HANDLING OF WATER-SEALED SAFETY DEVICES

- This device must be installed vertically. Check the water level every morning.
- In case of freezing, antifreeze solution can be added.



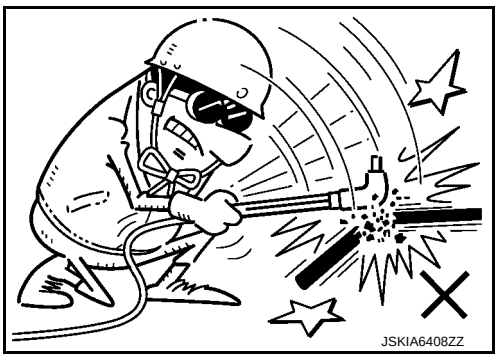
JSKIA6407GB

(6) HANDLING OF HOSES

- All hoses must be checked before use for flaws or leaks.
- Never use the pipe coupling made of copper or 70% copper alloy for the acetylene hose.
- Do not use compressed oxygen to clean the gas hose.
- Do not use any hose that has experienced backfire.

(7) HANDLING OF THE TORCH

- Keep the torch clean and free from oil.
- To replace the nozzle, use a special tool.
- Do not use the torch as a hammer, etc..
- Do not place it directly on the ground or on the floor.
- Check suction of the torch at the end of the inflammable gas pipe coupling.



(8) DANGER OF ARC WELDING ELECTRICAL SHOCK

- Keep cables and connections in good shape.
- Do not place machine in a wet place. Do not stand in a wet place when welding.
- Electrically ground welder. The vise clamp is not an electrical ground connection.

WORKING WITH BODY STRAIGHTENING EQUIPMENT

WORKING WITH BODY STRAIGHTENING EQUIPMENT : Use of Protectors

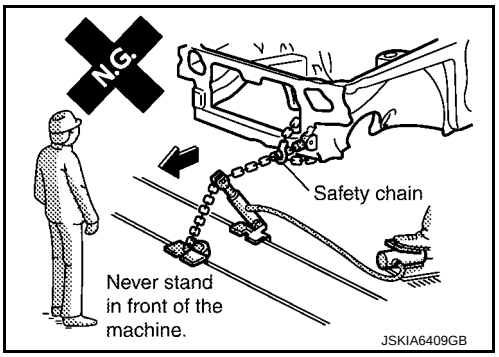
INFOID:0000000014642509

- Use of work clothes should be the same as for “PROTECTORS”. Refer to BRM-49, "PRECAUTIONS FOR OPERATION : Protectors".
- Wear a safety helmet and safety shoes.
- When working under a vehicle or when using a grinder, wear goggles.

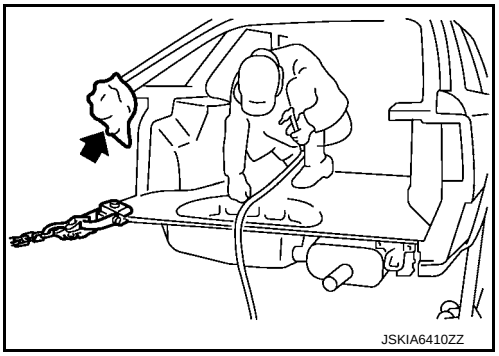
WORKING WITH BODY STRAIGHTENING EQUIPMENT : Precautions while Working

INFOID:0000000014642510

- To prevent danger in case the clamp slips or the panel breaks, be sure to apply a safety chain. Be careful not to stand near the area where the chain is stretched.



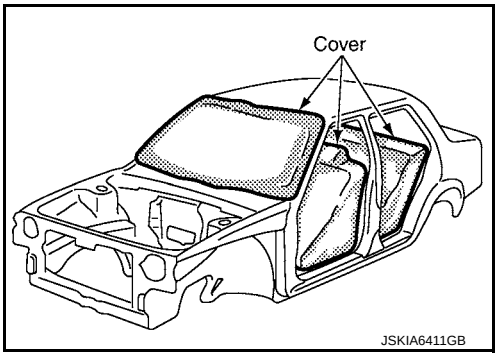
- To prevent danger, any excessive slack in the safety chain must be taken up and properly wound.
- Do not wear a working glove on the hand that is hammering.
- Cracked glass must be removed or taped to prevent separation.
- Any cut panels must be protected with cloth or tape.



WORKING WITH BODY STRAIGHTENING EQUIPMENT : Protection of Vehicle

INFOID:0000000014642511

- The seats and glass must be removed or covered with incombustible material, according to the type of work to be done, to prevent contamination and welding spatter.
- When removing parts, utilize padding (cloth) or protective tape.



WORKING WITH GRINDING THE BODY FILLER (PUTTY)

WORKING WITH GRINDING THE BODY FILLER (PUTTY) : Danger from Dust

INFOID:0000000014642512

If workers continue to inhale dust generated during paint film removal or body filler grinding work for long periods, they may suffer from respiratory insufficiency, which results in pneumoconiosis or asthma.

WORKING WITH GRINDING THE BODY FILLER (PUTTY) : Precautions during Dust Generating Work

INFOID:0000000014642513

- Workers must use a sander equipped with a dust collecting function.
- Workers must work in the facilities where a dust collector is installed on the floor or the wall.

WORKING WITH GRINDING THE BODY FILLER (PUTTY) : Protector and Equipment

INFOID:0000000014642514

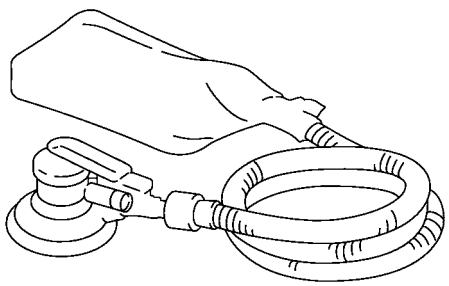
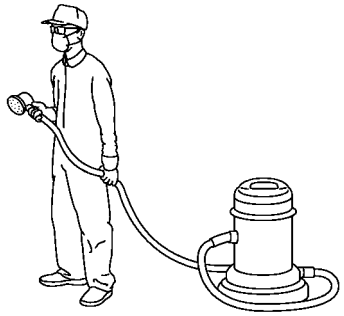
(1) DUSTPROOF RESPIRATOR

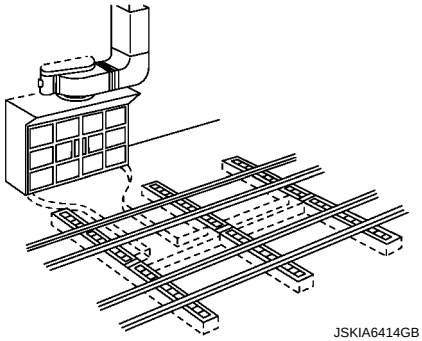
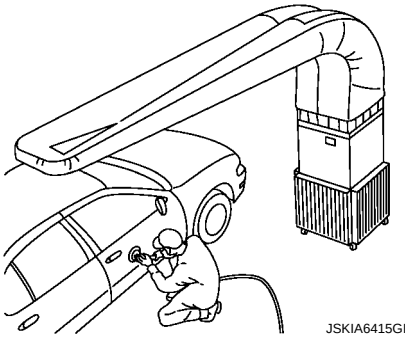
- This is an important protector to prevent workers from inhaling dust.
- The cup type, gauze type, and other types of respirators are available.
- The respirators with the deodorizing function which utilizes activated carbons, or with the exhaust valve to release air can be selected.
- In order to maximize the respirator performance, be sure to cover your nose and mouth.
- Do not use the respirator whose useful life has expired. This is because the function of the respirator has been deteriorated.

(2) DUSTPROOF GOGGLES

- Dustproof goggles prevent dust from entering workers' eyes.
- Goggles which can be worn on top of ordinary eyeglasses are also available.

(3) DUST COLLECTOR

Dustproof sander equipped with dust collecting bag	Dustproof sander hose connected to the industrial cleaner
 JSKIA6412GB	 JSKIA6413GB

Dust collector installed on the floor or the wall	•Dust collected through the filter •Ambient air forcibly circulated
 JSKIA6414GB	 JSKIA6415GB

WORKING WITH GRINDING THE BODY FILLER (PUTTY) : Precautions during Air Blow

INFOID:0000000014642515

- Workers must wear dustproof goggles and dustproof respirators, even during cleaning work after grinding.
- Adjust the pressure for air blow duster gun to prevent dust from being scattered all over the place.
- Be sure not to disturb other workers.

PAINT SAFETY PRECAUTIONS

PAINT SAFETY PRECAUTIONS : Paint Safety Precautions

INFOID:0000000014642516

Observe the following precautions to maintain a safe painting work area.

- Wear an approved respirator and eye protection when painting.
- Wear approved gloves and appropriate clothing when painting. Avoid contact with skin.
- Spray paint only in a well-ventilated area.
- Cover spilled paint with sand or another absorbent material, or wipe it up at once.
- If paint gets in your mouth or on your skin, rinse and wash thoroughly with water. If paint gets in your eyes, flush with water and get prompt medical attention.
- After the painting work is finished, wash your face and gargle with water.
- Paint is flammable. Store it in a safe place, and keep it away from sparks, flames, or cigarettes.

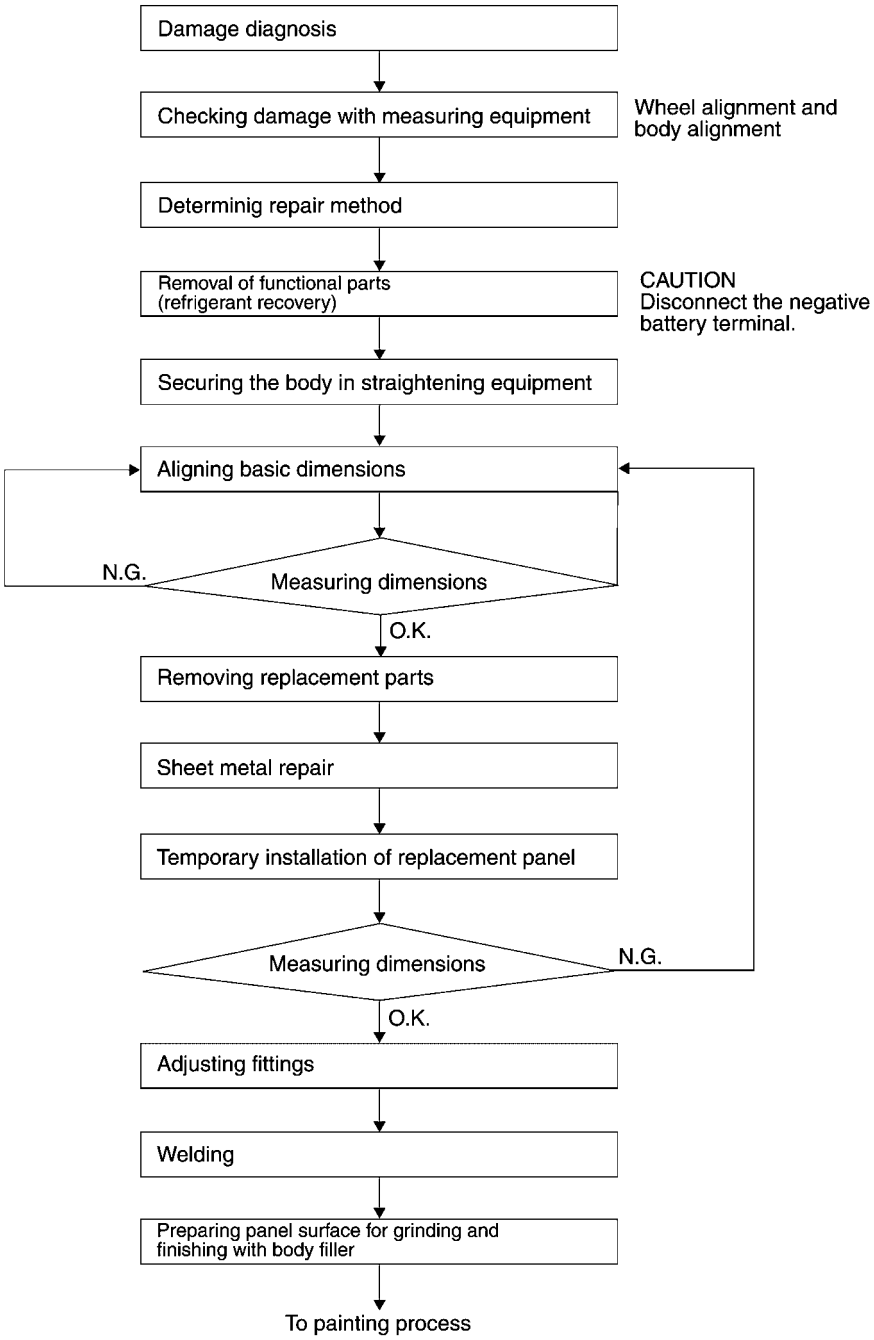
REPAIRING PROCEDURES AND PRECAUTIONS
FUNDAMENTALS OF BODY REPAIR

FUNDAMENTALS OF BODY REPAIR : Fundamentals of Body Repair

INFOID:0000000014642517

There are many kinds of damage caused by collisions.Therefore, the appropriate repair method for the damage should be selected. This section outlines repair methods of major damage and how to use the main tools.

BODY REPAIR FLOWCHART



JSKIA6416GB

DAMAGE DIAGNOSIS

DAMAGE DIAGNOSIS : Damage Diagnosis

INFOID:0000000014642518

The damage must be diagnosed using the following criteria.
- Location of damage
- Range of affected area
- Degree of damage

These three points relate directly to the quality, efficiency and cost of damage repair, and they must be determined correctly.

DAMAGE DIAGNOSIS : Determining Various Conditions of the Collision

INFOID:0000000014642519

- Size, shape, position, rigidity, etc. of the other vehicle involved in the collision
- Speed of both vehicles at the time of collision
- Collision angle and direction
- Number of occupants and their positions at the time of collision
- Size, shape, hardness, etc. of load in the vehicle
- History of damaged portion, date of occurrence, and range of affected area

DAMAGE DIAGNOSIS : External Appearance

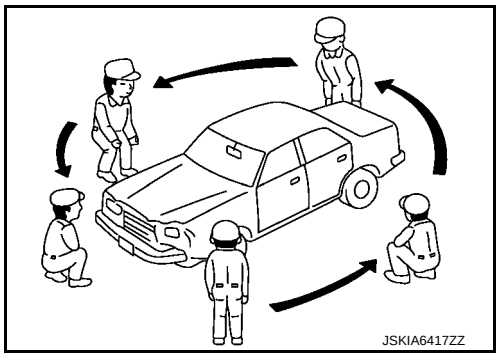
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In body repair work, be careful not to overlook indirect damage. To avoid this, mechanical and structural analysis of the vehicle body is essential.

(1) OBSERVATION OF OVERALL VEHICLE

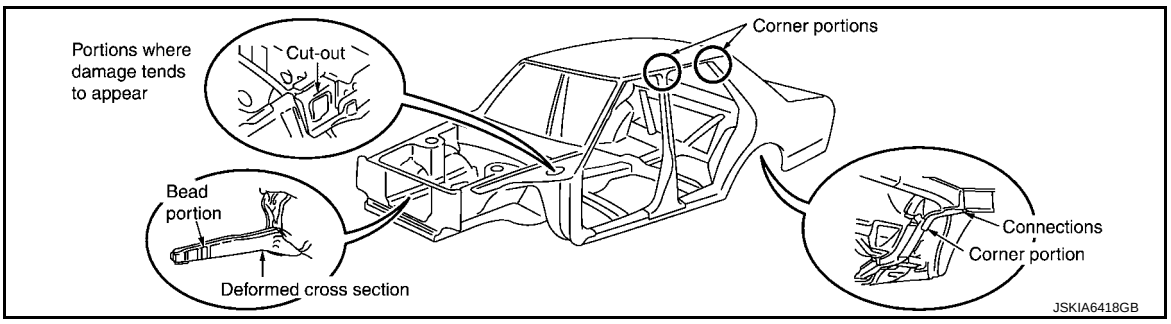
- The extent of the impact damage
- Twisting, bending, and inclination of the whole vehicle
- Amount and location of damage: Check by examining the whole vehicle

Examples
- Cracked or stressed paint
- Cracked or broken glass



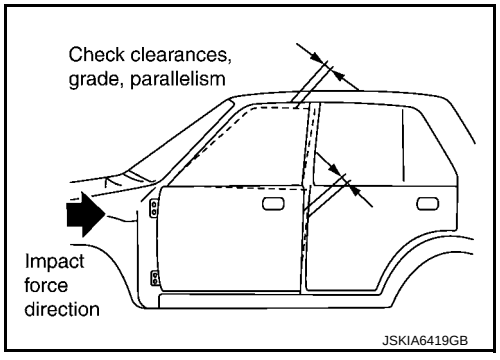
(2) DETAILED OBSERVATION OF VEHICLE

Check for any gaps or dislocation at the welded seams of panels, or cracks in paint film, undercoating or sealing material.



(3) OBSERVATION OF FITTING

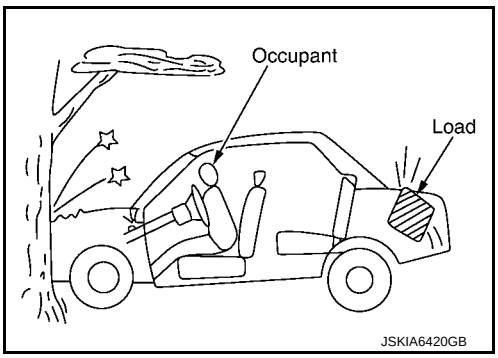
Examine the fit of various portions without lifting them.
Estimate the damage in the pillar and hinge portions.
- Door alignment
- Alignment of hood and trunk lid
- How doors, hood, and trunk lid open and close
- Smooth operation of windows



(4) CHECKING FOR MECHANICAL DAMAGE

Damage analysis also involves inspecting mechanical, steering and suspension parts for damage. When inspecting mechanical parts, look for signs of damage such as

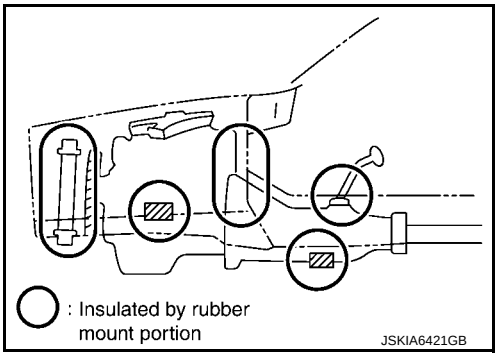
- Bent or damaged parts
- Fluid leaks
- Binding or noise when turning the steering wheel



(5) DAMAGE BY INERTIA

Check indirect damage such as a concave roof in frontend collisions, load damage and damage to the engine, which is insulated by rubber mounts.

- Damaged or misaligned mounting points.



DAMAGE DIAGNOSIS : Key Points in Choosing Repair Methods

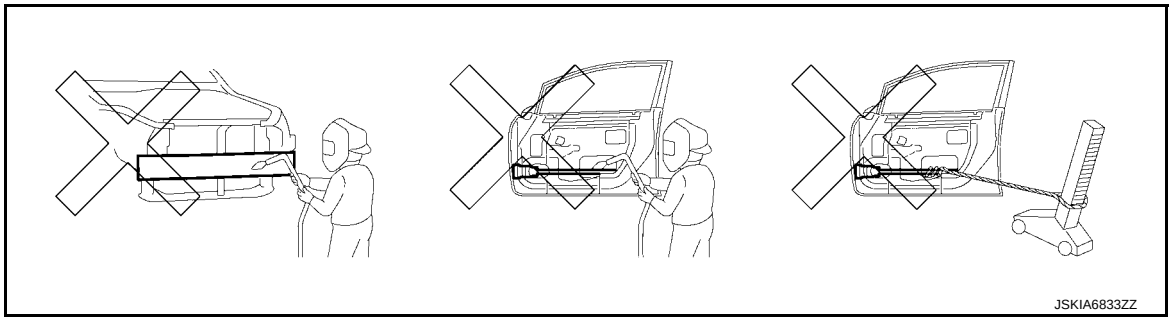
INFOID:0000000014642521

- Do not reduce strength when repairing panels. Avoid excessive hammering which may lead to extending the panel.
  Also avoid prolonged heating.
- Do not increase the strength of impact absorbing portions unnecessarily. Do not patch these parts.
- Choose a method for properly aligning the body.
  For example, if changing the front side member of an FF car, it is recommended that the front suspension mounting member be left alone.
- Examine carefully how past collision damage was repaired. This is necessary to properly decide the range to be repaired.

DAMAGE DIAGNOSIS : Parts to be Replaced

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- High-strength steel parts: The strength of these parts will be reduced if repaired by heating.
- Parts relating to body alignment and wheel alignment: Replacement of such parts would not provide proper alignment.
- When repair costs exceed replacement cost.
- Availability of service parts.
- When asked by customer.
- Repair of door side impact beam and bumper reinforcement is prohibited: Beams and reinforcements must be their original shape to perform as designed. Always replace door side impact beams and bumper reinforcements if damaged.



When performing repair work, it is necessary to consider quality, efficiency and cost, as well as safety and health. It is also important to gain the customer's confidence.

CHECKING DAMAGE

CHECKING DAMAGE : Checking Damage

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When completing body and frame repairs, the front body and underbody dimensions must be correct, because these dimensions directly affect wheel alignment and steering angles.
The degree of damage should be determined by using a steel tape, tram tracking gauge and centering gauge or other measuring device. The measuring points are shown in the Body Repair Manual for each model. Wheel alignments are shown in the Service Manual for each model.

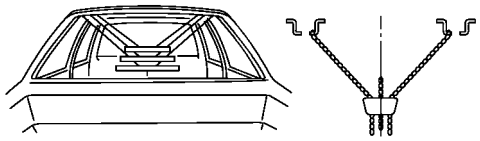
CHECKING DAMAGE : Centering Gauge

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Suspend the body so that it is symmetrical to the frame member. Check for bending or twisting in the body.

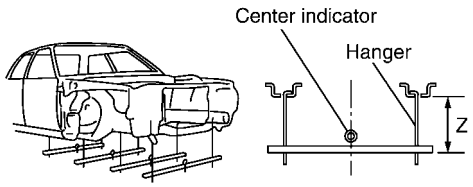
(1) TYPES

Chain type



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Bar type

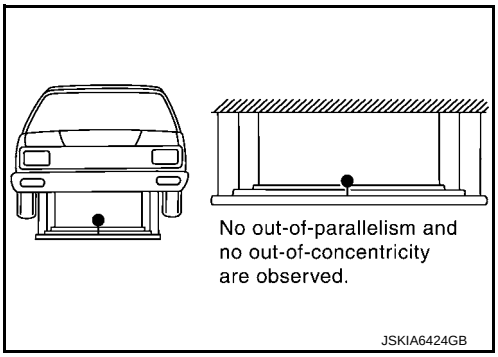


Z: Distance shown is the underbody point in the BRM for each model.

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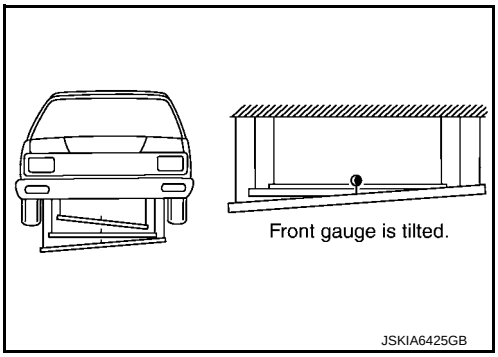
(2) DETERMINING STATE OF DEFORMATION

- Normal state
  The horizontal bar and center target are in their correct positions.



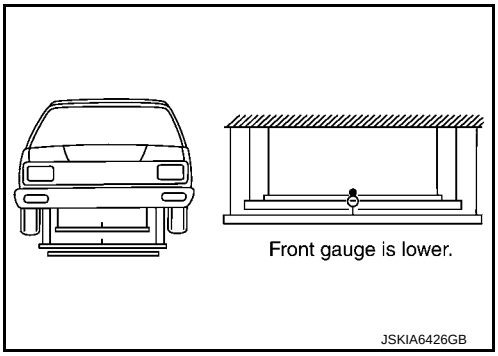
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- Twist
  The horizontal bar is tilted on both ends.

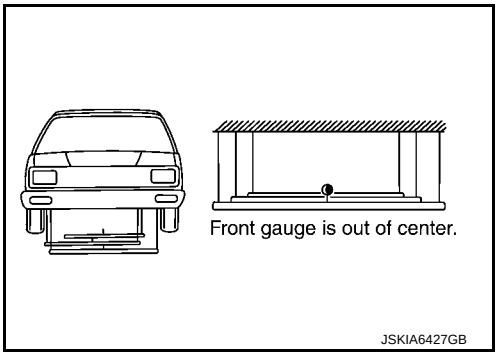


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- Sag
  One of the horizontal bars is lower in the vertical direction than the others.



- Side-sway
  The horizontal bars are correctly aligned, but the center target is displaced.



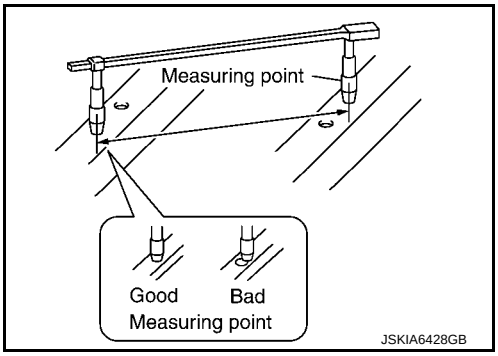
CHECKING DAMAGE : Tracking Gauge and Steel Tape

INFOID:0000000014642525

Measure the distance between two points. Before using the tracking gauge, check the measuring points with the steel tape.

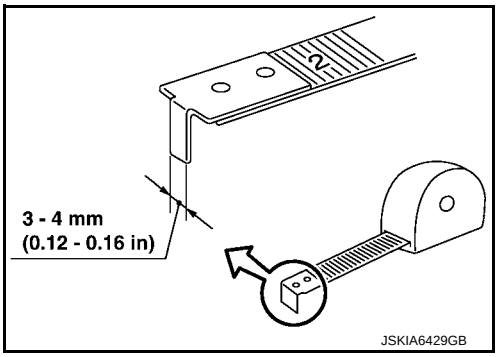
(1) TRACKING GAUGE

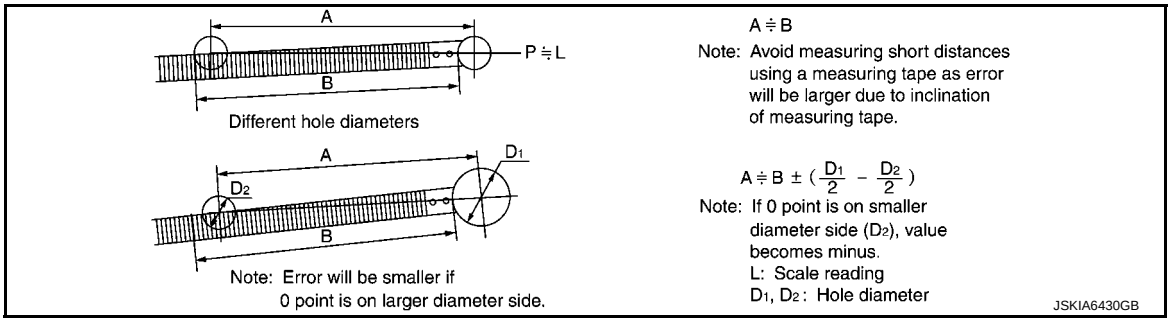
- Fit the tracking gauge correctly to the measuring point.
- The dimension is indicated between the hole center.
  If measurement is unavailable, use the method shown below.



(2) STEEL TAPE

- Shape the end of the rule for ease of measurement.
- If the measuring point hole diameter is different, use the following measuring method.





BODY STRAIGHTENING EQUIPMENT

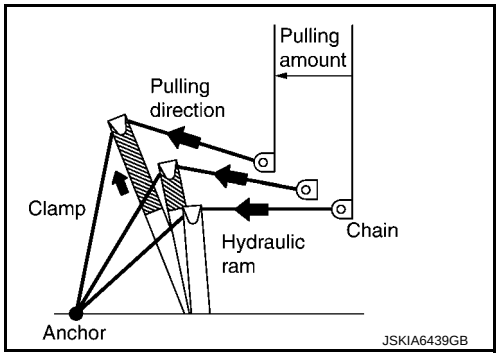
BODY STRAIGHTENING EQUIPMENT : Comparison of Pulling Methods

INFOID:0000000014642526

(1) HYDRAULIC RAM TYPE

In this method, the pressing force of a hydraulic ram is converted to a pulling force by a chain.

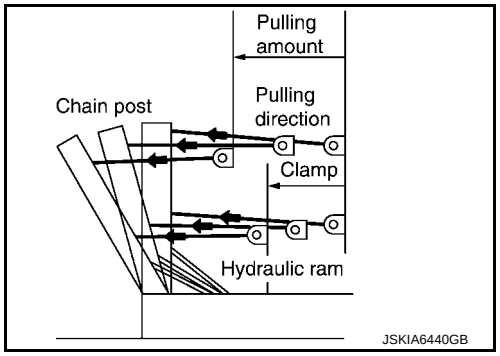
- Pulling points on the body may be added easily, and there is more freedom to select the pulling direction.
- The pulling direction changes during pulling.
- Difficult to simultaneously pull several points on a vertical line.



(2) TOWER TYPE I

In this type, force is applied by the hydraulic ram pushing the post.

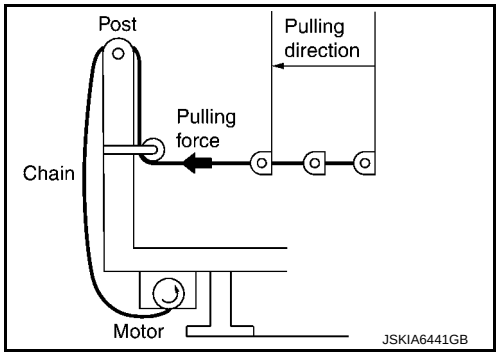
- A strong force is obtained because a large ram is used, creating much leverage.
- The chain can be hooked to the post in many ways.
- Leverage can be increased or decreased by changing the position of the hook.
- The pulling direction is not restricted by the shape of the bench or a floor anchor.
- The pulling direction changes during pulling.
- Difficult to increase the number of pulling points on the body because the pulling tool itself is large.



(3) TOWER TYPE II

The chain is wound up through the tower by an electric or hydraulic motor.

- The direction of force does not change during pulling.
- The chain is easily set on the post because the pulling direction is constant.
- Provides great flexibility in pulling direction.
- Pulling points on the body are restricted by the number of posts.
- Pulling force is relatively strong.



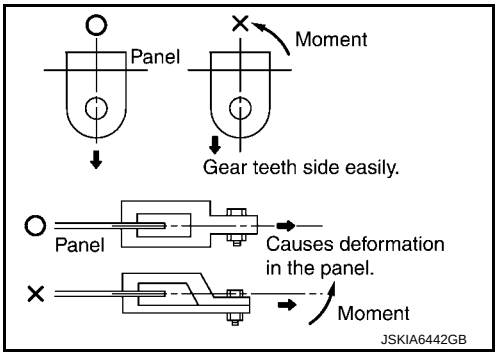
BODY STRAIGHTENING EQUIPMENT : Clamps

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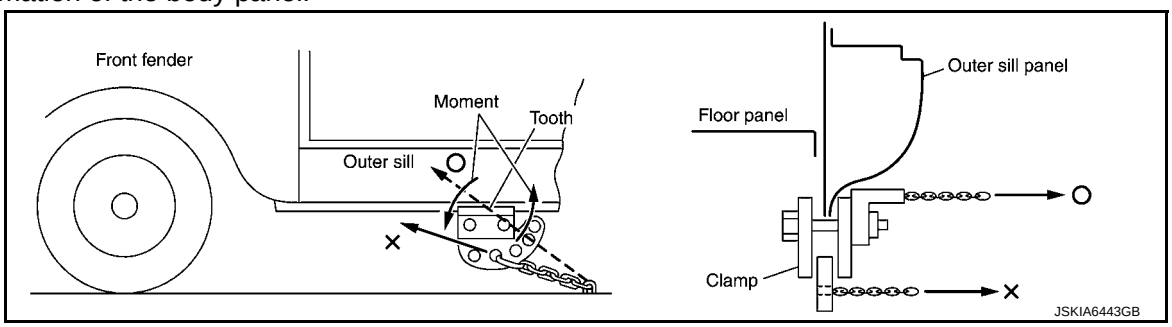
Generally speaking, when a body has to be straightened, the pulling device and the body must be attached to each other and the body itself must remain stationary. For this purpose, various clamps are used.
Common types of clamps and their characteristics are listed below:

DIRECTIONAL CHARACTERISTICS

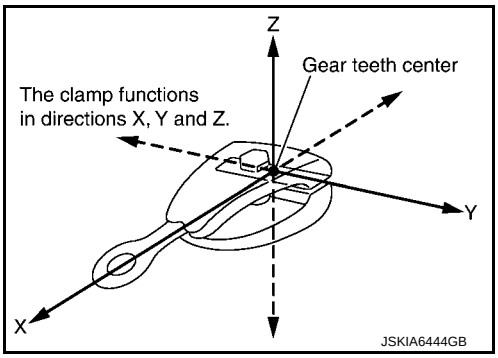
When pulling the clamp, the line of pulling force must extend through the center of the clamp teeth. Otherwise, the clamp may come off or damage the body panel as the clamp rotates.



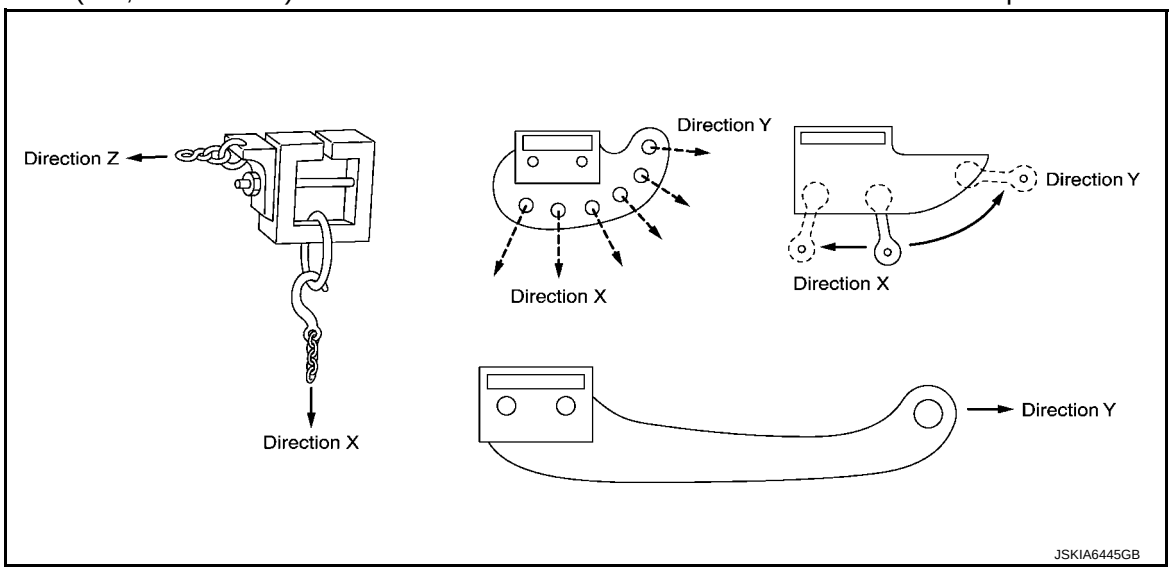
- The figure shows how the direction of the chain's pulling force is at a downward angle from the center of the teeth. This generates a turning force on the entire clamp in the direction of the arrow. This force is amplified because of leverage, but only some of its teeth are engaged. Thus, the clamp tends to slip, which results in deformation of the body panel.



- Clamp direction is important in creating the pulling force. Fundamentally, three directions are considered, "X", "Y" and "Z".



- DIrectional ("X", "Y" and "Z") characteristics are shown below for several kinds of clamps.

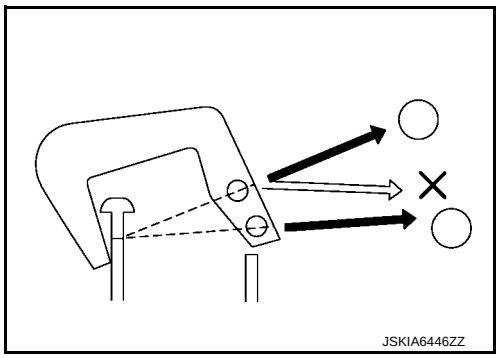


BODY STRAIGHTENING EQUIPMENT : Hooks and Other Tools

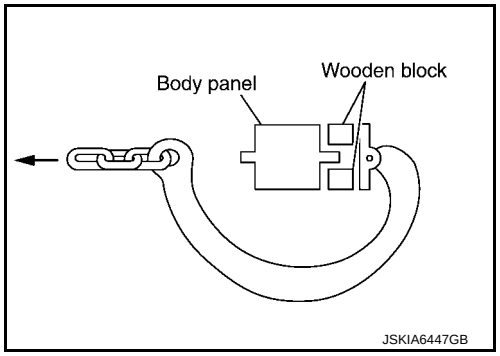
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(1) HOOKS

- Unlike clamps which grab an object, hooks are curved tools that pull on the body. When a hook is used, it must be set so that the point where the body is pulled and the position of the hook's chain are lined up straight.

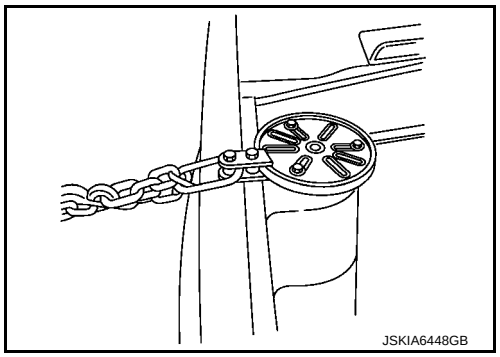


- When a hook is used, a piece of wood, etc. should be inserted between the hook and body in order to prevent damage to the body.



(2) SPECIFIC-USE PULLING TOOL

Specific-use pulling tools are special jigs which are used to repair a specific part of the vehicle.
An example of a specific-use pulling tools, a strut puller, is shown in the figure.



BODY STRAIGHTENING EQUIPMENT : High Intensity Cabin Structure

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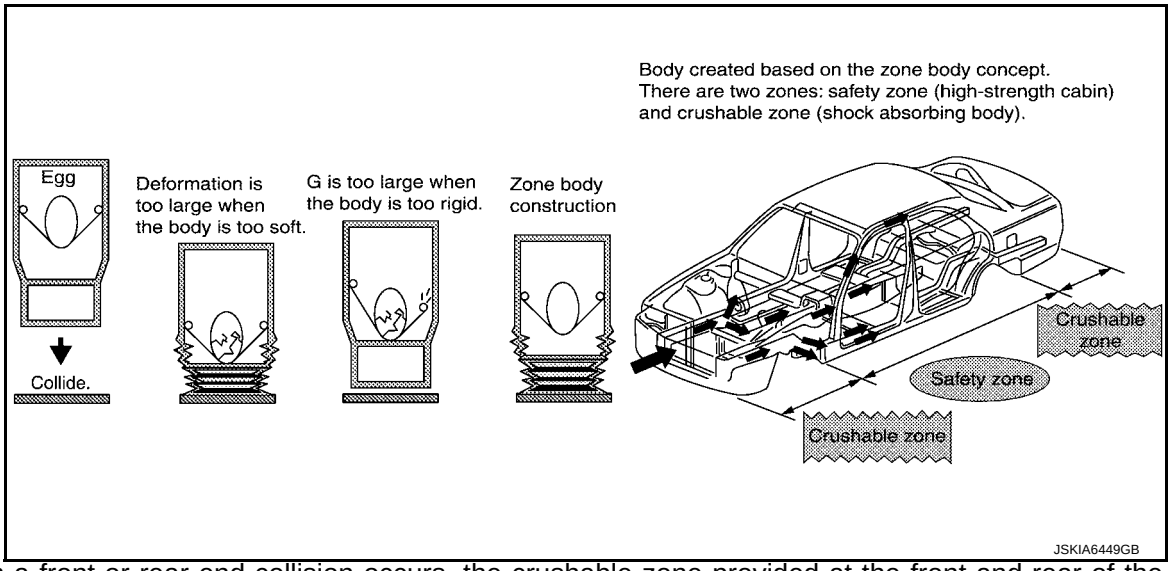
In recent years, the body construction of vehicles is changing for the purpose of protecting passengers at the time of the collision.
A greater use of high strength sheet steel reinforcements and the adoption of sheet steels of different thicknesses are good examples of securing survival space for passengers. Deformation caused when the vehicle body is damaged is controlled through modification of the body construction.

The following points must be kept in mind when high intensity cabin structure bodies need to be repaired.

- No special skills are necessary in body straightening work.
- Body technicians must have a good understanding of the construction of the vehicle body to be repaired.
- Understanding the accurate damage range (performing accurate measuring work) is necessary.
- A greater force is required for straightening because of an increased use of high strength steel plate reinforcements.
  It is necessary to perform additional anchoring for the frame straightening equipment with which multiple jig anchoring is not possible in order to prevent secondary damage.
- Pulling force must be applied evenly to prevent welded points from breaking. (Simultaneous pulling in multiple directions, etc..)

- The anchoring jig specific to each vehicle model is used for vehicles which cannot be anchored at the sill lower flange.

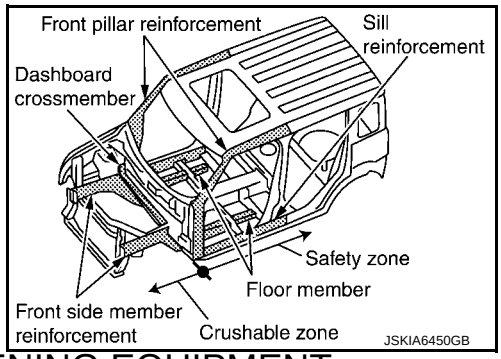
(1) HIGH INTENSITY CABIN STRUCTURE



- When a front or rear end collision occurs, the crushable zone provided at the front and rear of the vehicle effectively absorbs impact energy and cushions the shock to the passengers. In addition, the safety zone securely maintains a survival space.
- Energy absorbing beads and high strength sheet steel reinforcements are used as front side members.
- Outrigger construction. (Distributes impact energy from front side members.)

(2) HIGH INTENSITY CABIN STRUCTURE (SIDE IMPACT)

- To improve the lateral strength of the occupant compartment, lateral strength such as crossmembers, steering member and reinforcements for roof side, center pillars and body sills are redesigned.
- When a side collision occurs, the side door beams and doors minimize deformation of the body by absorbing impact energy subjected from the lateral direction, and by distributing energy over the reinforced body side.



REPAIR TECHNIQUES USING BODY STRAIGHTENING EQUIPMENT

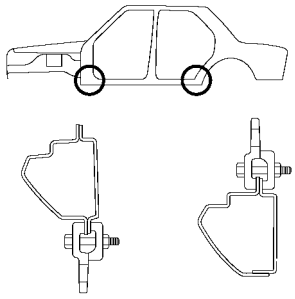
REPAIR TECHNIQUES USING BODY STRAIGHTENING EQUIPMENT : Securing the Vehicle

INFOID:0000000014642530

To prevent the movement of vehicle, use a suitable method that can resist the pulling force required for repair.

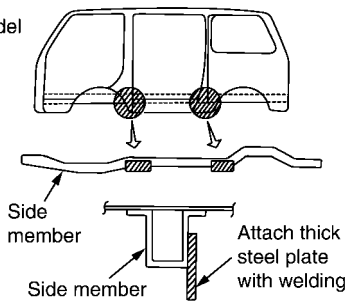
(1) ANCHORING POINT

For passenger vehicle



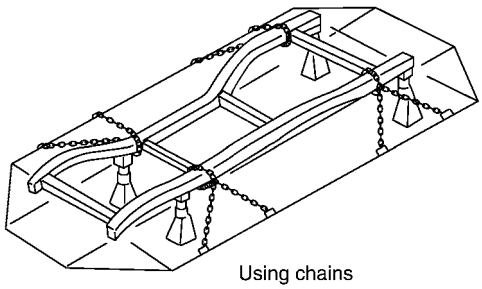
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For van model

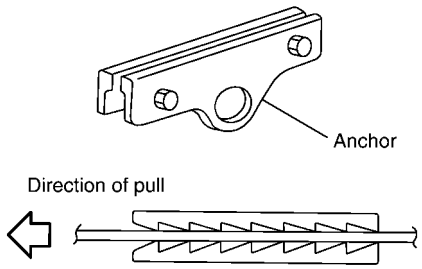


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For frame model



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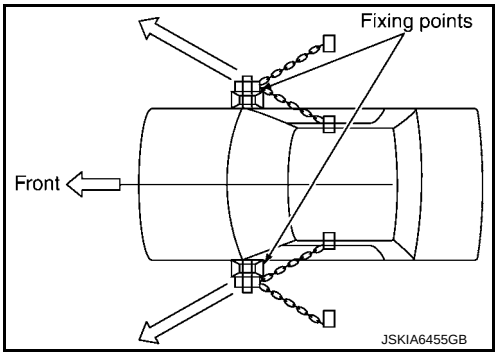
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CAUTION:

- **Choose the foundation of a rigid pillar or a member for anchoring point.**
- **Set the equipment so that the direction of claw clamp is opposite to the direction of pull.**

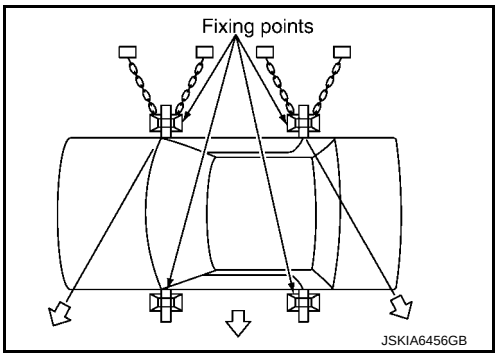
(2) ATTACHMENT OF CHAINS

- Pulling to the front of vehicle
  The vehicle will be secure if it is pulled in the range indicated by the arrows in the figure. The rear side is the opposite of this.



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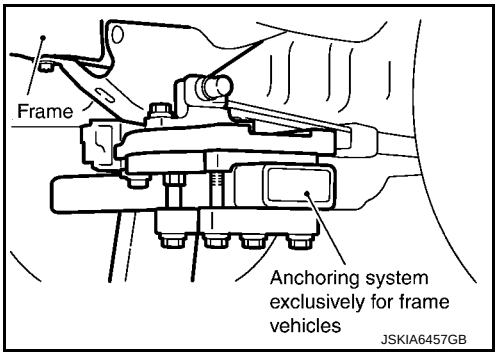
- Pulling to the left or right side
  Pull the vehicle within the range indicated by arrows.



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(3) ANCHORING POINT FOR FRAME MODEL USING FRAME CLAMPING

If the frame cannot be anchored to the straightening equipment with the basic anchoring method the frame can be directly anchored by using frame clamping system. The figure shows an example in which the spring shackle is anchored without the spring being removed.



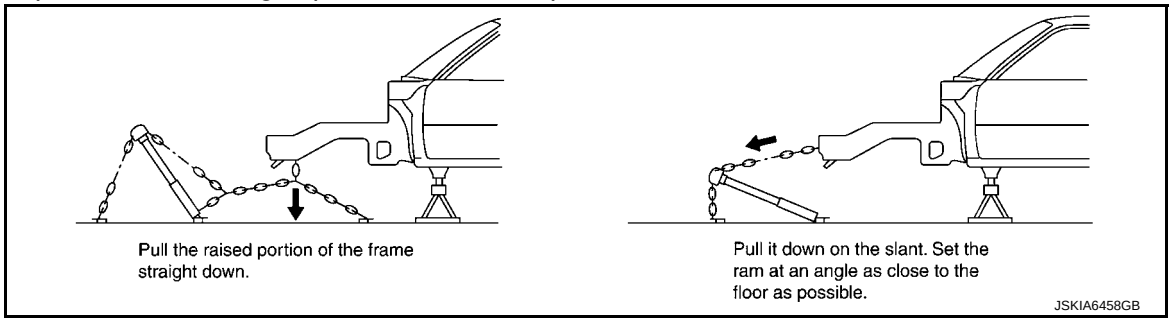
REPAIR TECHNIQUES USING BODY STRAIGHTENING EQUIPMENT : Securing and Pulling

INFOID:0000000014642531

In principle, the pulling force must be applied in the exact opposite direction of the impact force (input). The securing method must match this pulling direction.

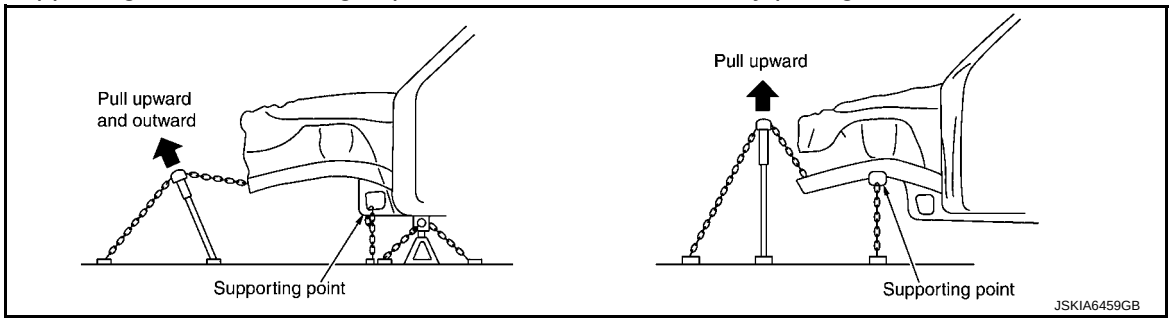
(1) DOWNWARD PULL

Secure as close to the damaged portion as possible. If there is a separation between the pulling point and damaged point, the undamaged portion will also be pulled.



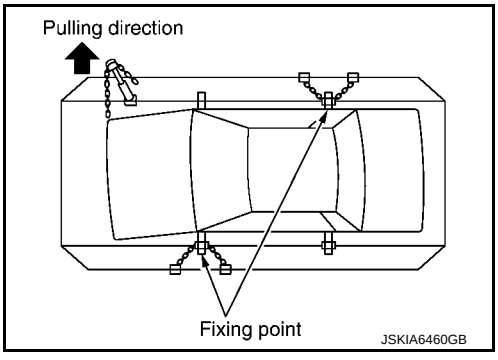
(2) UPWARD PULL

Set the supporting so that undamaged portions will not be affected by pulling.



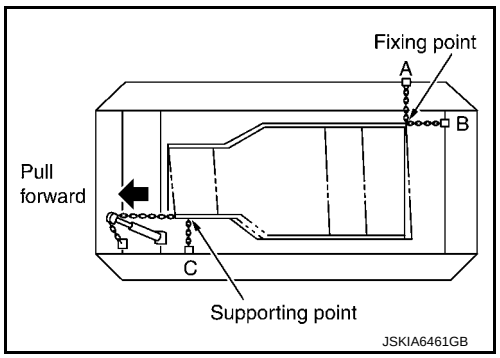
(3) FIXING AND PULLING METHOD FOR SIDE BEND

To pull the front part of vehicle, secure the vehicle body to avoid movement by the moment of rotation caused by pulling.



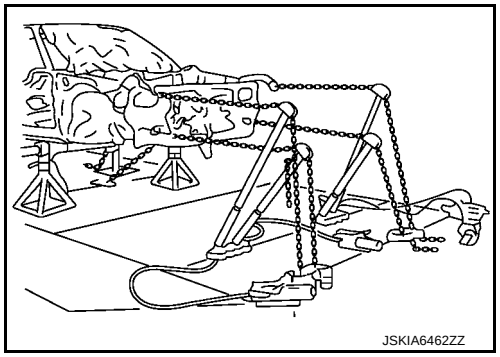
(4) FIXING AND PULLING METHOD FOR DIAMOND

If only points (A) and (B) are secured, a moment of rotation may result. Establish another supporting point at portion (C).



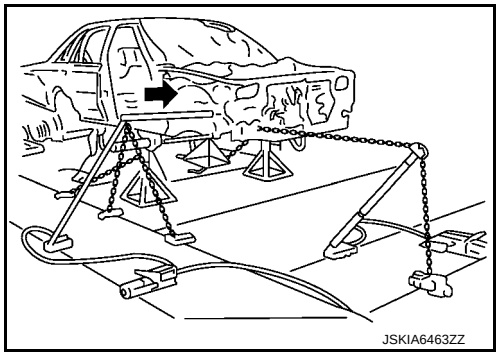
(5) SIMULTANEOUS PULLING IN MULTIPLE DIRECTIONS

This method can shorten repair time, and also prevent secondary damage.



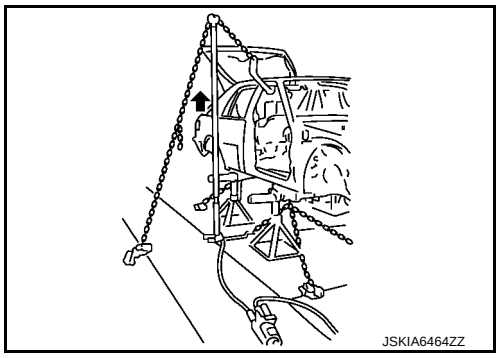
(6) SIMULTANEOUS PUSH-PULL METHOD

This method may be used when stress is concentrated at the front side member. The front of the front side member is bent inward while the rear is bent outward.



(7) ROOF DAMAGE

Connect an extension tube to the ram.
Positioning it near the vehicle body will result in increased pulling length.



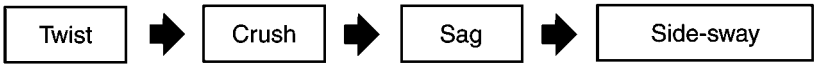
REPAIR PROCEDURE FOR PULLING

REPAIR PROCEDURE FOR PULLING : Repair Sequence

INFOID:0000000014642532

In general, no single bend or twist is produced in a collision. Body deformation results from a combination of bending and twisting and other types of damage.
Repair should start where the damage is most deeply propagated.

If concentrating only on apparent damage while overlooking the propagation of impact to the whole body, it is impossible to obtain correct body alignment.



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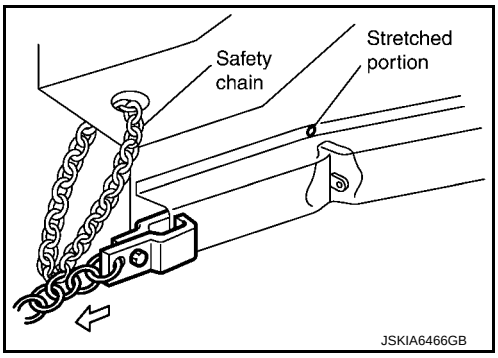
Repair work should basically be performed in this order of damage.

REPAIR PROCEDURE FOR PULLING : Key Points in Actual Repair Work

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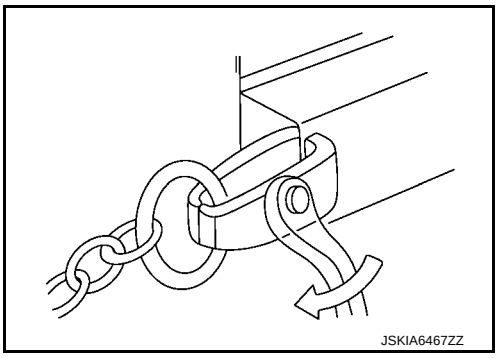
(1) STRETCHING SHRUNK PORTIONS

- The repair of a bent closed cross-sectional structure, such as a side member, is done by clamping the surface of the bent-in side and pulling. The pulling direction should be such that force is applied in the direction of an imaginary straight line extending through the original position of the part.



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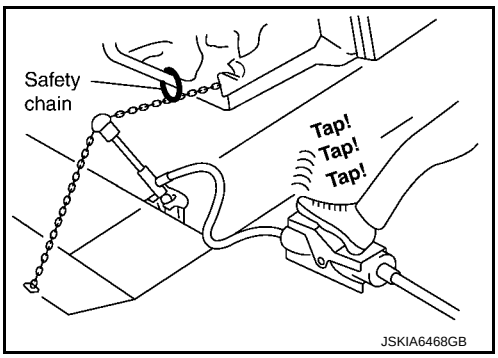
- Sometimes a load of approximately 5,000 kg (11,025 lb) is applied during repair work. Accordingly, the clamp must be tightened securely. Be sure to use safety chain.



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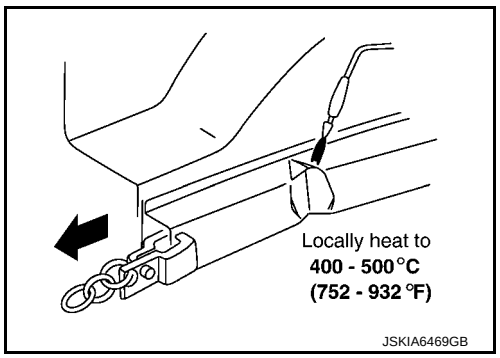
(2) GRADUAL PULL

- Pull step by step.
  The damaged portion may be work hardened.
  Pulling all at once may cause cracking.



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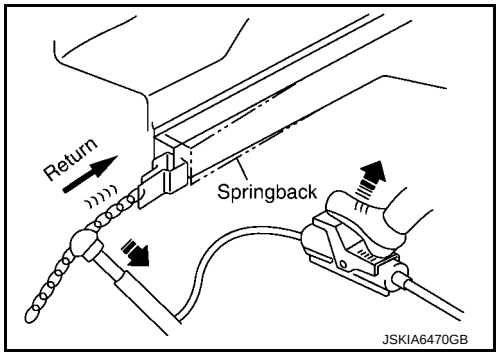
- Reduce the hardness of the work-hardened portion.
  Locally heat the panel to 400°C - 500°C (752°C - 932°F) to the extent that the panel is not colored. Do not heat above 700°C (1,292°F), or strength will be reduced. Do not raise to a temperature of more than 550°C (1,020°F) for HSS parts.



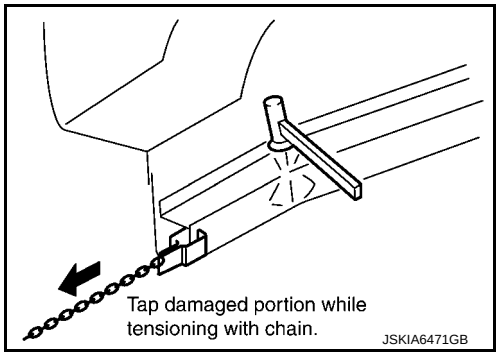
(3) CONSIDER SPRING-BACK

When pulling force is applied to a panel, spring-back is generated by the residual stress.

- Proper amount of pull
  Pull 2 mm - 3 mm (0.08 in - 0.12 in) more than the required dimension. Adjust the amount of pull corresponding to the spring-back.

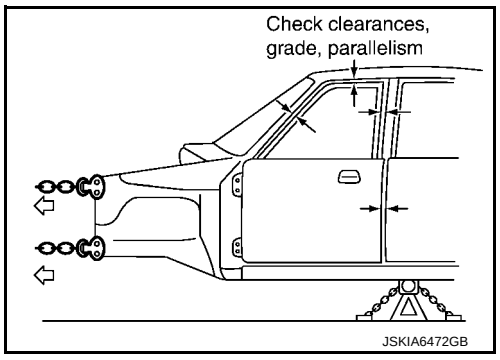


- Use of hammer
  Residual stress caused by kinetic energy of the collision can be removed by hammering.



(4) DETERMINING PROPER AMOUNT OF PULL BY OBSERVING DOOR FIT

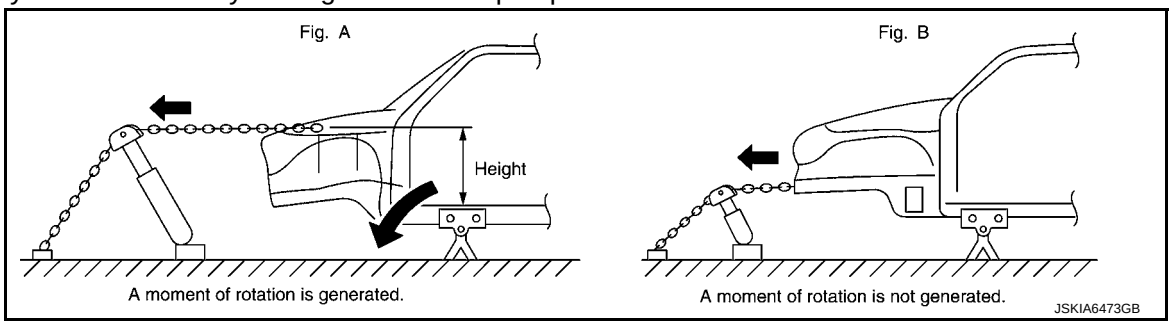
The proper amount of pull can be determined by observing the clearance at the door or trunk lid.



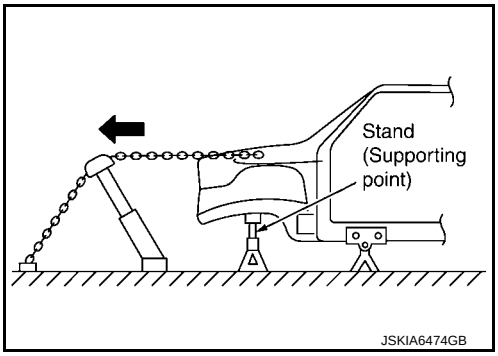
(5) PULLING UPPER PORTIONS FROM UNDERBODY CLAMP

Note that if there is distance between the pulling point and the underbody clamp, as indicated by (A) in the figure, a moment of rotation is produced.

This may cause secondary damage to the clamped portion.

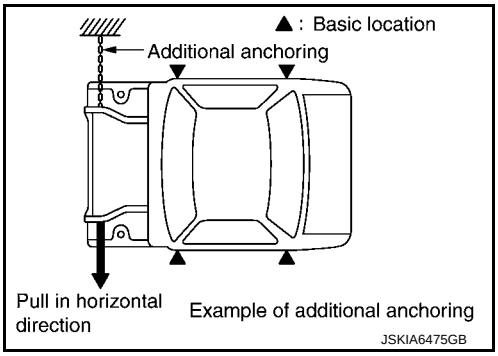


Provide a supporting point under the side member to prevent generation of this moment of rotation.



(6) ADDITIONAL ANCHORING

Pulling work must be performed with care taken not to damage the anchoring points or undamaged area of the body. If area not targeted for repair is affected by the excessive pulling force or the direction of pulling, additional anchoring points need to be provided to protect undamaged areas. Side sills are strong enough against longitudinal force, however, they are easily damaged by downward or lateral force. For this reason, additional anchoring should be provided by supporting side members with the port power, or attaching a clamp and chain.



(7) PURPOSE OF BODY ALIGNMENT

This operation is necessary to obtain correct alignment of parts to be used again. Therefore, the damage caused by propagated impact is recovered by pulling out the first input point.

REPLACEMENT OF PANEL

REPLACEMENT OF PANEL : Replacement of Panel

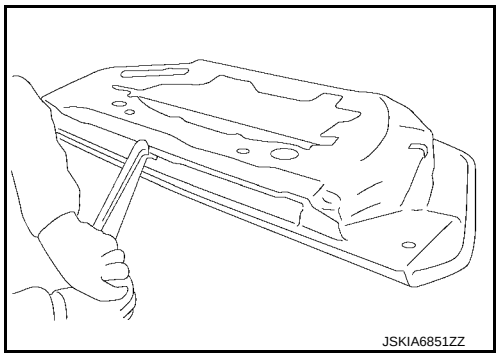
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Panel replacement work includes replacement of the front fenders and hood which are installed by bolts, and replacement of rear fenders and the roof which are welded. This section explains panel replacement procedures after adjusting body alignment.

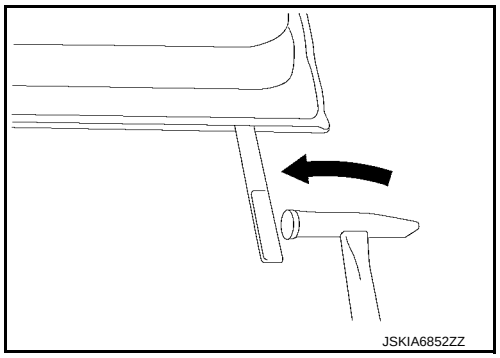
REPLACEMENT OF PANEL : Door Hemming

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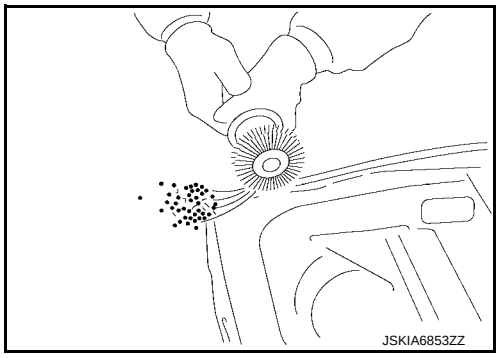
(a) Sand the edge part of door outer panel using belt sander.



(b) Insert the tip of a sharp-edged tool, such as a chisel, into the clearance at door outer panel. Use a hammer to tap the tool inserted into the clearance from the side to separate the door inner panel and door outer panel.

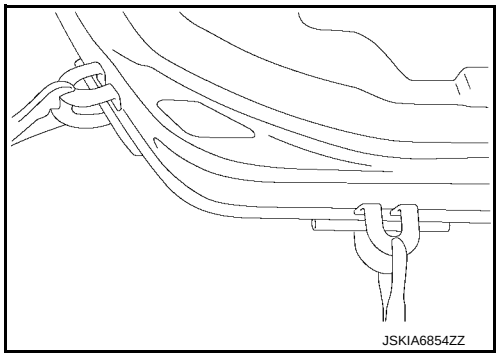


(c) Remove the adhesive adhering to the door inner panel flange area surface.

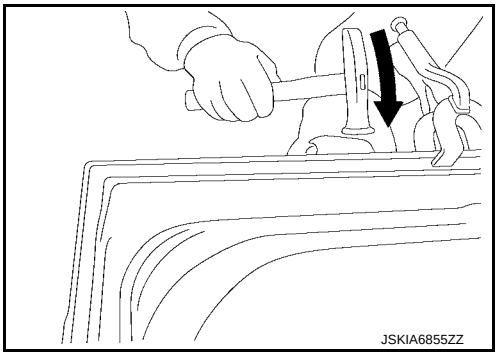


(d) Adjust the position where the new door outer panel and door inner panel overlap. Once these are positioned correctly, fix them with clamps to prevent them from being displaced.
Apply new adhesive to both door outer panel and door inner panel.

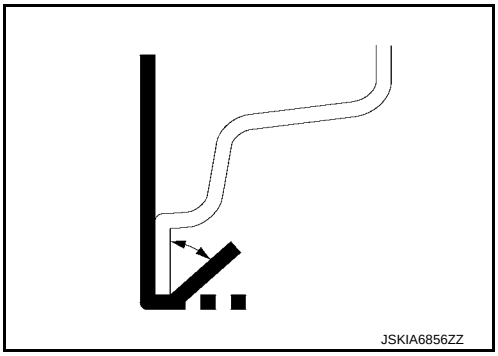
<Adhesive> 3M™ Automix™ Panel Bond 8115 or equivalent



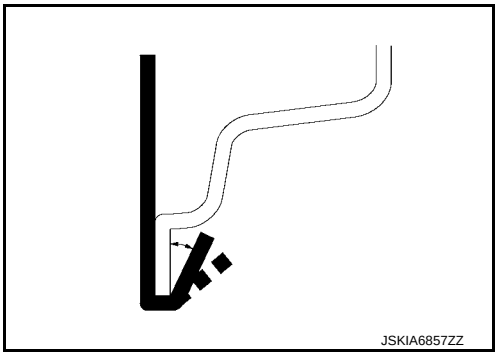
(e) Hold the dolly on the corners of the flange at door outer panel. Tap the dolly with a hammer to bend the door outer panel flange area gradually.



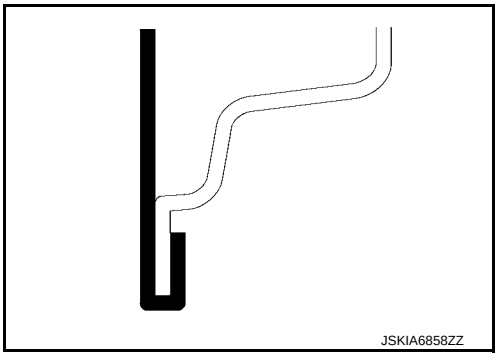
(f) Bend with hammer until the angle of the whole circumference of the door outer panel flange area becomes approximately 45°.



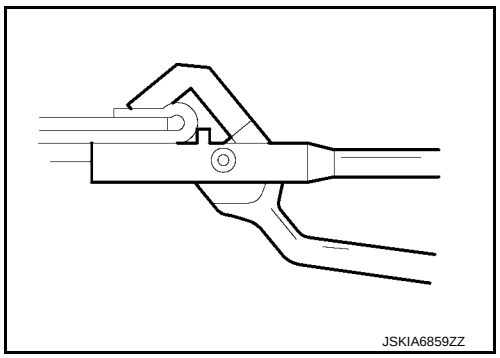
(g) Check that the position of the door outer panel and door inner panel is not displaced while tapping it with a hammer to bend it until the angle of whole circumference of the door outer panel flange area becomes approximately 15°.



(h) Check that the position of the door outer panel and door inner panel is not displaced while taping it with a hammer to bend it until the angle of the whole circumference of the door outer panel flange area becomes approximately 0°.

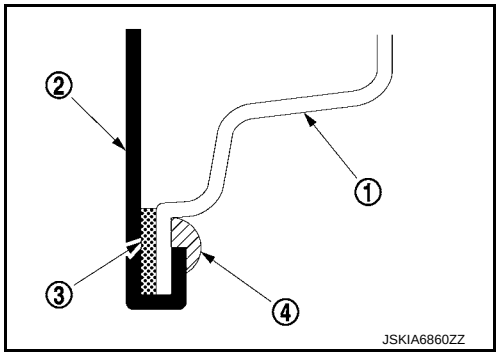


(i) Use the hemming tool [SST: KV991-10000] to adjust the shape of the whole circumference of the door outer panel flange area.



(j) Seal up the area around the hemmed end of the flange.

① **Door inner panel**
② **Door outer panel**
③ **Adhesive**
④ **Sealant**

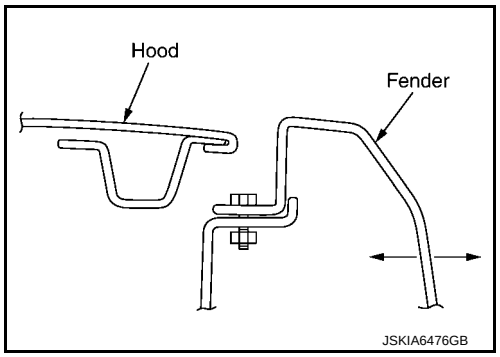


REPLACEMENT OF PANEL : Adjustment Fitting of Front Fender

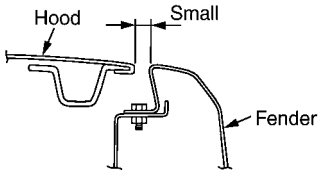
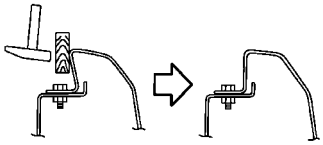
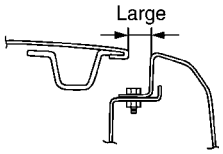
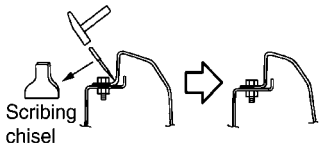
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Fitting adjustment means adjustment of clearance or gradient of the hood, door, front fender, etc. with respect to its adjacent part, and adjustment of gradient at the press line.
Adjustment of front fender is described as an example.

- Adjust the fitting at the front fender mounting position. Tighten the front fender mounting bolts loosely, and adjust the fit by moving the front fender sideways or in the up-down direction while observing the clearance with the hood and door.



- Adjust the front fender bend angle.
  If a proper fit cannot be obtained by step (1) above, change the bending angle of the front fender.

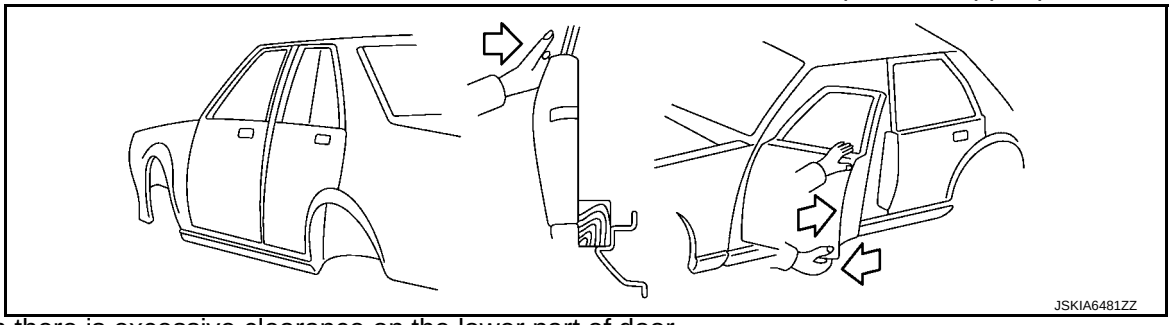
Explanation	Condition	Correction method
When the clearance between the front fender and hood is too small: Apply a flat wood plate to the upper corner of front fender, and correct by hammering. Before hammering, securely tighten the front fender mounting bolts.	 JSKIA6477GB	 JSKIA6478ZZ
When the clearance between the front fender and hood is too large: Apply a scribing chisel to the bend at the base of the front fender. Tap with a hammer to adjust the clearance. Securely tighten the front fender mounting bolts before tapping. Apply the scribing chisel along the press line.	 JSKIA6479GB	 JSKIA6480GB

REPLACEMENT OF PANEL : Adjustment Fitting of Door Assembly

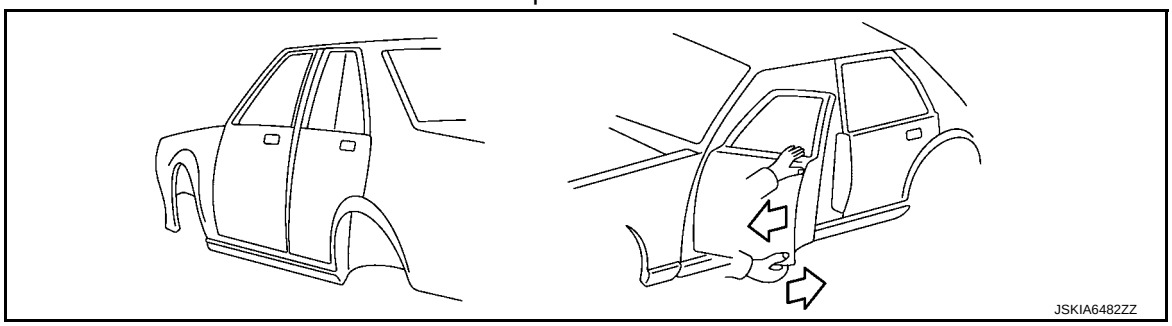
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When there is excessive clearance on the upper part of door:

- Apply a wood block between the outer sill and the lower side of door, and push the upper part of door.


JSKIA6481ZZ

- When there is excessive clearance on the lower part of door.


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PARTIAL REPLACEMENT OF PANEL (WELDED PANEL)

PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Partial Replacement of Panel (Welded Panel)

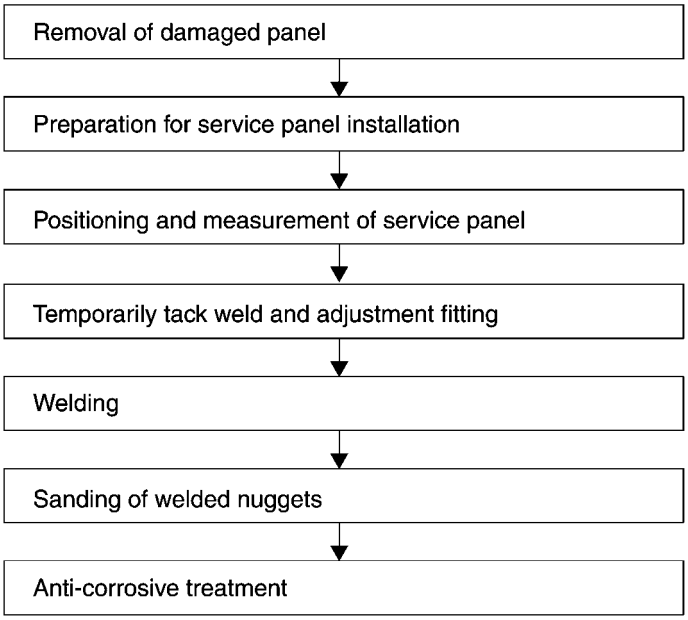
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If damage occurs in a welded panel, it can be entirely replaced by a service panel or partial replacement can be done by cutting and replacing damaged portion with a service panel.

PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Welded Panel Replace-

ment Procedure

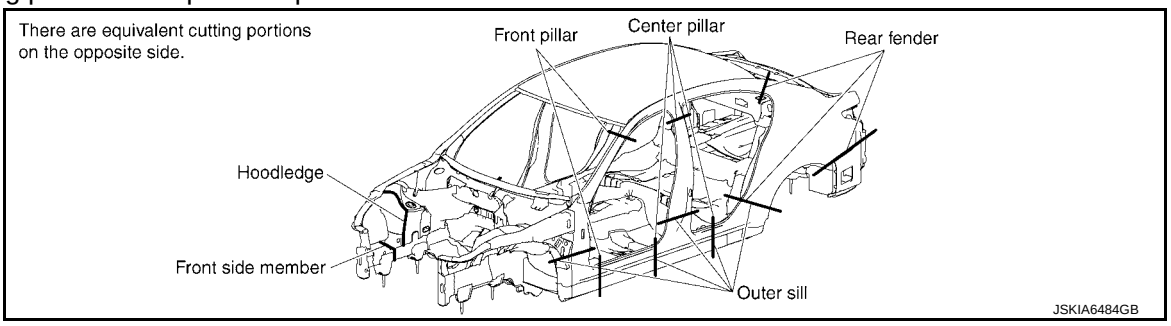
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NOTE:
When welding and dressing the parts, cover up holes of these parts with tape to prevent debris from entering.

- Assembly panel replacement or partial panel replacement
  Assembly panel replacement means replacement of a complete panel by cutting all the welded portions.
  Partial panel replacement is a method by which only the damaged portion of a panel is replaced. Partial panel replacement can be used when assembly panel replacement is too costly and time consuming, and when the damage is localized.
- Cutting positions for partial replacement



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Cutting panels for partial replacement is not allowed on some portions. If panels are cut in improper portions, body strength cannot be maintained. The allowable positions vary with body structure, panel strength or shape and differ from model to model. They are indicated in the Body Repair Manual of each model. In principle, the following portions may be cut:

- Portions without reinforcement or ducting
- Portions where no stress concentration occurs
- Portions with small finish area where finishing can be easily accomplished (where the connected portions can be covered by garnish or moulding)
- Portions where work area or disassembling of parts is minimized

PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Rough Cutting of Panel

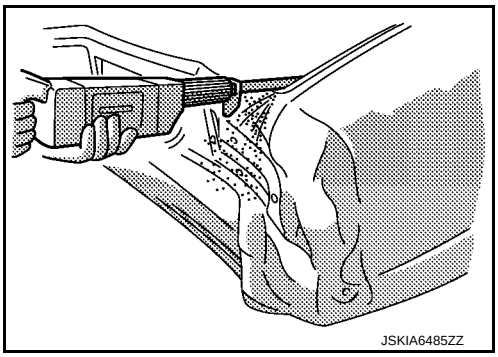
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Most body panels are joined by spot welding. It is difficult to cut them at the welded portion.

To shorten work time, pull the damaged portion roughly, them cut near the panel joint in advance so that tools can be used properly to cut the spot welded portion. It is commonly used on panels having complicated structures.
Cutting body panel and service panels by leaving an overlap tolerance is also called rough cutting.
Use the cutting tools properly according to the portion to be cut, panel thickness, and panel structure.
Tools commonly used for this purpose and their features are described below:

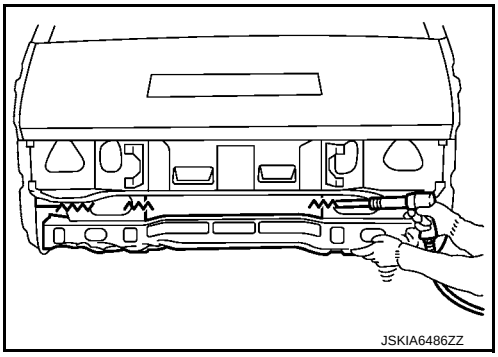
(1) ROUGH CUTTING USING AN AIR SAW

(a) Major application
Members and pillars including side member, cross member, rear pillar, etc..
(b) Features
Clear cut line. Suitable for cutting both thin and comparatively thick sheet metal.


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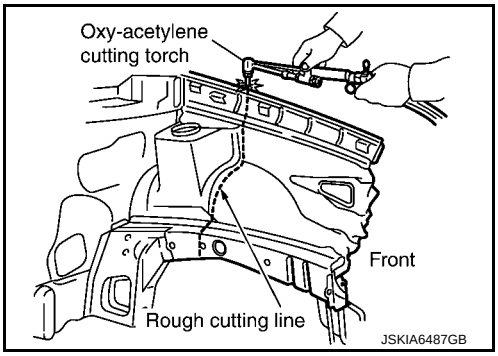
(2) ROUGH CUTTING USING AN AIR CHISEL

(a) Major application
Thin sheet metal including the rear fender and rear floor
(b) Features
Faster cutting speed
High noise level
Not applicable to thick sheet metal
Irregular cut line
Excessive sparking


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(3) ROUGH CUTTING WITH AN OXY-ACETYLENE CUTTING TORCH

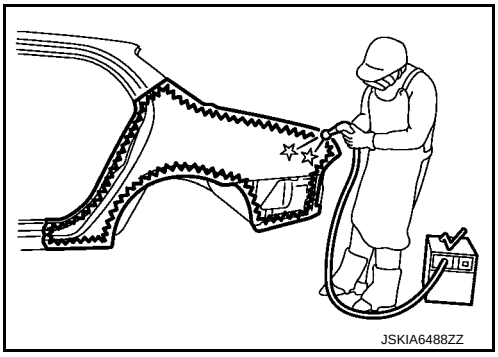
(a) Major application
Thick sheet metal including side member, cross member, hoodledge, etc..
(b) Features
Faster cutting speed



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(4) ROUGH CUTTING WITH A PLASMA CUTTER

(a) Major application
Floor, door, rear fender, roof, flat panels.
(b) Features
Faster cutting speed
Only small will be affected by heat.
This is suitable for cutting conductive materials.
Aluminum, stainless, and carbon steel can be cut.
Cut off damaged portion as shown in the figure.
Be careful not to cut inner rear pillar reinforcement.


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PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Cutting Off Welded Por-

tions

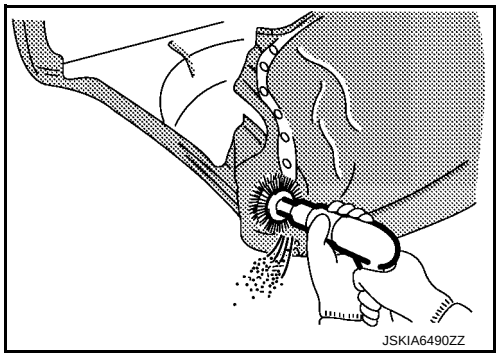
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A vehicle body is constructed by using three different welding methods [spot welding, gas shielded arc (GSA) welding and brazing]. Cutting welded portion by these methods is described below.
Spot welding is generally used on two or more overlapped panels. The tool or cut off method must be changed according to whether the panel to be removed is on the top, in the middle or on the bottom.

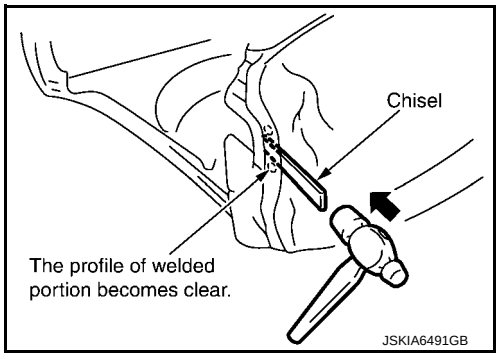
(1) CONFIRMING THE SPOT WELDED POSITION

Remove paint, undercoat, and sealer from the panel to confirm the spot welded positions.

(a) Using air sander or rotary wire brush:
When using this method, do not grind too much of the panel. Sand or brush the panel while confirming the spot welded portion.


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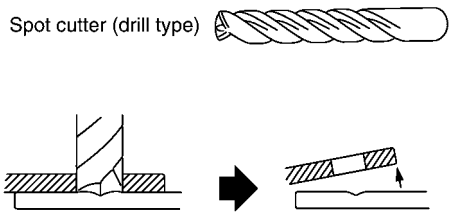
(b) Using a chisel:
If the spot welded portion is indiscernible even after removing paint, insert the chisel blade between the panels and tap lightly with a hammer for confirmation.



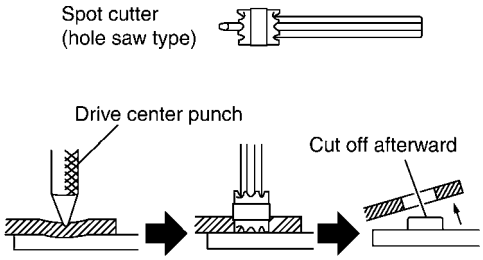
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(2) CUTTING OFF SPOT WELDED PORTION

(a) Using a spot cutter:
There are two types of spot cutters (a drill type and a hole saw type). When using the spot cutter, be careful not to cut the lower panel.

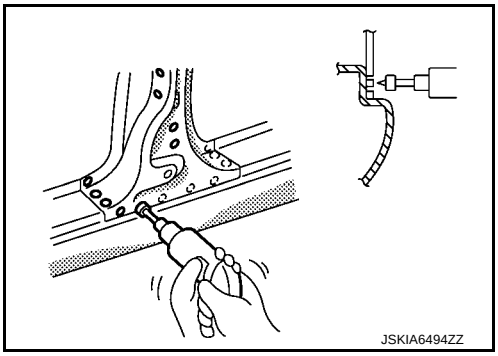


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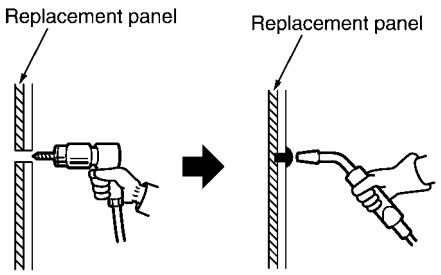


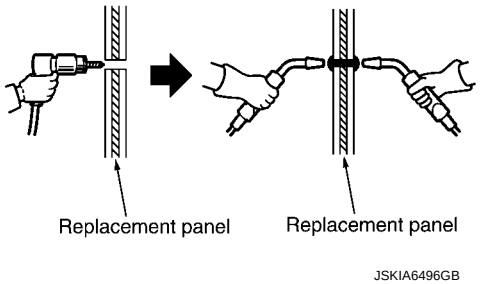
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If it is difficult to weld from behind the lower panel, the spot cutter may be used to cut the spot welded portions without drilling the bottom panel.
The hole saw type spot cutter requires grinding of the spot weld after cutting. This requires additional work time.

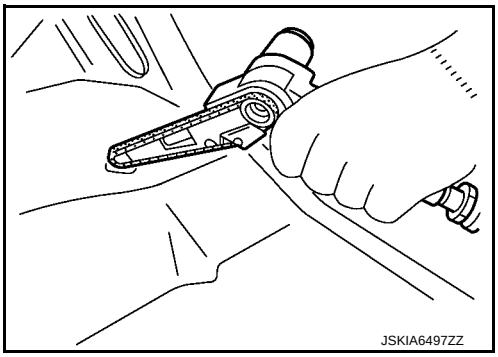


(b) Using drill:
The drill may be used to cut welds from any portion welded by plug welding, by drilling out the plug welded portion.

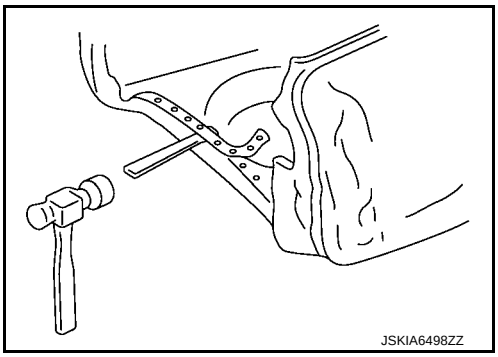




(3) CUTTING SPOT WELDED PORTIONS WITH AN AIR SANDER
If the spot cutter cannot be used, use the air sander (or belt sander) to cut off the spot welded portion.

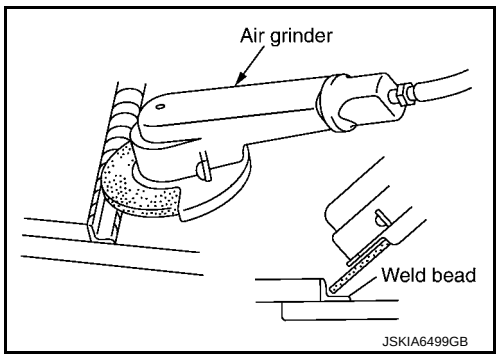


(4) REMOVING PANEL WITH A CHISEL
After cutting the spot welded portions, separate the panel using the chisel.
By doing this, spot welded portions will separate from their mating surfaces. Thus, work can proceed while confirming the separation of spot-welded portions.



(5) CUTTING GSA WELDED PORTIONS

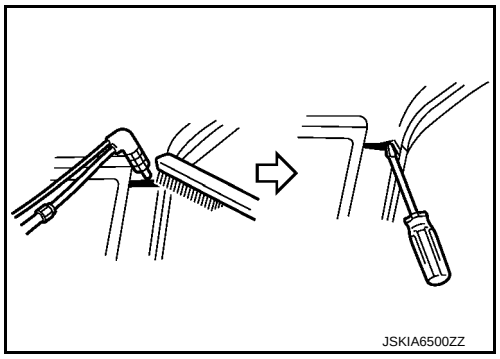
The GSA welding method is divided into two types (plug welding and seam welding). The plug weld portion can be cut off with a spot cutter or the like. To cut off the seam welded portion, grind the seam-weld bead with an air grinder to cut the welded portion. Be careful to grind from the replacement panel. Do not grind the reused panel excessively.
GSA = Gas Shielded Arc welding



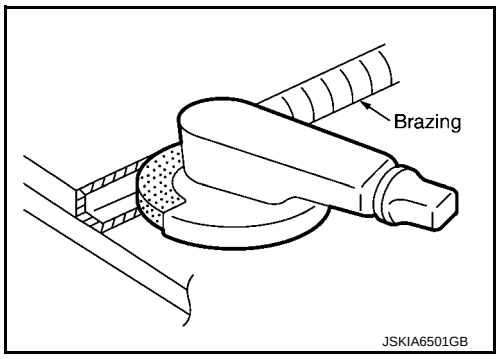
(6) CUTTING OFF BRAZED PORTION OF PANEL

Brazing is used to improve the external appearance of the joined portion (roof and fender) of the body outer panel as well as to improve sealing. Brazed portions can be generally disconnected by dissolving the braze with an oxy-acetylene torch.
If arc brazing was used, cut off the welded portion with an air sander or the like. The melting temperature of arc brazed metal is higher than that of ordinary brazing, and the panel may be damaged by this high temperature. Ordinary brazing and arc brazing may be discriminated by observing the color of the brazed metal. Ordinary brazing looks like a brass, while arc brazing has a copper color.

(a) Cutting with an oxy-acetylene torch
Melt the filler metal with the oxy-acetylene torch.
Remove the metal with a wire brush and separate the panel. While the filler metal is still hot, insert the tip of a screwdriver or the like between panels to prevent re-adhesion.



(b) Cutting with an air grinder
Cut off the brazed portion with the air grinder. Do not grind excessively the panel to be reused.

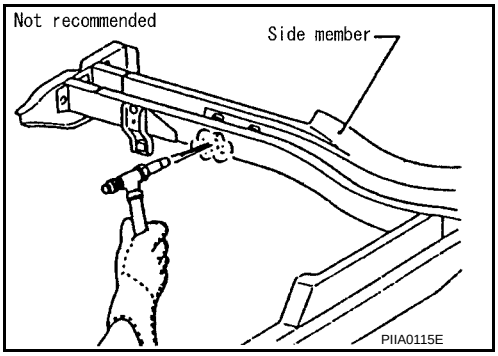


PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Precautions for High Strength Steel (HSS)

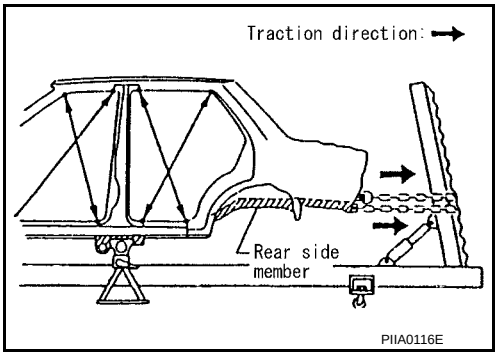
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High strength steel (HSS) means the steel from 440 MPa - 979 MPa.

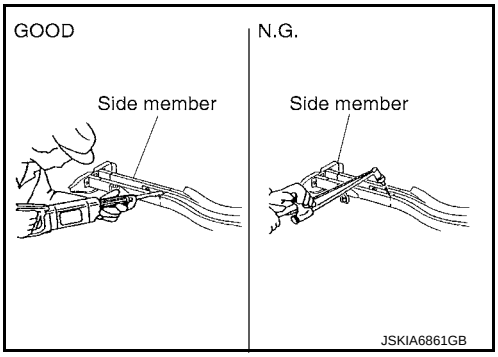
(a) The repair of reinforcements (such as side members) by heating is not recommended since it may weaken the component. When heating is unavoidable, do not heat HSS parts above 550°C (1,022°F). Verify heating temperature with a thermometer. (Crayon-type and other similar type thermometer are appropriate.)



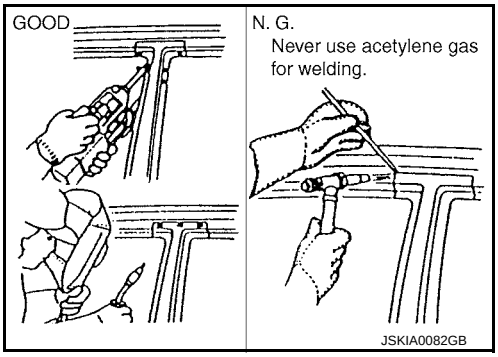
(b) When straightening body panels, use caution in pulling any HSS panel. Because HSS is very strong, pulling may cause deformation in adjacent portions of the body. In this case, increase the number of measuring points, and carefully pull the HSS panel.



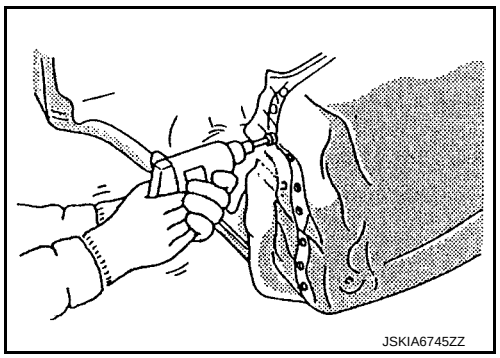
(c) When cutting HSS panels, avoid gas (torch) cutting if possible. Instead, use a saw to avoid weakening surrounding areas due to heat. If gas (torch) cutting is unavoidable, allow a minimum margin of 50 mm (1.97 in).



(d) When welding HSS panels, use spot welding whenever possible in order to minimize weakening surrounding areas due to heat.
If spot welding is impossible, use GSA welding. Do not use gas (torch) welding because it is inferior in welding strength.



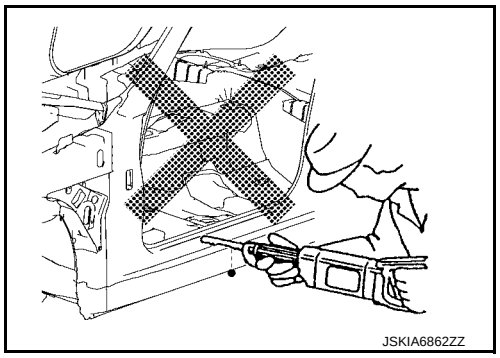
(e) The spot weld on HSS panels is harder than that of an ordinary steel panel.
Therefore, when cutting spot welds on a HSS panel, use a low speed high torque drill (1,000 rpm - 1,200 rpm) to increase drill bit durability and facilitate the operation.


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PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Prohibition for Ultra High Strength Steel (UHSS)

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Ultra high strength steel (UHSS) means the steel from 980 MPa or higher.
Never cut and joint the panel, plate and reinforcement made of ultra high strength steel (UHSS).
If such part is damaged, replace the part.


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PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Rear Fender Hemming Process

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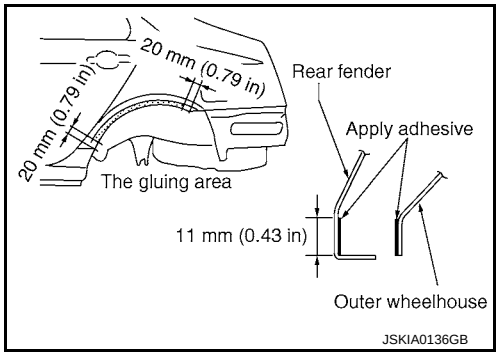
When the rear fender and the outer wheel housing have been joined with adhesive, the panel replacement method described below is used.
1. A wheel arch is to be installed and hemmed over left and right outer wheel house.
2. In order to hem the wheel arch, it is necessary to repair any damaged or defaced parts around outer wheel house.

CAUTION:
Ensure that the area that is to be glued around outer wheelhouse is undamaged or defaced.

Procedure of the hemming process

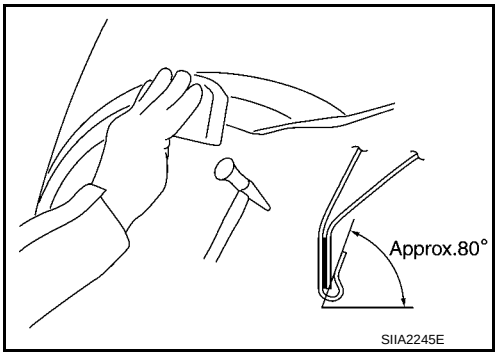
(a) Peel off old bonding material on the surface of outer wheelhouse and clean thoroughly.
(b) Peel off a primer coat in the specified area where new adhesive is to be applied on rear fender. (the replacing part.)
(c) Apply new adhesive to both specified areas of outer wheelhouse and rear fender.

<Adhesive> 3M™ Automix™ Panel Bond 8115 or equivalent

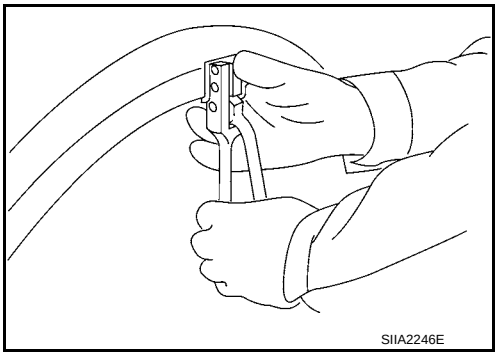


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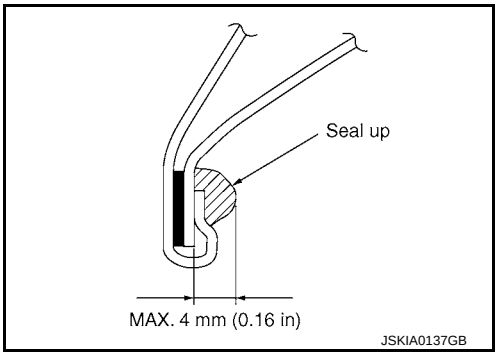
(d) Attach rear fender to the body of the car, and weld the required part except the hemming part.
(e) Bend the welded part starting from the center of the wheel arch gradually with a hammer and a dolly. (Also hem the end of the flange.)
(f) Hemming with a hammer is conducted to an approximate angle of 80°.



(g) Starting from the center, hem the wheel arch gradually, using slight back and forth motion with a hemming tool [SST: KV991-10000].



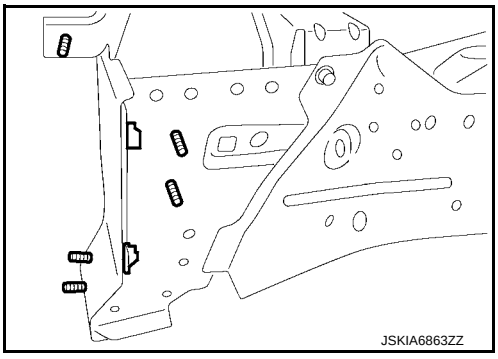
(h) Seal up the area around the hemmed end of the flange.



PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Welding Method for Stud Bolt and Nut

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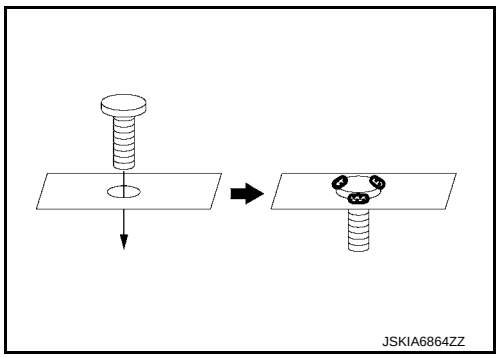
When stud bolts and weld nuts are not welded on the part acquired for repair, and are supplied as separate parts, use the following method to perform welding.



(1) FLANGE BOLT

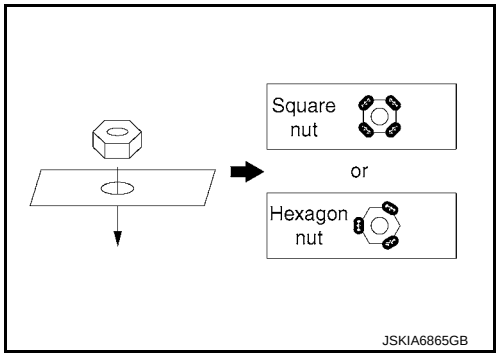
1. Remove paint, rust, or oils on the surface of the panel.
2. Insert the bolt, temporarily tighten the matching nut of the bolt, and perform centering.
3. Weld 3 points evenly by MIG weld. [approximately 3 mm (0.12 in)]
4. Apply an appropriate anti-corrosive treatment to the respective locations.

NOTE:
The same welding method is also applied when welding on a panel surface without a through hole. Welding is performed with the bolt head surface and panel contact surface contacting.


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(2) WELD NUT

1. Remove paint, rust, or oils on the surface of the panel.
2. Put the nut on the panel center of the hole, temporarily tighten the matching bolt of the nut, and perform centering.
3. Weld 3 or 4 points evenly by MIG weld. [approximately 3 mm (0.12 in)]
4. Apply an appropriate anti-corrosive treatment to the respective locations.



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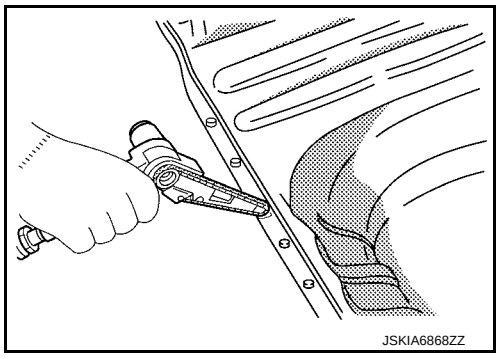
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Preparation for Service Panel Installation

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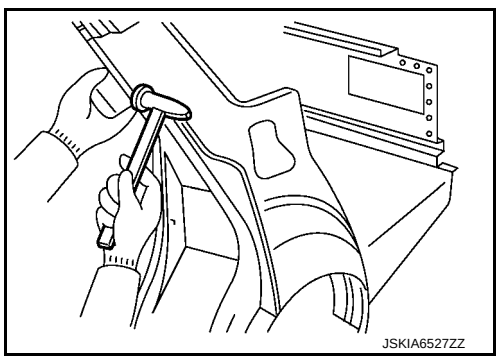
After removing the damaged panel, two operations are needed. Preparation for service panel installation and finishing of the panel mounting portion of the body.

(1) FINISHING BODY

(a) Grind clean around the area where the spot-welded panel has been removed. Thoroughly remove rust and other contamination from the mating surface.
Also, remove paint from the portion to be welded.
Any brazing metal should be thoroughly removed, otherwise welding will be impaired.


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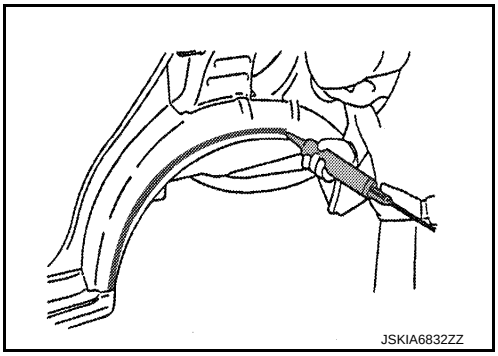
(b) Irregularities on the panel mating surface prevent the panel from being welded correctly. Using a hammer and dolly, correct the shape of the mating surface.


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(c) Apply conductive anti-corrosive treatment [spot sealer for spot welding or weld through primer (metallic solution) for GSA welding] in places that cannot be painted in the subsequent painting process.

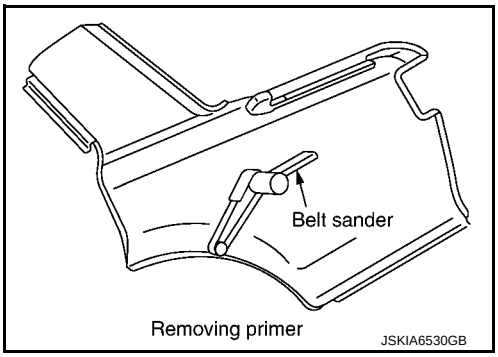


(d) If it is impossible to apply sealer after welding the service panel, sealer should be applied before welding.



(2) PREPARATION FOR SERVICE PANEL INSTALLATION

(a) The service panel is coated with primer. Remove the primer and apply spot sealer at the portions to be welded. Do not allow the spot sealer to be forced out of the mating surface of the panel.

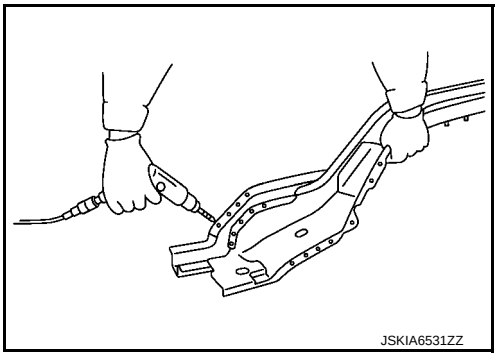


(b) Drill the service panel for plug welding, if necessary.

Refer to the Body Repair Manual of applicable model for the number of holes to be drilled for plug welding. The number of holes must be the same as the number of original spot welds. The drill holes must be spaced equally. Drill hole diameter must be changed according to panel thickness to maintain welding strength.

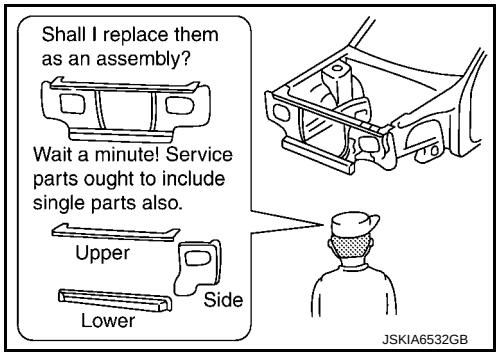
Plug hole diameter and panel thickness

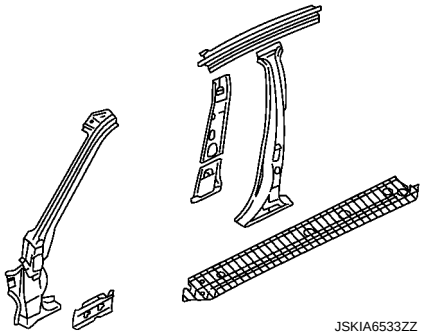
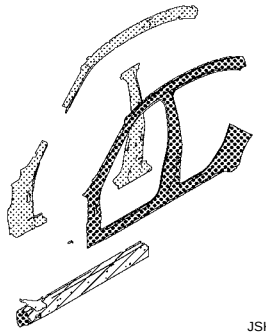
Panel thickness	Plug hole dia.
Below 1.0 mm (0.039 in)	Below 5 mm (0.20 in)
1.0 mm - 2.4 mm (0.039 in - 0.094 in)	6.5 mm - 10 mm (0.256 in - 0.394 in)
Over 2.4 mm (0.094 in)	Over 10 mm (0.39 in)



(3) UNDERSTANDING SERVICE PARTS

This is important in judging when the panel should be replaced, or in determining conditions for efficient operation.
Service parts should be prepared with reference to the Parts Catalog for each model.
The integral type outer body side panel consists of two types of service panels. These service panels need to be cut for use depending on the location and degree of the damage.



Separate type outer body side panel	Integral type outer body side panel
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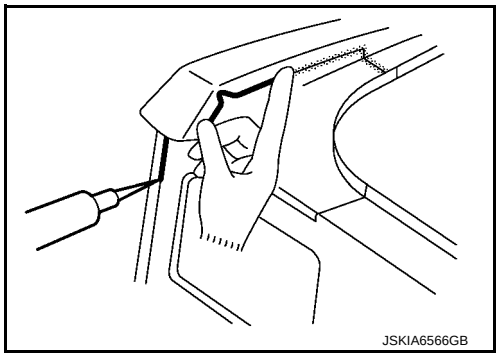
PARTIAL REPLACEMENT OF PANEL (WELDED PANEL) : Anti-corrosive Treatment

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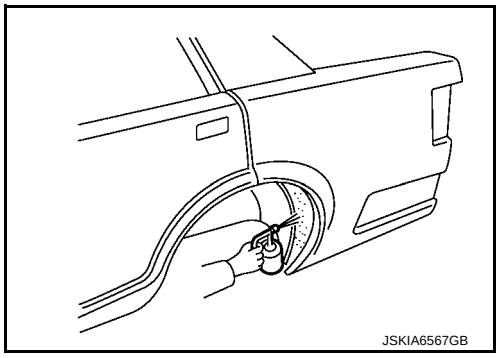
Anti-corrosive treatment may be performed on three different occasions (before welding, before painting, and after painting). This section explains anti-corrosive treatment for the latter two occasions.

(1) ANTI-CORROSIVE TREATMENT BEFORE PAINTING

- Application of body sealer
  Body sealer prevents water or mud from entering through the mating surface of the panel. It also prevents formation of corrosion. The sealer nozzle hole should be small. Use a finger or brush to shape the applied sealer. Refer to the Body Repair Manual for body sealer application points.

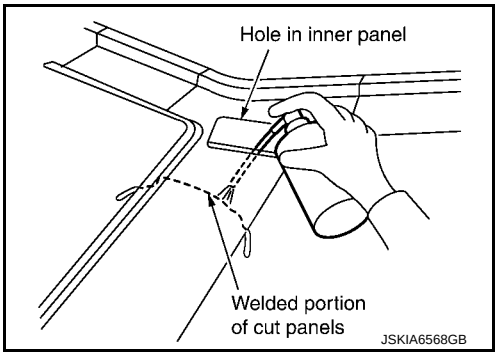

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- Application of undercoating
  Apply undercoating to the underbody and inside of wheelhouse. Do not apply it to the exhaust pipe, suspension or driving portions.


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(2) ANTI-CORROSIVE WAX AFTER PAINTING

Apply anti-corrosive wax to the back of the panel where painting is difficult. Insert the nozzle of anti-corrosive wax into the holes in the inner panel. Apply until the anti-corrosive wax bleeds out from panel mating surface.



USE OF BODY FILLER (PUTTY) AND GRINDING

USE OF BODY FILLER (PUTTY) AND GRINDING : Use of Body Filler (Putty) and Grinding

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Panel irregularities may be corrected with a hammer and dolly. However, exact restoration of the original shape with theses tools takes a long time. Body filler may be used to restore the original panel profile. For this purpose, the panel surface is finished slightly lower than the original surface.
Filler is applied to finish the shape and also to reduce the time needed for repair.
In body repair shops, the most commonly used materials are body filler, polyester putty, and detail putty.
This section mainly describes the body filler.
Polyester putty is described in the paint manual.

USE OF BODY FILLER (PUTTY) AND GRINDING : Types of Filler and Putty

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Type (Standard thickness limits)		Characteristics
Body Filler Putty (For repairing of large dents or scratches) [10 mm (0.39 in)]	Surform type	• This type of filler requires surforming (rough grinding). It will clog sandpaper if it is sanded only. • Can be thickly applied to panel. • After drying, grindability is poor as it is harder than other types.
	Light Type	• This type of filler contains tiny hollow beads. It feels gritty when applied with a spatula. • Suitable for thick application to panel • Superior grindability after application • Forms blowholes easily
	Glass Fiber or Aluminum Powder Type	• Excellent thick application to panel • Superior corrosion prevention and durability • Suitable for repairing rusty holes in panel
Intermediate Filler Putty [10 mm (0.39 in)] (For repairing of large dents or scratches)		• Good sanding characteristics. • It is difficult for fine grain pores to form in it, so poly putty can be eliminated and surfacer can be applied directly over intermediate filler.
Polyester Putty (For filling pores and sand scratches in body filler)	Spatula Type [3 mm (0.12 in)]	• Not very much thickness can be built up. • It has fine grain and good flexibility. • Since no volatile content remains, there is no depletion after baking. • Sanding characteristics are good.
	Spray Type [1 mm (0.04 in)]	• Not very much thickness can be built-up. • Since a spray gun in used, it can be applied easily to any location. • Drying time is approximately two times as long as putty applied with a spatula.

Type (Standard thickness limits)	Characteristics
Lacquer Putty [0.1 mm (0.004 in)] (Detail putty)	• It is soft and flexible. • It cannot be used to built up low areas. • Standing characteristics are extremely good. • The thicker the built-up, the longer the drying time.
Ultraviolet Curing Putty	• Since the drying time is short (approximately 20 seconds after UV irradiation), body work can be completed in a short period of time. • This is often used for minor repairs. • Putty becomes very hard after hardening, therefore its grindability with sandpaper is not good. • It is expensive.

NOTE:
Putty film thickness limits should be decided with putty manufacturer because limits vary from maker to maker.

USE OF BODY FILLER (PUTTY) AND GRINDING : Procedure for Applying Body Filler

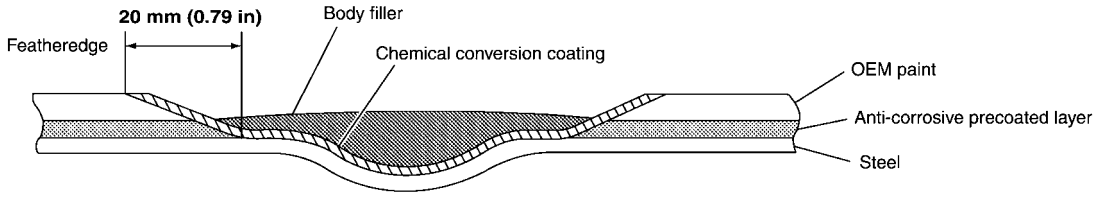
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(1) REMOVAL OF PAINT

Using an air sander, remove old paint from the panel surface for better filler adhesion. Form a featheredge on the panel surface approximately 20 mm (0.79 in) wider than the correction area in order to eliminate traces of body filler application.

(2) CHEMICAL CONVERSION COATING

Body skin panels of NISSAN vehicles use anti-corrosive steel. These panels should be coated with chemical conversion coating before applying common body filler.

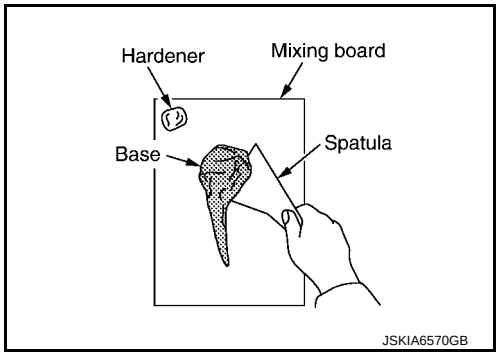


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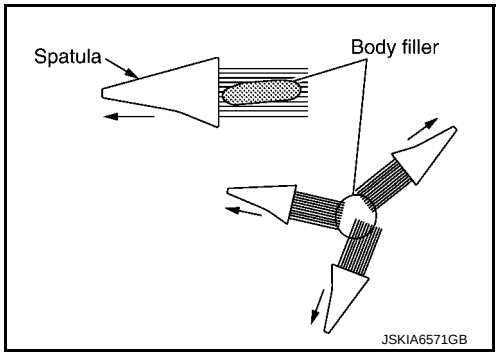
If body filler has been developed for anti-corrosive steel, chemical conversion coating will not be needed. (Please confirm this with the body filler supplier.)

(3) SPATULA MOVEMENT

Move the spatula lengthwise when applying to an oval shaped area. If applying to a round area, move the spatula in many directions as shown in the figure.



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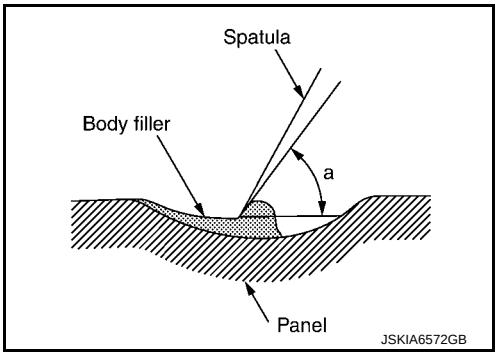


(4) APPLYING TECHNIQUE

Apply body filler in several thin layers.

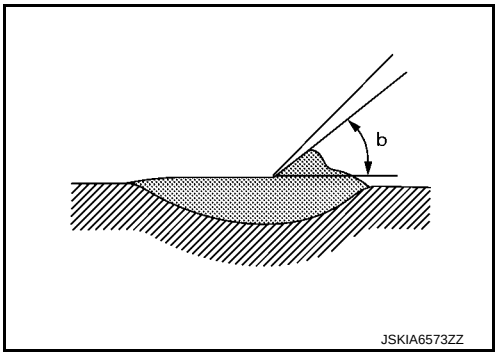
(a) Hold spatula well balanced and hold slightly standing position, then squeeze putty into scratches.

a : 60° – 90°



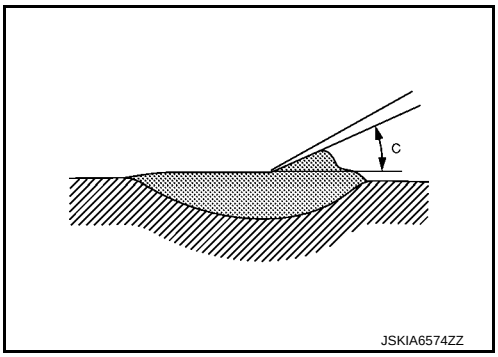
(b) Put a large amount of filler on the spatula.
Hold spatula slightly lean, then apply several times (do not put much in once) until covered above datum level.

b : 30° – 45°



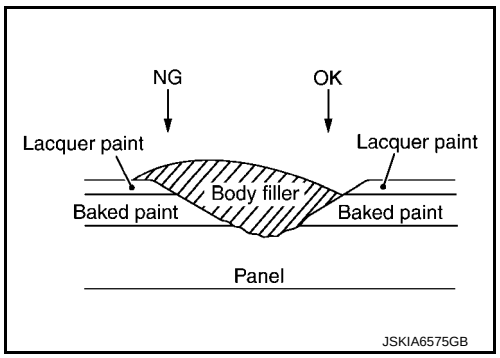
(c) Use the spatula to smooth the applied filler.
Perform finishing work for smoothening the surface. The filler surface should be slightly higher than the panel surface.

c : Less than 30°



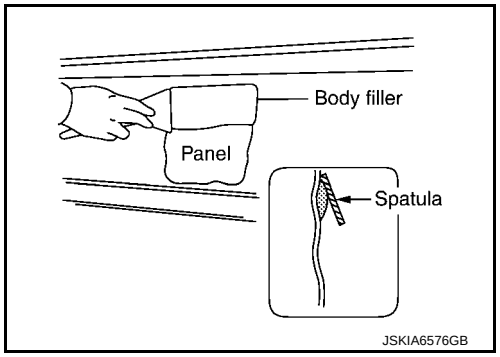
(5) PRECAUTION FOR APPLYING

Be careful not to place body filler over the old lacquer type paint. If this is done, the paint will be softened by the thinner when painting. This causes the body filler to shrink and concave will result.

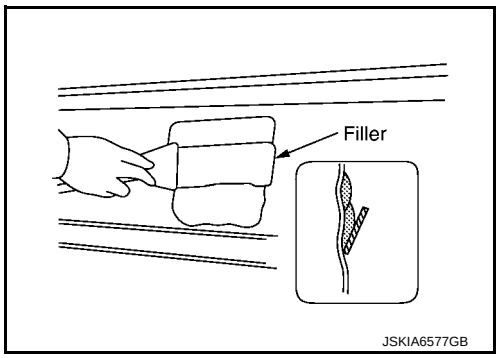


(6) APPLICATION OF BODY FILLER TO FLAT SURFACE

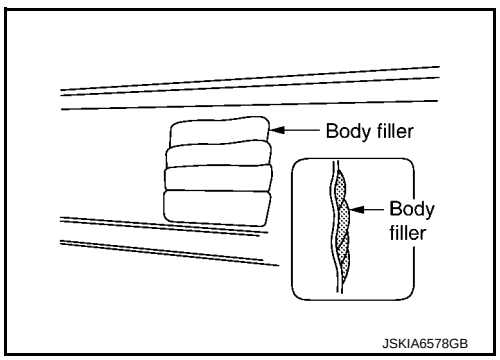
(a) Apply filler so that the corrected surface is flush with the surrounding panel surface.



(b) Apply another layer of filler to overlap 1/3 - 2/3 of the previous application to eliminate the step.

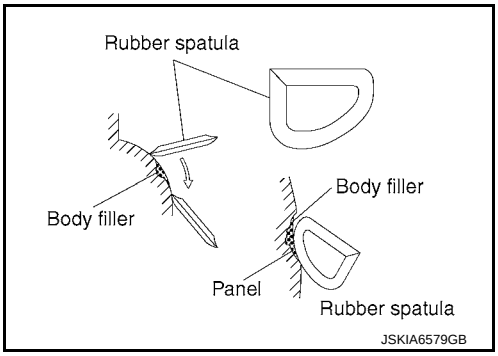


(c) Repeat (b) until the filler is correctly applied to the desired portion.



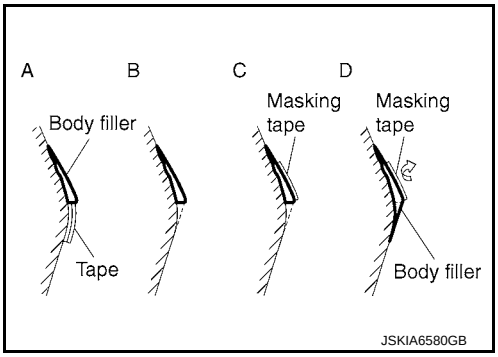
(7) APPLICATION OF BODY FILLER TO CURVED SURFACE

Use of a flexible rubber spatula is recommended for application to curved surfaces.



(8) APPLICATION OF BODY FILLER TO PRESS LINE

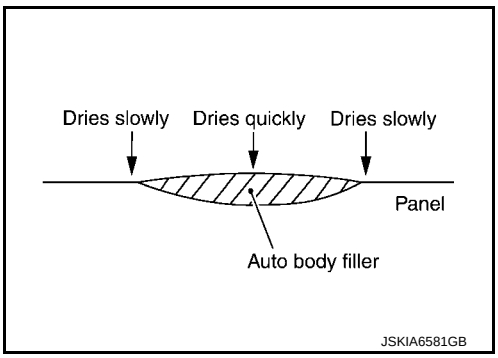
(A) Apply tape along the press line. Then apply filler to only one side of the press line.
(B) Peel the tape from the half-dried filler.
(C) Apply tape along the filled and half-dried filler line.
(D) Apply filler to the other side of the press line.



USE OF BODY FILLER (PUTTY) AND GRINDING : Drying the Body Filler

INFOID:0000000014642551

When the hardener is mixed with the base, the filler begins to harden. Heat is also generated, which accelerates hardening. For this reason, filler drying speed varies with the applied thickness.
If a thick coat of filler is applied, the generated heat remains inside, hence it hardens quickly.
Where the filler is not so thick, it hardens rather slowly because heat dissipates to the outside.



Approximately 10 - 20 minutes (at 20°C or 68°F) after application, the filler becomes hard enough to permit grinding with a surform. When the ambient temperature is low, use a panel heater or adjust the drying time. To check whether the filler is dry or not, press a thin portion with finger. If it is dry, then it is suitable for grinding.

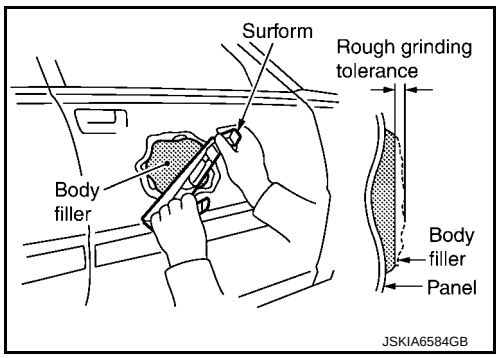
USE OF BODY FILLER (PUTTY) AND GRINDING : Grinding the Filled Area

INFOID:0000000014642552

Grind the filler when it is half-dried. Half-dried filler means the condition where the surface, if ground lightly with a surform, will produce continuous linear chips. Grinding with the surform will be difficult after the filler hardens completely.

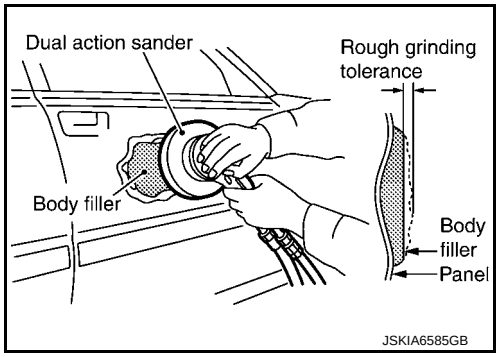
(1) ROUGH GRINDING BY SURFORM

Smooth the filler surface by grinding with the surform or the like. Grind in many different directions. Better results may be obtained if the surform is inclined 30° - 40° with respect to the direction of movement. Be careful not to damage the surrounding panel surface.



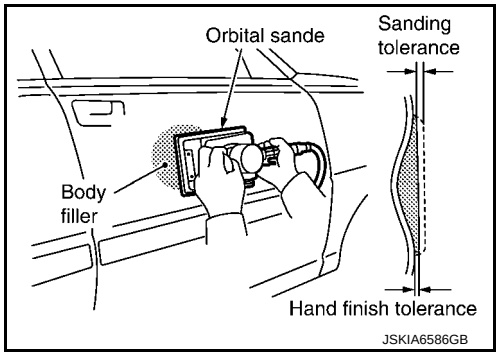
(2) ROUGH GRINGING BY AIR SANDER

Smooth the filler surface by grinding with the dual action sander or orbital sander. Grind in many different directions.
This grinding method is faster than the method using a surform. However, if the worker is not accustomed to performing this type of grinding, an uneven surface may result from excessive grinding. #60 - #80 sandpaper is used.



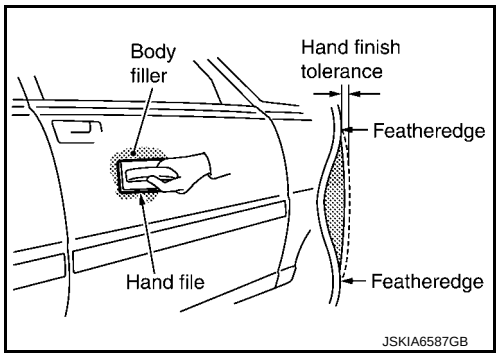
(3) SHAPING THE ENTIRE PANEL

Using an orbital sander or dual action sander, trim the shape of the filled panel. Leave the amount required for final finishing. #120 - #180 sandpaper is used.



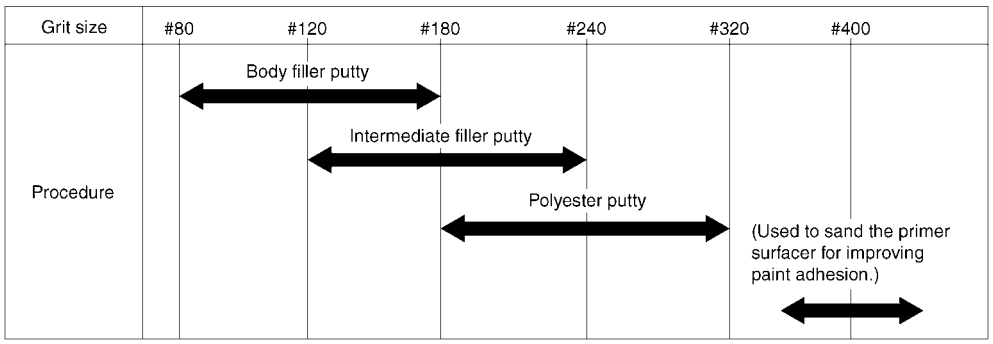
(4) FINAL FINISH BY HAND FILE

Using a hand file, orbital sander or dual action sander, smooth and form featheredge on the filler surface until it is flush with the surrounding panel. #240 - #320 sandpaper is used.



USE OF BODY FILLER (PUTTY) AND GRINDING : Sandpaper Grits

INFOID:0000000014642553



JSKIA6834GB

Select a sandpaper with a grit, appropriate to the putty used. Sanding marks that occur due to sanding are removed with further sanding.

SWITCHING TO A SANDPAPER OF A DIFFERENT GRIT

Sanding marks that occur during sanding are sanded with a sandpaper of the next finer grit. When doing this, do not sand using a sandpaper of a grit two grades or more finer than the previously applied sandpaper.

NG : #80 ⇒ #180 ⇒ #320 ⇒ #400

*: Note that, if sanding with a sandpaper of a grit two grades or more finer than the last one used, removing deep sanding marks that occur during sanding with a coarser sandpaper, as well as removing any remaining deep sanding marks may take longer.

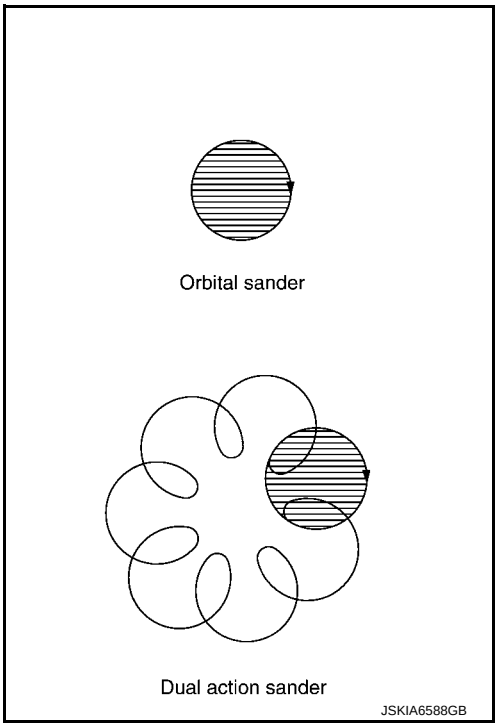
OK : #120 ⇒ #180 ⇒ #240 ⇒ #320 ⇒ #400

USE OF BODY FILLER (PUTTY) AND GRINDING : Grinding Power of Air Sander

INFOID:0000000014642554

The diameter (shown in the figure) of a circle traced by a part of the dual action sander and the orbital sander is called an orbit diameter. The larger the area shown with diagonal lines, the greater the grinding power is.
When surface accuracy is required, a sander with a smaller orbit diameter should be selected. When grinding power is required, a sander with a larger orbit diameter should be selected.

Work content	Orbit diameter
Sanding a body filler	7 mm - 10 mm (0.28 in - 0.39 in)
Sanding a primer surfacer	4 mm - 5 mm (0.16 in - 0.20 in)
Roughing surface before topcoating	3 mm - 4.5 mm (0.118 in - 0.177 in)



JSKIA6588GB

REPAIR OF RUST AND CORROSION

REPAIR OF RUST AND CORROSION : Repair of Rust and Corrosion

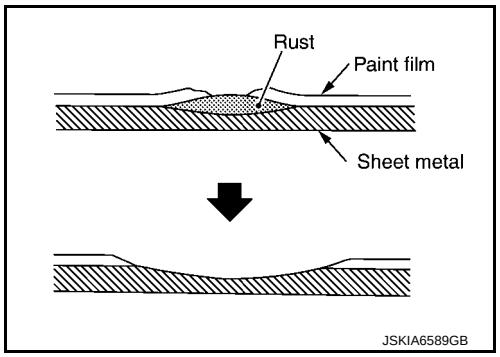
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Rust on sheet metal is the result of the chemical reaction of steel to oxygen in the air, which is called oxidation. This rust, if left untreated, will increase and finally corrode and damage the sheet metal. If the vehicle is used for a long time under severe environmental conditions, rust or corrosion may form on body surfaces. When repairing rust and corrosion, it is necessary to keep rust from spreading from the repaired portion.

REPAIR OF RUST AND CORROSION : Removal of Rust Limited to the Skin Panel Surface

INFOID:0000000014642556

Grind the rusted portion with an air sander or the like.
Rust may be more extensive than it appears from the outside. Therefore, it is necessary to grind the area around rusted portion. Repair the ground out portion using body filler.

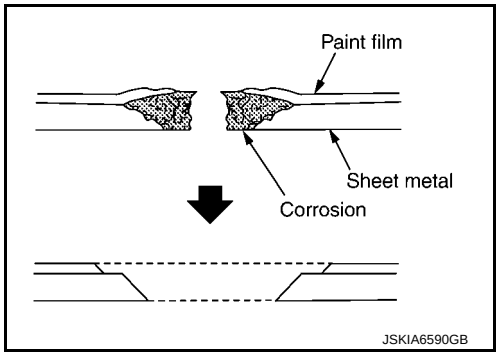


REPAIR OF RUST AND CORROSION : Repair of Corroded Panel

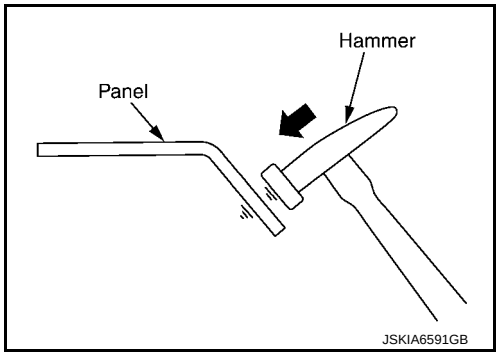
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(1) FILLING WITH FIBERGLASS

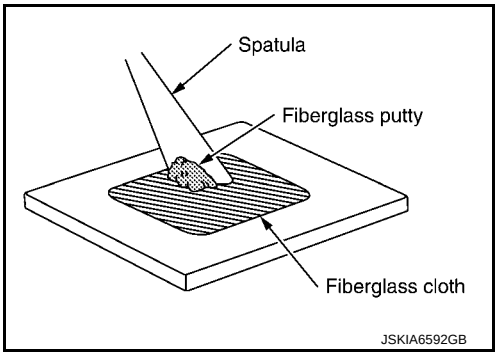
(a) Grind off the corroded portion of the panel with an air sander. If corrosion is severe, cut off the affected portion with a chisel or tinman's shears. Remove the paint from the surrounding areas.



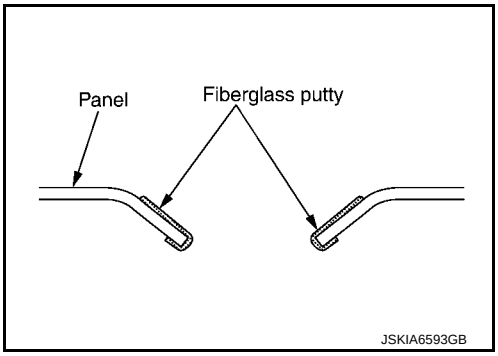
(b) Hollow the area surrounding the repair hole by tapping with a hammer and bending the panel.



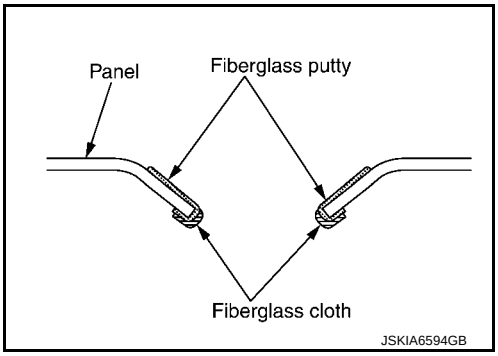
(c) Cut a piece of fiberglass cloth. The cloth should be large enough to overlap the repair hole.
Apply fiberglass putty to the cloth using a spatula until the mesh is filled. Prepare the fiberglass putty by mixing 100 parts of base with 2 to 3 parts of hardener.



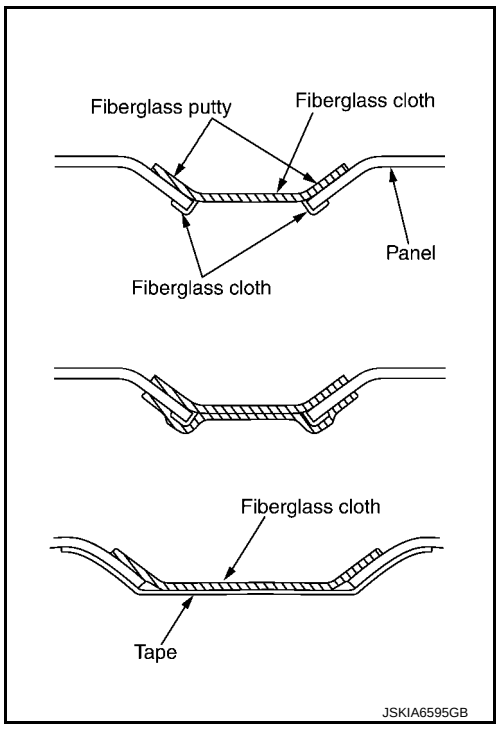
(d) Apply a thin coat of fiberglass putty to the panel where the piece of fiberglass cloth is to be attached.
Apply putty also to the edge and back of the repair hole.



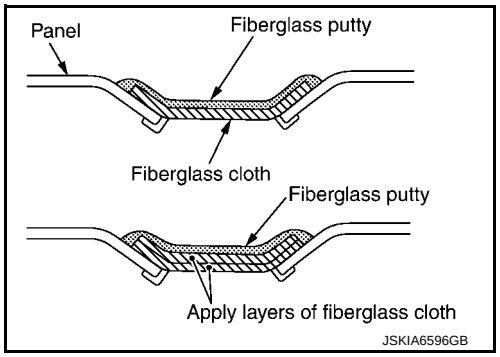
(e) Apply the piece of fiberglass cloth to the surrounding portion and the back of the repair hole.
This is necessary to prevent rust.



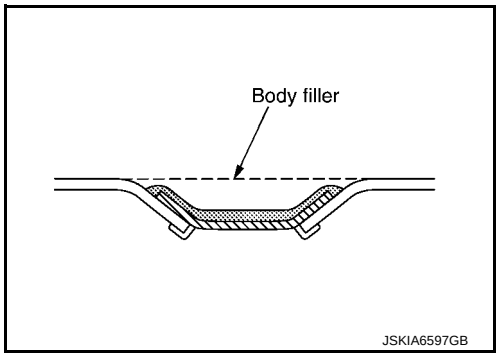
(f) Apply the piece of fiberglass cloth prepared in step (c) above to the repair hole. Press the periphery of the cloth to the panel for better adhesion. If the repair hole is large and the cloth sags in the center, support the cloth with tape applied behind the panel.



(g) Apply the fiberglass putty to the piece of fiberglass cloth. The fiberglass putty surface should be below the surrounding panel surface. If the area to be repaired is deep, use two or more piece of fiberglass cloth. In such a case, avoid thick application of fiberglass putty. Thick fiberglass putty will crack after drying.

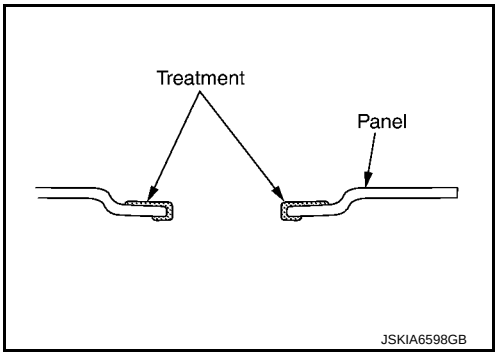


(h) Dry the fiberglass putty, and grind the surface with an air sander. Then trim the entire panel using body filler.
When force drying fiberglass putty, allow the putty to sit for approximately 20 minutes. Then heat at a temperature below 60°C (140°F). Rapid heating which causes the putty to change color must be avoided, as it will lead to cracked putty. Fiberglass putty forms blowholes easily. Body filler must be used to finish the surface of fiberglass putty.

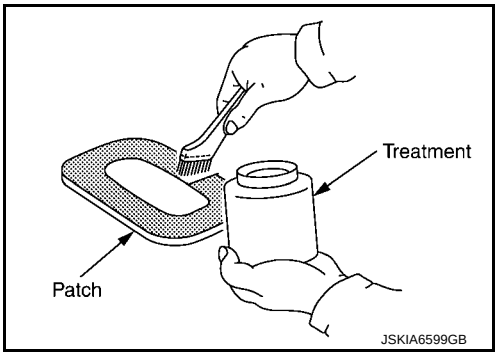


(2) PATCHING

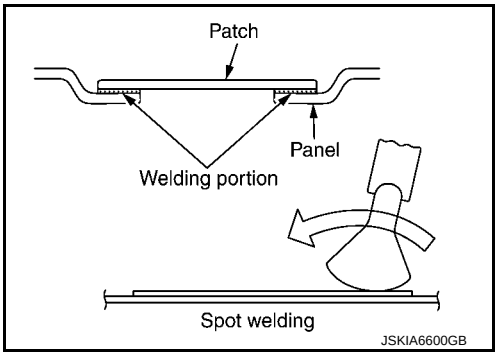
(a) Remove the corroded portion of the panel.
Remove paint from the panel around the repair hole.
Make a flange by bending the surrounding panel with pliers and hammer, then apply anti-corrosive treatment (Metallic solution).



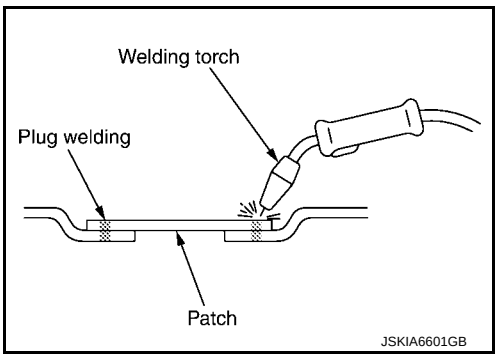
(b) Using tinman's shears, cut a patch large enough to overlap the repair hole. Apply the anti-corrosive treatment to the portion to be welded. Use of stainless steel is recommended to avoid rusting. If the repair hole is large, use a panel having the same thickness as the original panel to retain the original strength.



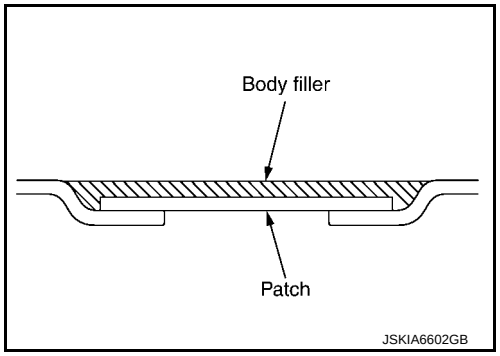
(c) Weld the patch to the repair hole. If stainless steel is used, use the MIG welding or spot welding method.



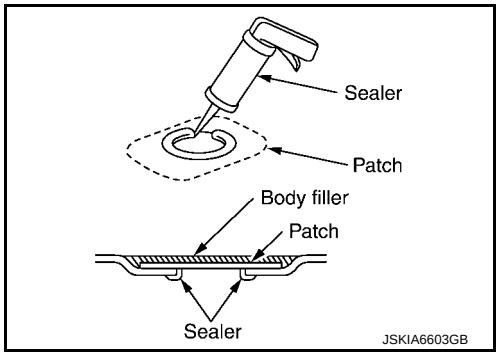
NOTE:
When welding the patch by GSA welding, use the plug welding method.



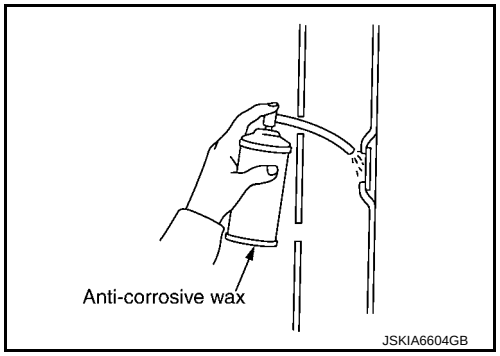
(d) Apply the body filler to the repaired portion of the panel.



(e) Apply the anti-corrosive treatment to the back of the panel. If accessible from behind, apply a sealer to the panel-to-patch mating section.



(f) If inaccessible from behind, apply an anti-corrosive wax from an inner panel opening or the like. It is also important to apply the anti-corrosive treatment to other portions in addition to the repaired portion.



ALUMINUM REPAIR

SHEET METAL WORK (ALUMINUM)

SHEET METAL WORK (ALUMINUM) : Sheet Metal Work (Aluminum)

INFOID:0000000014642558

Repairing aluminum alloy panels is basically the same as repairing steel panels. Special considerations for repairing aluminum alloy are listed below.

SHEET METAL WORK (ALUMINUM) : Sanding

INFOID:0000000014642559

Aluminum alloy panels are softer than steel plates. It is important to select the proper type and grade of sanding disc. Also, care must be taken not to overgrind the surface.
Because aluminum powder is light and tends to float in the air, eyes and respiratory parts of the body must be fully protected during grinding work.

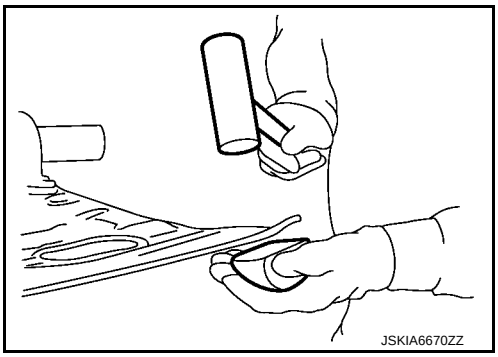
Application examples

Tool	Coarse	Application
Disc sander	Approx. #120	• Removal of old paint • Sanding aluminum surface
Double action sander	Approx. #120 - #180	• Make featheredge • Removal of putty

SHEET METAL WORK (ALUMINUM) : Hammering

INFOID:0000000014642560

Elongation of aluminum alloy during hammering will be greater than with steel plates. Therefore, a wooden or plastic hammer should be used with a softer blow to prevent stretching and work hardening of panels. Observe the following in case body filler is applied after hammering.
Apply wash primer and let it dry for 1 hour at 20°C (68°F) before applying body filler.
Use putty that can be used for aluminum panels. Do not perform forced drying because the coefficient of linear expansion is twice as much as that of sheet steel.

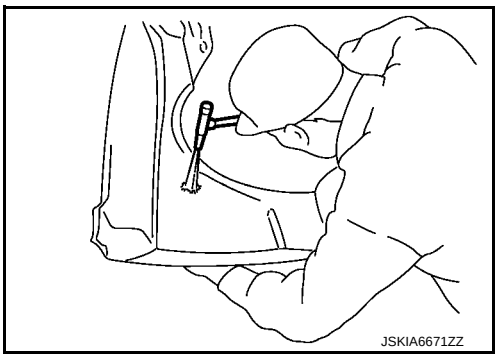


SHEET METAL WORK (ALUMINUM) : Heating Repair

INFOID:0000000014642561

While hammering work is being performed during the rough repair stage, the area needs to be heated. First, cover your hand with a glove (cloth material), and then place hand on the reverse side of the panel near the repair area. Apply heat to the entire repair area using a gas burner (oxy-acetylene gas welder) until your covered hand feels heat.

WARNING:
The panel may crack when hammered without sufficient heat being applied.



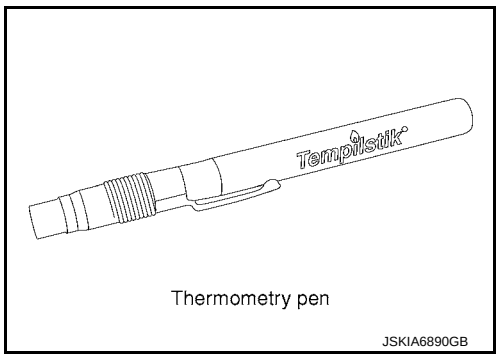
SHEET METAL WORK (ALUMINUM) : Shrinking

INFOID:0000000014642562

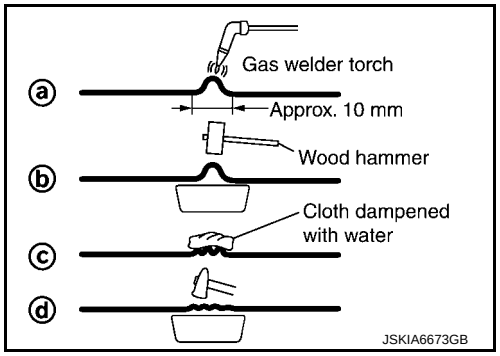
(1) FLAME SHRINKING

- The area should be heated to approximately 250°C.
  Aluminum alloy panels do not turn red when heated like steel plates. Prior to heating up the panel you are trying to repair, first practice with a scrap piece to get a good idea of how much heat is needed. This way the number of passes with the gas burner needed to achieve the correct temperature can be determined.

- A thermometry pen may be applied to the repair area before heat application. Apply the thermometry pen to the heated part. Check if the thermometry pen is melted to judge if the temperature on the heated area is within the range of the specified temperature. When measuring temperature, use two thermometry pens of different specified temperatures. This allows the top and bottom of the temperature range to be judged accurately.
  (Example: Tempilstik or equivalent)

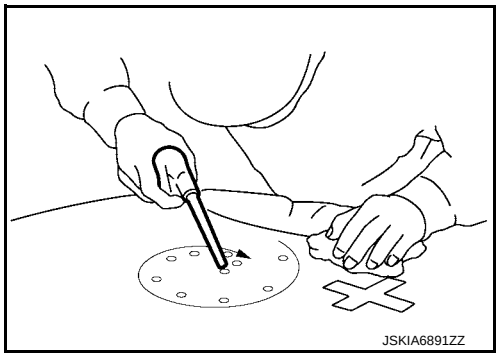


- The heat conduction efficiency of aluminum alloy panel is approximately twice that of steel plate, which allows heat to be absorbed and released at a faster rate. Hammering [(b) in the figure] and rapid cooling work [(c) in the figure] must be performed while the area is still hot.
- Don't use a shrinking hammer because it causes a crack.



(2) SHRINKING BY ELECTRIC WELDING

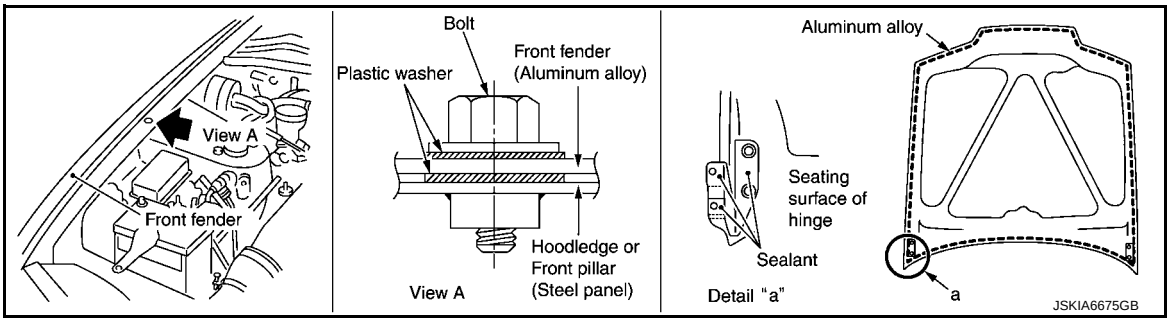
Shrinking with an electric welder is easier than with a gas burner, however this method leaves spark marks, scratches, carbon deposits, and oxide film on the panel surface.
For this reason, as an undercoating preparation, the panel surface must be cleaned using silicon off and a stainless steel wire brush.
When spark marks and scratches are large, the impurities are first completely removed using a wire brush, and then wash primer and putty are applied.



SHEET METAL WORK (ALUMINUM) : Precautions during Assembly

INFOID:0000000014642563

When installing parts, insulating materials such as resin washers (bolts at front fender) and anti-corrosion sealant (hood hinges) are inserted between the aluminum alloy panel and steel plates to prevent contact corrosion which occurs where different metals touch.



WELDING (ALUMINUM)

WELDING (ALUMINUM) : Welding (Aluminum)

INFOID:0000000014642564

To repair a crack or a hole in a steel plate, welding is usually used. Either oxygen and acetylene gas welding, arc welding, or brazing is commonly used. For aluminum alloy panels, TIG or MIG welding, which use inert gases (argon gas) as a shield gas, are usually used. This is because aluminum alloy has the following special features.

- Its melting temperature is lower than iron, however the specific heat and latent heat are higher. It also has good conductivity. For these reasons, a large amount of heat must be applied in a very short time.
- The melting point of aluminum alloy oxidized film is 2,020°C (3,668°F). In order to remove this film, cleaning by argon welding (TIG welding, MIG welding) or flux treatment is required.
- Not removing oxidized films results in incomplete fusion or blowholes.
- Heat expansion and contraction is approximately twice that of iron, which allows for easy distortion by welding.

WELDING (ALUMINUM) : Comparision of Chemical and Physical Properties between Aluminum and Iron

INFOID:0000000014642565

Property	Aluminum alloy	Iron	Effect of welding
Melting temperature °C (°F)	560 - 640 (1,040 - 1,184)	600 × 2.5 (1,112 × 2.5)	• Aluminum alloy melts before it turns red. • This makes it difficult to judge the temperature.
Heat conduction efficiency cal/cm/sec/°C (BTU in/m^2/h/°F)	0.28 (812.69)	0.28 × 0.57 (812.69 × 0.57)	Large amount of heat in a short time required for welding.
Modulus of elasticity kg/mm^2 (lb/in^2)	7,000 (9,646,875)	7,000 × 3 (9,646,875 × 3)	Easily deformed and very fragile.
Coefficient of linear expansion (10^{-6})	23.8	23.8 × 0.5	
Conductivity (%)	30	30 × 0.52	Large current flow is required when compared to iron.
Oxidized film	Al_2O_3	Fe_2O_3	The melting point of aluminum alloy oxidized film is 2,020°C (3,668°F). In order to remove this film, cleaning by argon welding or flux treatment is required.

WELDING (ALUMINUM) : Filler Metal

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For a filler metal, TIG welding rods and MIG welding electrode wires are available. Use filler metal that is suitable to the parent metal.

Main selection standards of filler metal

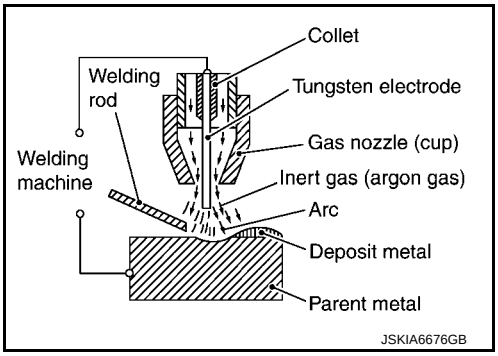
Parent metal	Filler metal
Front fender, hood: 5000 series, 6000 series	A5356
Door: 6000 series	A5356

WELDING (ALUMINUM) : TIG Welding

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TIG is the abbreviation for tungsten inert gas shielded arc welding. TIG has the following special features.

Special features
- Initial cost of the equipment is low, as is maintenance expense.
- For ordinary electric power, high frequency alternating current is used.
- Easy to learn in a short time.
- Excellent strength and anti-corrosion properties.
- Ideal for welding instruction and training.



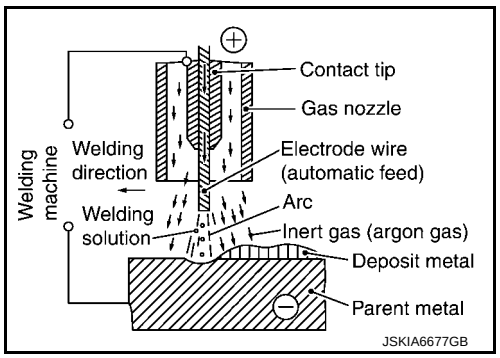
WELDING (ALUMINUM) : MIG Welding

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MIG is the abbreviation for metal inert gas shielded arc welding. MIG welding has the following special features.

(1) NORMAL MIG WELDING

MIG welding is the most commonly used welding method. As shown in the figure, a wire serving as an electrode is continuously fed into the welding area, and an arc is generated between the wire tip and the parent metal. Normally, an electrode wire measuring 1.2 mm - 1.4 mm (0.047 in - 0.055 in) in diameter, with an electrical current of 110 A - 360 A, is used for welding a plate having a thickness of 2 mm (0.079 in) or more.



(2) SHORT ARC MIG WELDING METHOD

When welding a thin plate, a short arc welding method is generally used.

- As shown in the figure, a short circuit and arc pattern is repeated.
- When compared to ordinary MIG welding, using this short circuit transient method requires less heating, and therefore welding of a thin plate measuring 1 mm (0.04 in) in thickness can be accomplished.
- The short arc welding conditions are shown below.
  For the torch in the short arc welding, a thin wire measuring 0.8 mm - 1.2 mm (0.031 in - 0.047 in) in diameter and wound in a small spool is installed.

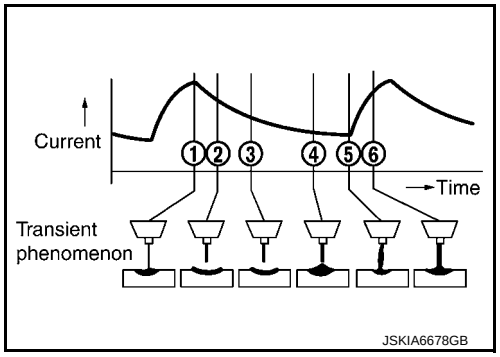
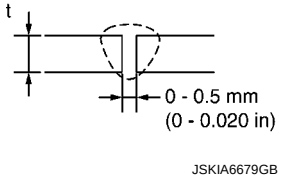


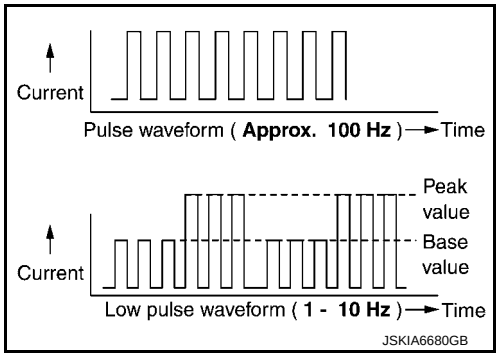
Plate thickness t = mm (in)	Shape of welding	Current (A)	Voltage (V)	Argon flow rate ℓ (US gal, Imp gal)/ min	Welding speed mm (in)/min
1 (0.04)		45	12	13 (3-3/8, 2-7/8)	600 (23.62)
2 (0.08)		85	15	15 (4, 3-1/4)	600 (23.62)
3 (0.12)		120	22	15 (4, 3-1/4)	600 (23.62)

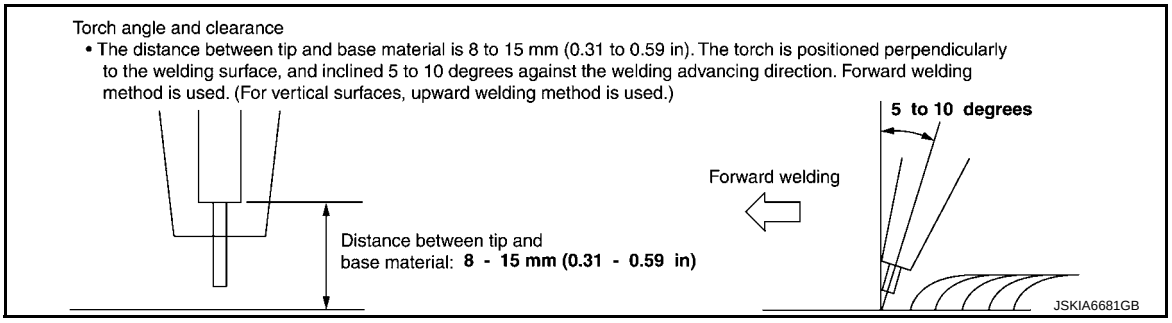
(3) PULSED ARC WELDING METHOD

To enable spray transfer, even in the current range, which is equivalent to or lower than the critical current (spray transfer limiting current), pulse waveform is added to this welding method. Because this method allows stable penetration and bead shape while preventing heat gain, it is suitable for thin plate welding.

LOW PULSE FUNCTION

- In addition to the pulse function, this function makes it easier to create imbricate bead shape.
- It is effective in preventing burn through during the thin plate welding and the welding of panels with a gap present in between.





WELDING (ALUMINUM) : MIG Welding Method

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(1) PLUG WELDING

MIG plug welding method is used to repair the spot welded portions.
Keep the upper panel and lower panel tightly together. Before welding, contact closely the points to be plug welded.
Observe the welding condition described in the Body Repair Manual.

(a) Welding condition (plug welding)
Basically, the following welding conditions are intended for horizontal welding. Therefore, depending on the welding direction, adjustment may be necessary.

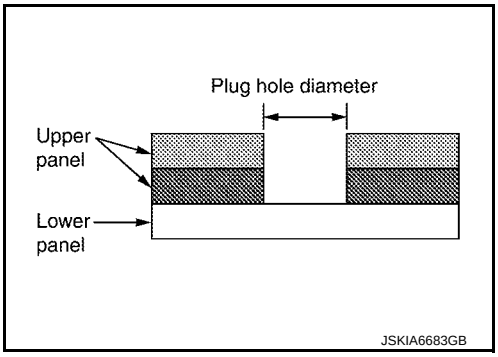
• Two-sheet plug welding conditions

• **Welding wire** **A5356-WY 1.2 mm (0.047 in)**
• **Low pulse function** **Use 5Hz**

Upper panel T mm (in) / Lower panel T mm (in)	1.0			2.0			3.0			4.0			5.0		
	Diameter mm (in)	Current (A)	Voltage (V)	Diameter mm (in)	Current (A)	Voltage (V)	Diameter mm (in)	Current (A)	Voltage (V)	Diameter mm (in)	Current (A)	Voltage (V)	Diameter mm (in)	Current (A)	Voltage (V)
1.0 (0.039)	8.0 (0.315)	100 (3.94)	18 (0.71)	8.0 (0.315)	100 (3.94)	18 (0.71)	8.0 (0.315)	120 (4.724)	19 (0.75)	8.0 (0.315)	160 (6.30)	19 (0.75)			
2.0 (0.079)	8.0 (0.315)	150 (5.91)	19 (0.75)	9.0 (0.354)	180 (7.09)	20 (0.79)	9.0 (0.354)	180 (7.09)	20 (0.79)	9.0 (0.354)	190 (7.48)	20 (0.79)	9.0 (0.354)	200 (7.87)	20 (0.79)
3.0 (0.118)	8.0 (0.315)	180 (7.09)	20 (0.79)	9.0 (0.354)	180 (7.09)	20 (0.79)	11.0 (0.433)	200 (7.87)	20 (0.79)	11.0 (0.433)	210 (8.27)	21 (0.83)	11.0 (0.433)	210 (8.27)	21 (0.83)
4.0 (0.157)	8.0 (0.315)	180 (7.09)	20 (0.79)	9.0 (0.354)	190 (7.48)	20 (0.79)	11.0 (0.433)	210 (8.27)	21 (0.83)	12.0 (0.472)	220 (8.66)	22 (0.87)	12.0 (0.472)	220 (8.66)	22 (0.87)
5.0 (0.197)				9.0 (0.354)	200 (7.87)	20 (0.79)	11.0 (0.433)	220 (8.66)	22 (0.87)	12.0 (0.472)	230 (9.06)	23 (0.91)	13.0 (0.512)	230 (9.06)	23 (0.91)

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(b) Three-sheet plug welding condition
Consider the total thickness of two upper panels as the upper panel thickness. Using this thickness, apply the two-sheet plug welding conditions to set plug hole diameter, current, and voltage.

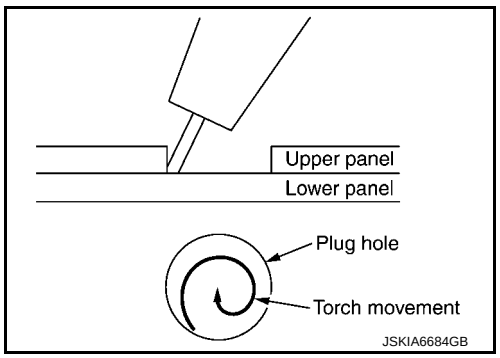


(c) Torch movement

- Thickness of lower panel

1.4 mm (0.055 in) or less

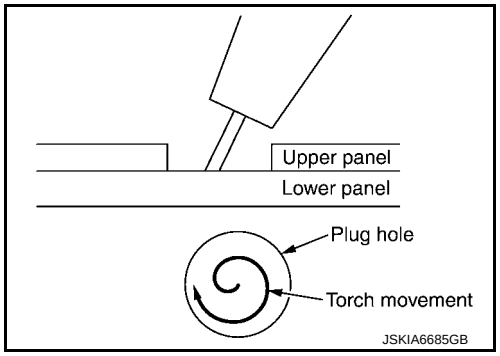
Weld from the plug hole circumference toward the center in a circular motion.



- Thickness of lower panel

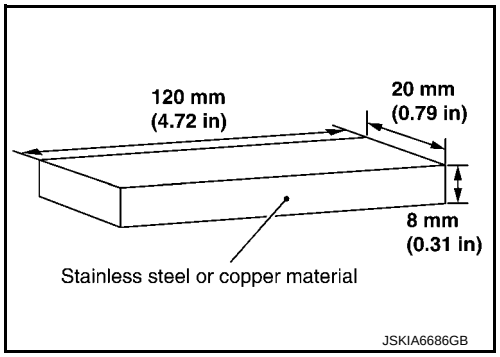
1.5 mm (0.059 in) or more

Weld from the plug hole center toward the circumference in a circular motion.



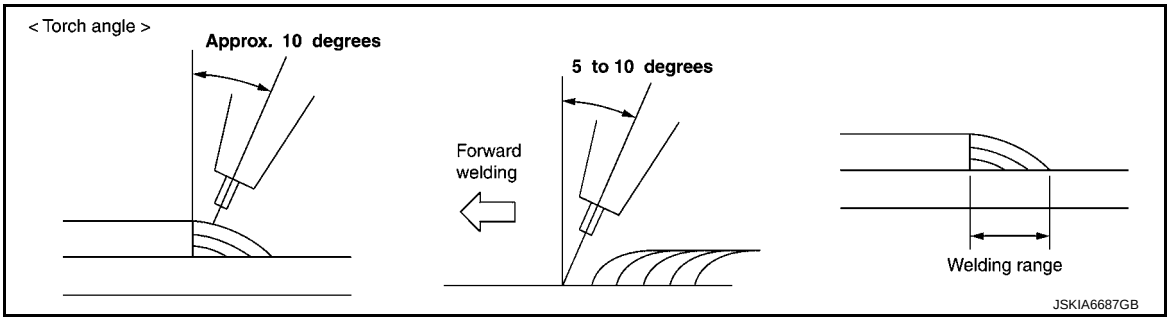
(d) Backing block

When thin panels are plug welded, a backing block, as shown in the figure, is placed on the underside of the panels, and fixed onto the plug hole side with a clamp.
This is to prevent thin panels from burning through.
For locations where backing strips cannot be applied, be careful not to burn through.



(2) FILLET WELDING

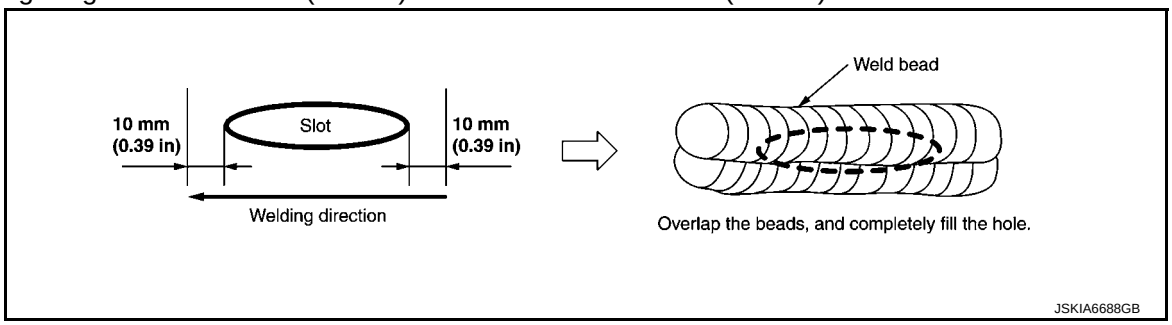
- Before welding, contact closely the points to be fillet welded.
- Observe the welding conditions and lengths specified in the Body Repair Manual.
- Set the welding range for the fillet welding cross section so that it is same as the panel thickness or wider. When the panels have different thicknesses, perform welding according to the welding conditions applicable to the thinner panel.



(3) SLOT WELDING

- Before welding, contact closely the points to be slot welded.
- Observe the welding conditions specified in the Body Repair Manual.

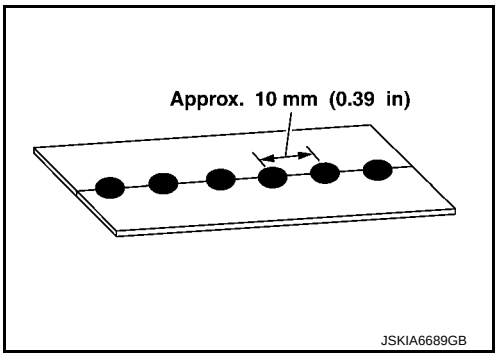
- Welding range is from 10 mm (0.39 in) before the slot to 10 mm (0.39 in) after the slot.



(4) BUTT WELDING

Observe the welding conditions specified in the parts replacement procedure.

1. Tack welding: Temporarily, but securely weld at approximately 10 mm (0.39 in) intervals.
2. Remove aluminum oxides and magnesium oxides generated at tack welded points. Not doing so results in a welding malfunction.
3. Regular welding.

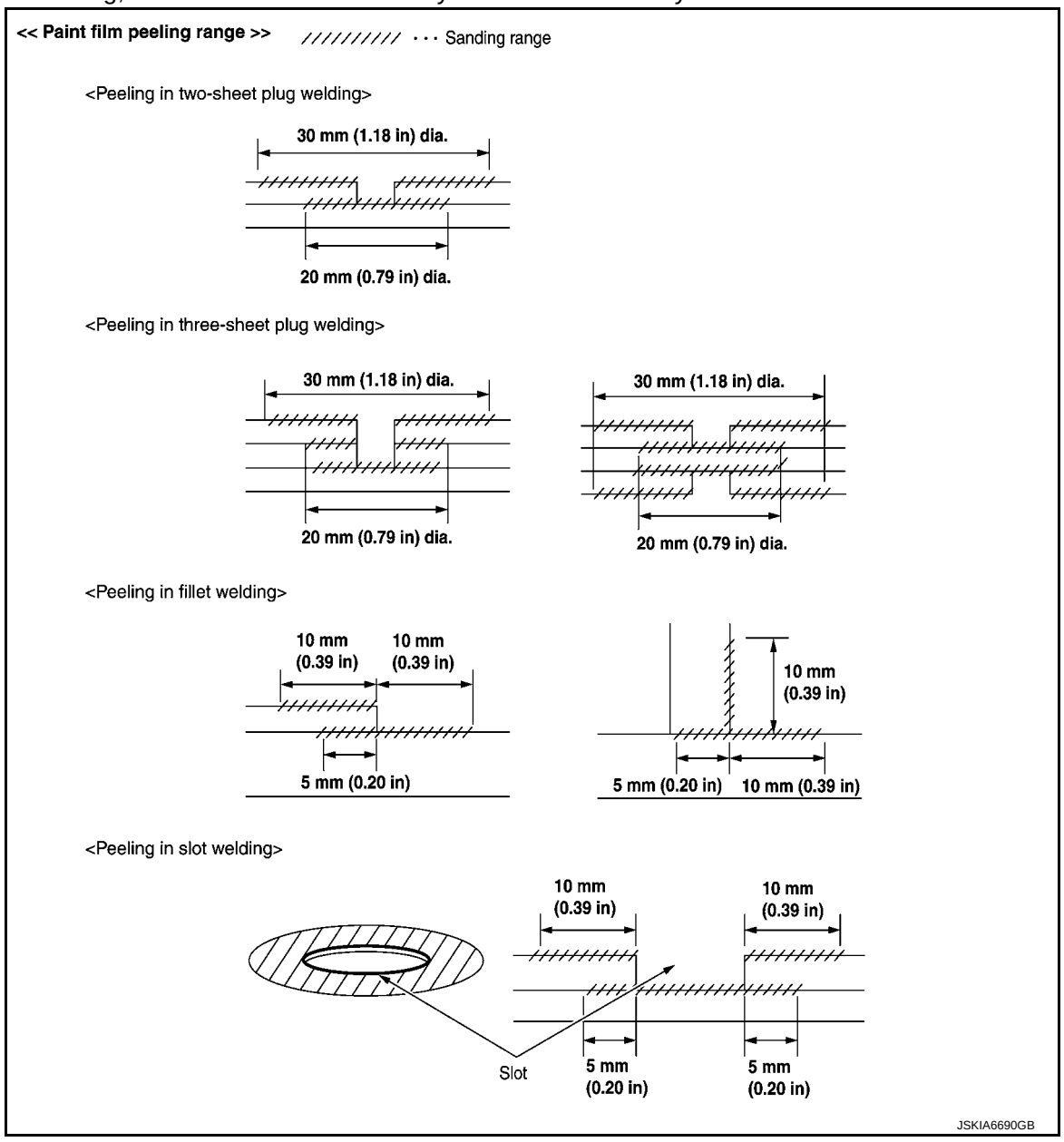


WELDING (ALUMINUM) : Precautions during Welding

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- Wear long sleeved work uniform, work cap, and safety shoes. Wear safety goggles, gloves, earplugs, and dustproof respirator if necessary.
- MIG arc welding for aluminum plates emits sparks. Do not stare directly at them. Before working, be sure to wear protectors to avoid getting burned.
- Always perform pre-treatment of the parent metal.
  Dirt and oxidization film on the parent metal will cause defective welding. The following pre-treatment should be performed prior to welding. Oil film should be cleaned using Silicon Off or white gasoline.
  Surface should then be polished using a thin wire stainless steel brush.
  Oxide film is reproduced in approximately 30 minutes to 1 hour.
  Therefore, it is best to perform the pre-treatment immediately before welding.
  Even if pre-treatment for various locations has already been performed, it is necessary to use a wire brush again immediately before welding.
- Use filler metal (welding rod or welding wire) that is suitable for the parent metal.
- Filler metal used for aluminum welding flows easier than for steel welding, and therefore the welding surface should be in the horizontal position.
- For TIG and MIG welding, even a 0.5 m/s (1.6 ft/s) breeze will greatly effect the seal. When performing welding outside, select a place where dust and moisture are minimized. A shelter should be constructed for protection from wind or rain.
- Remove paint film of the welding portions and electrodeposition coating of the service parts using a disc sander.

When removing, be careful not to excessively sand aluminum alloy base material.

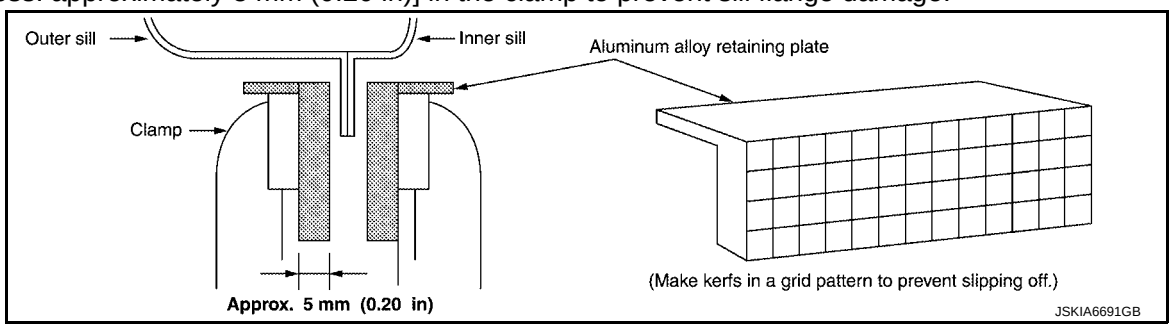


BODY STRAIGHTENING (ALUMINUM)

BODY STRAIGHTENING (ALUMINUM) : Securing the Vehicle

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When fixing the aluminum body to the body straightening equipment, set an aluminum alloy retaining plate [thickness: approximately 5 mm (0.20 in)] in the clamp to prevent sill flange damage.



BODY STRAIGHTENING (ALUMINUM) : Frame Straightening

INFOID:0000000014642572

- Buckling portions have been work hardened. When straightening frames, straighten by pulling out while heating with oxy-acetylene gas welder. Unlike steel plates, aluminum alloy does not change color even when heated. Use a noncontact type thermometer or thermometry pen to control the temperature. Be careful not to overheat.
  <Reference> Melting point of aluminum alloy: approximately 640°C (1,184°F)

  Possible heating temperature

  Extrusion molding material (6000 series) : 110°C (230°F)

  Press molding material (5000 series) : 350°C (662°F)

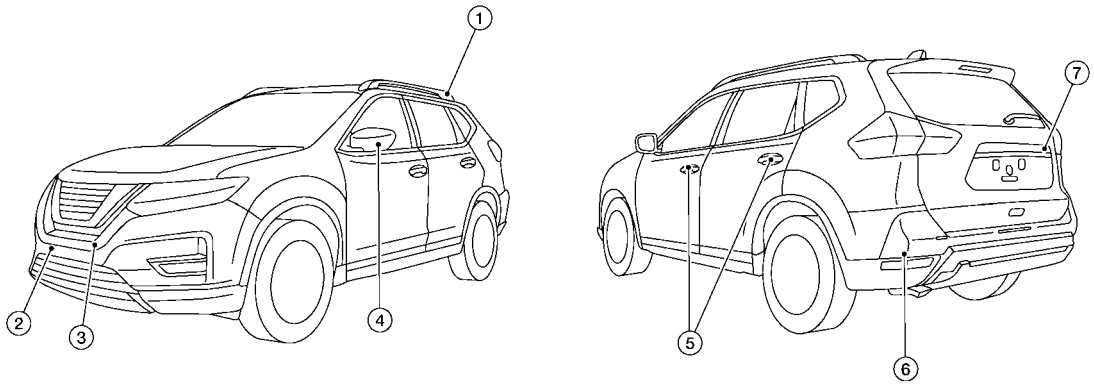
- During pulling work, pulling fully with large force causes weld to peel (spot weld peeling or cracks are generated in fillet weld). Pull out gradually.
- Aluminum alloy has high thermal conductivity. When heating, remove interior equipment and other related parts extensively.

VEHICLE INFORMATION

BODY EXTERIOR PAINT COLOR

Body Exterior Paint Color

INFOID:0000000014625681



ALKIA4563ZZ

Component		Color code	EAN	EBB	K23	KAD	G41	QAK	NBF	QAB	RBY
		Description	Green	Orange	Silver	Gray	Black	White	Red	White	Dark Blue
		Paint type	M	M	M	M	M	2S	M	3P	M
		Clear coat	x	x	x	x	x	x	x	x	x
1.	Roof rack	Silver	Silver	Silver	Silver	Silver	Silver	Silver	Silver	Silver	Silver
2.	Front bumper fascia	Body color	EAN	EBB	K23	KAD	G41	QAK	NBF	QAB	RBY
3.	Front grille	Black/Chrome	Black/ Cr	Black/ Cr	Black/ Cr	Black/ Cr	Black/ Cr	Black/ Cr	Black/ Cr	Black/ Cr	Black/ Cr
4.	Door mirror finisher	Body color	EAN	EBB	K23	KAD	G41	QAK	NBF	QAB	RBY
5.	Door outside handle	Chrome	Cr	Cr	Cr	Cr	Cr	Cr	Cr	Cr	Cr
6.	Rear bumper fascia	Body color	EAN	EBB	K23	KAD	G41	QAK	NBF	QAB	RBY
7.	Back door finisher	Chrome	Cr	Cr	Cr	Cr	Cr	Cr	Cr	Cr	Cr

M = Metallic, 2S = Solid and Clear, 3P = 3-coat pearl, x = Standard clear coat

PAINTING BACK DOOR (SERVICE PART)

The supplied back door (service part) is painted by Color Code K23 (silver).

CAUTION:

- **Glass may drop off. To prevent the glass from dropping off, do not paint the bonding surface (masking area) of the glass.**
- **Sand and degrease the paint surface before painting it in body color. (For painting methods, observe the instructions provided by the paint manufacturer.)**
- **Repaint the surface by K23 even when the body color is color code K23. (The paint surface is grinded.)**

PRECAUTION

PRECAUTIONS

Precautions for Body Repair

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WARNING:

- **The repair information in this section is intended for trained body repair technicians who have attained a high level of skill and experience (e.g. ASE Collision Repair Certification, I-CAR Professional Development Program [PDP] training, etc.) in repairing collision damaged vehicles using appropriate tools and equipment. Performing repairs without the proper training, tools or equipment could damage the vehicle or cause personal injury or death to you or others.**
- **The information in this Body Repair Manual is a guideline for repairing collision damaged vehicles. However, this information cannot cover all possible ways that a vehicle can be damaged. As such, the body repair technician is responsible for making sure that the repair does not affect the structural integrity or safety of the vehicle. Improper repair of a damaged vehicle may result in a collision, property damage, personal injury or death.**
- **Nissan recommends using only new genuine Nissan replacement body parts. Use of used, salvaged or aftermarket body parts is not recommended by Nissan. Non-genuine Nissan components may affect the vehicle's structural integrity and crash safety performance, which could result in serious personal injury or death in an accident.**

Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER"

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The Supplemental Restraint System such as “AIR BAG” and “SEAT BELT PRE-TENSIONER”, used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the SR and SB section of this Service Manual.

WARNING:

- **To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision which would result in air bag inflation, it is recommended that all maintenance and repair be performed by an authorized NISSAN/INFINITI dealer.**
- **Improper repair, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see the SR section.**
- **Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.**

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

- **When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the Ignition ON or engine running, DO NOT use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.**
- **When using air or electric power tools or hammers, always switch the Ignition OFF, disconnect the battery or batteries, and wait at least three minutes before performing any service.**

REPAIRING HIGH STRENGTH STEEL

High Strength Steel (HSS)

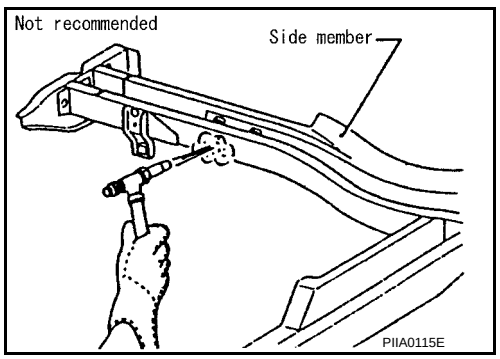
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High strength steel is used for body panels in order to reduce vehicle weight.
Accordingly, precautions in repairing automotive bodies made of high strength steel are described below:

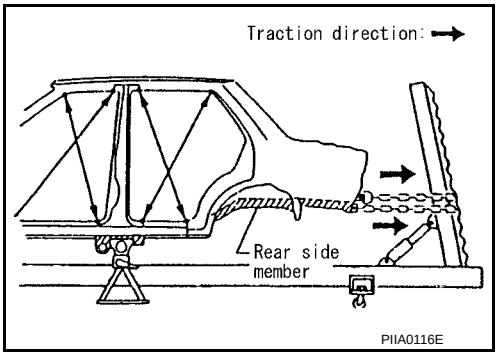
Tensile strength	Major applicable parts
590 - 780 MPa	• Side dash • Rear floor front sides • Hoodledge reinforcement • Front strut housing • Rear seat crossmember • Roof bow No. 1 reinforcement • Inner side roof rail • Rear floor seat belt reinforcement • Front suspension mounting bracket • Front floor • Center front floor • Center rear crossmember • Rear side member extension • Roof bow No. 2 • Upper inner front pillar • Outer sill reinforcement • Rear bumper stay • Inner rear pillar
980 - 1350 MPa	• Lower dash crossmember • Lower front pillar hinge brace • Inner sill • Center pillar reinforcement • Inner center pillar • Front bumper reinforcement assembly • Lower front pillar hinge brace • Outer front pillar reinforcement • Rear bumper reinforcement • Front floor side reinforcement • Lower dash • Front side member closing plate assembly • Front side member • Front side member extension • Rear side member assembly • Front roof rail • Upper inner front pillar • Center pillar reinforcement • Front door assembly • Rear door assembly

Read the following precautions when repairing HSS:

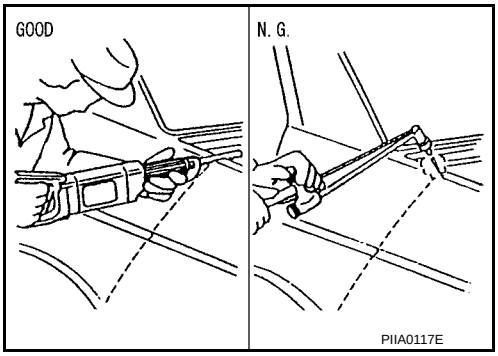
1. Additional points to consider
   - The repair of reinforcements (such as side members) by heating is not recommended since it may weaken the component. When heating is unavoidable, do not heat HSS parts above 550°C (1,022°F).
     Verify heating temperature with a thermometer.
     (Crayon-type and other similar type thermometer are appropriate.)



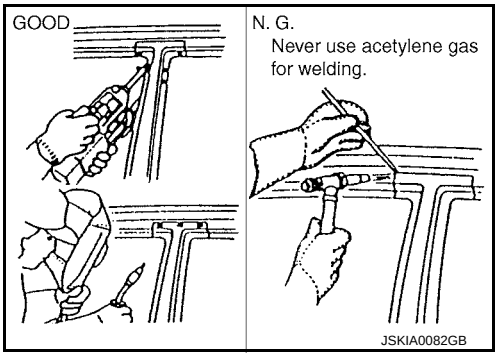
- When straightening body panels, use caution in pulling any HSS panel. Because HSS is very strong, pulling may cause deformation in adjacent portions of the body. In this case, increase the number of measuring points, and carefully pull the HSS panel.



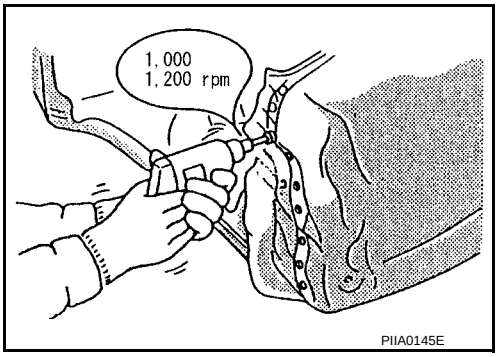
- When cutting HSS panels, avoid gas (torch) cutting if possible. Instead, use a saw to avoid weakening surrounding areas due to heat. If gas (torch) cutting is unavoidable, allow a minimum margin of 50 mm (1.97 in).



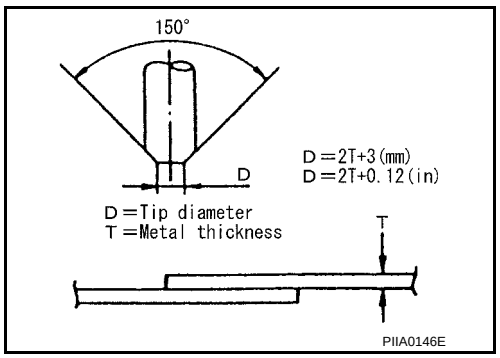
- When welding HSS panels, use spot welding whenever possible in order to minimize weakening surrounding areas due to heat.
  If spot welding is impossible, use MIG. welding. Do not use gas (torch) for welding because it is inferior in welding strength.



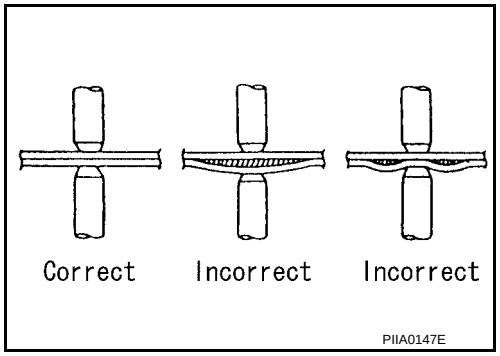
- The spot weld on HSS panels is harder than that of an ordinary steel panel.
  Therefore, when cutting spot welds on a HSS panel, use a low speed high torque drill (1,000 to 1,200 rpm) to increase drill bit durability and facilitate the operation.



2. Precautions in spot welding HSS
This work should be performed under standard working conditions. Always note the following when spot welding HSS:
- The electrode tip diameter must be sized properly according to the metal thickness.



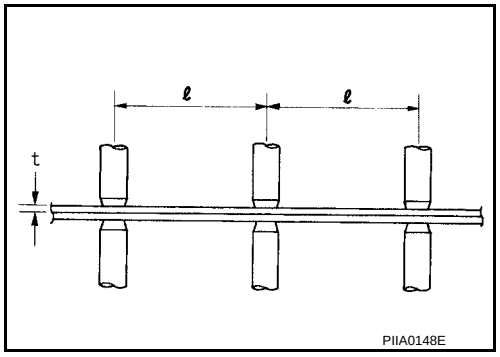
- The panel surfaces must fit flush to each other, leaving no gaps.



- Follow the specifications for the proper welding pitch.

Unit: mm (in)

Thickness (t)	Minimum pitch (l)
0.6 (0.024)	10 (0.39) or over
0.8 (0.031)	12 (0.47) or over
1.0 (0.039)	18 (0.71) or over
1.2 (0.047)	20 (0.79) or over
1.6 (0.063)	27 (1.06) or over
1.8 (0.071)	31 (1.22) or over



Handling of Ultra High Strength Steel Plate Parts

INFOID:0000000014625684

PROHIBITION OF CUT AND CONNECTION

Never cut and Joint the stiffener front side member (front floor inside frame parts) because its material is high strength steel plate (ultra high strength steel plate).
The front floor assembly must be replaced if this part is damaged.

LOCATION OF PLASTIC PARTS

Precautions for Plastics

INFOID:0000000014625685

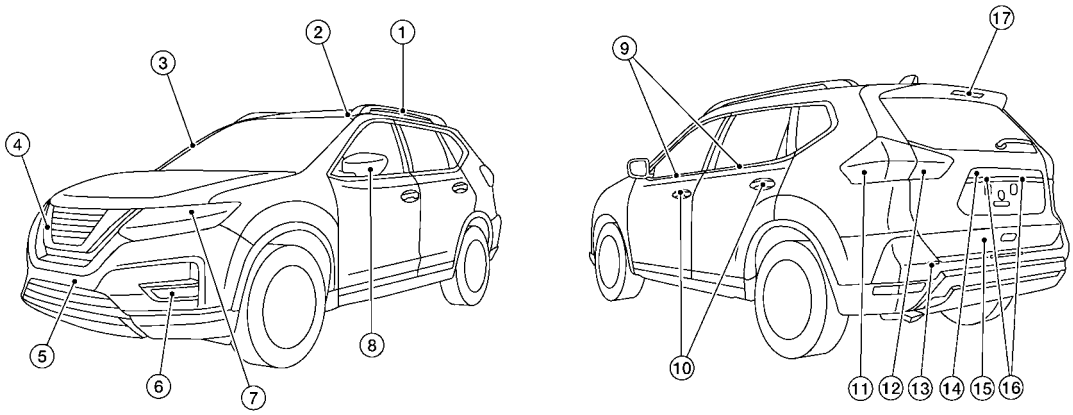
Abbre-viation	Material name	Heat resisting temperature °C (°F)	Resistance to gasoline and solvents	Other cautions
PE	Polyethylene	60 (140)	Gasoline and most solvents are harmless if applied for a very short time (wipe out quickly).	Flammable
ABS	Acrylonitrile Butadiene Styrene	80 (176)	Avoid gasoline and solvents.	—
AES	Acrylonitrile Ethylene Styrene	80 (176)	↑	—
EPM/ EPDM	Ethylene Propylene (Diene) co-polymer	80 (176)	Gasoline and most solvents are harmless if applied for a very short time (wipe out quickly).	Flammable
PS	Polystyrene	80 (176)	Avoid solvents.	Flammable
PVC	Poly Vinyl Chloride	80 (176)	Gasoline and most solvents are harmless if applied for a very short time (wipe out quickly).	Poisonous gas is emitted when burned.
TPO	Thermoplastic Olefine	80 (176)	↑	Flammable
AAS	Acrylonitrile Acrylic Styrene	85 (185)	Avoid gasoline and solvents.	—
PMMA	Poly Methyl Methacrylate	85 (185)	↑	—
EVAC	Ethylene Vinyl Acetate	90 (194)	↑	—
PP	Polypropylene	90 (194)	Gasoline and most solvents are harmless if applied for a very short time (wipe out quickly).	Flammable, avoid battery acid.
PUR	Polyurethane	90 (194)	Avoid gasoline and solvents.	—
UP	Unsaturated Polyester	90 (194)	↑	Flammable
ASA	Acrylonitrile Styrene Acrylate	100 (212)	↑	Flammable
PPE	Poly Phenylene Ether	110 (230)	↑	—
TPU	Thermoplastic Urethane	110 (230)	↑	—
PBT+ PC	Poly Butylene Terephthalate + Polycarbonate	120 (248)	↑	Flammable
PC	Polycarbonate	120 (248)	↑	—
POM	Poly Oxymethylene	120 (248)	↑	Avoid battery acid.
PA	Polyamide	140 (284)	↑	Avoid immersing in water.
PBT	Poly Butylene Terephthalate	140 (284)	↑	—
PAR	Polyarylate	180 (356)	↑	—
PET	Polyethylene terephthalate	180 (356)	↑	—
PEI	Polyetherimide	200 (392)	↑	—

CAUTION:

- **When repairing and painting a portion of the body adjacent to plastic parts, consider their characteristics (influence of heat and solvent) and remove them if necessary or take suitable measures to protect them.**
- **Plastic parts should be repaired and painted using methods suiting the materials' characteristics.**

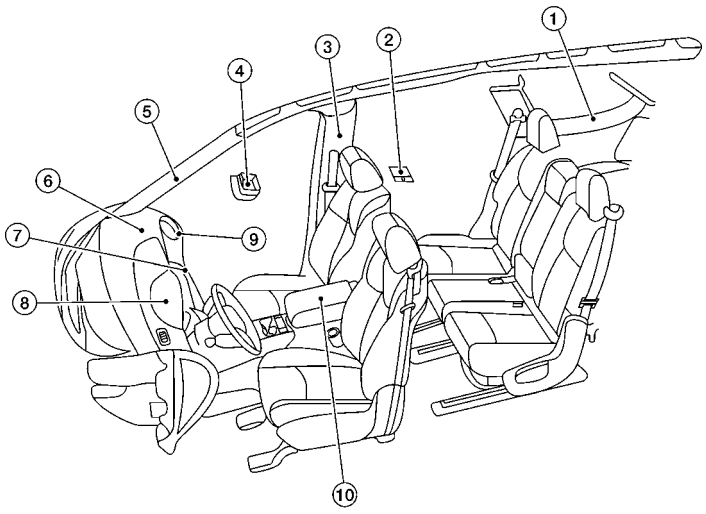
Location of Plastic Parts

INFOID:0000000014625686



AWKIA4200ZZ

Component			Material	Component			Material
1.	Roof rack finisher		AES	10.	Door outside handle		PC + ABS
2.	Roof side molding		PVC + Stainless	11.	Rear combination lamp	Lens	PMMA
3.	Windshield molding		PVC			Housing	ASA
4.	Front grille		ABS	12.	Back up lamp	Lens	PMMA
5.	Front bumper fascia		PP + EPM			Housing	ASA
6.	Front fog lamp	Lens	Glass	13.	Rear bumper fascia		PP + EPM
		Housing	PBT + ASA + Glass fiber	14.	Back door finisher		ABS
7.	Front combination lamp	Lens	PC	15.	Back door		PP
		Housing	PP	16.	License plate lamp	Lens	PC
8.	Door mirror	Finisher	ABS			Housing	PC
		Housing	PP	17.	High-mounted stop lamp	Lens	PMMA
		Base	PBT + PET			Housing	ABS
9.	Door outside molding		PVC + Stainless				



AWKIA3697ZZ

LOCATION OF PLASTIC PARTS

Component			Material	Component			Material
1.	Luggage side finisher		PP	6.	Instrument panel	Skin	TPO
2.	Room lamp	Lens	PC			Pad	PUR
		Housing	PA			Core	PPC
3.	Center pillar finisher		PP	7.	Cluster lid C		PC + ABS
4.	Map lamp	Lens	PC	8.	Cluster lid A		PP
		Housing	PP	9.	Glove box		PPC
5.	Front pillar finisher		PP	10.	Center console		PP

PREPARATION

REPAIRING MATERIAL

Foam Repair

INFOID:0000000014625687

During factory body assembly, foam insulators are installed in certain body panels and locations around the vehicle. Use the following procedure(s) to replace any factory-installed foam insulators.

URETHANE FOAM APPLICATIONS

Use commercially available Urethane foam for sealant (foam material) repair of material used on vehicle.

<Urethane foam for foaming agent>	**3M™ Automix™ Flexible Foam 08463 or equivalent**

Read instructions on product for fill procedures.

Example of foaming agent filling operation procedure

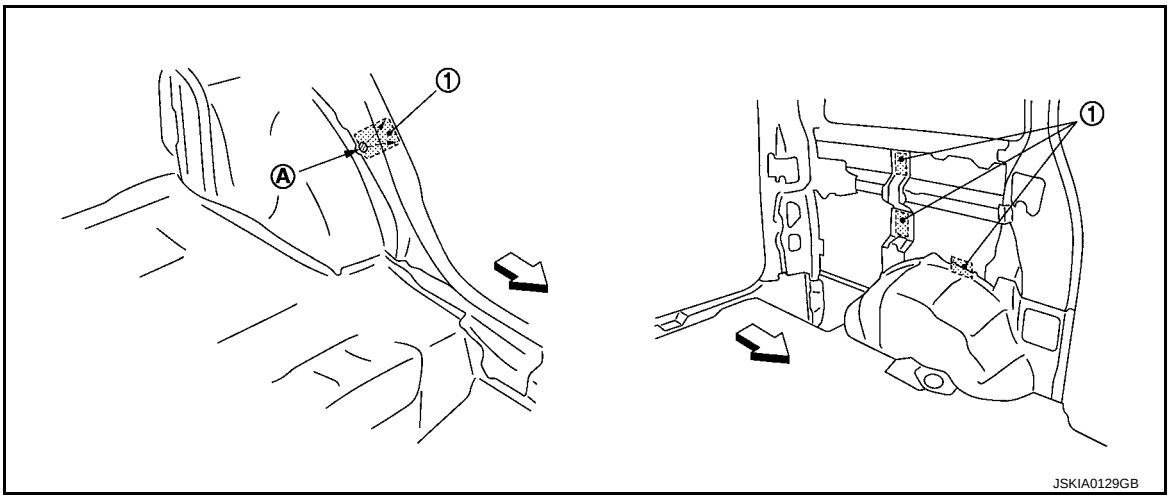
1. Fill procedures after installation of service part.

a. Eliminate foam material remaining on vehicle side.

b. Clean area after eliminating form insulator and foam material.

c. Install service part.

d. Insert nozzle into hole near fill area and fill foam material or fill enough to close gap with the service part.



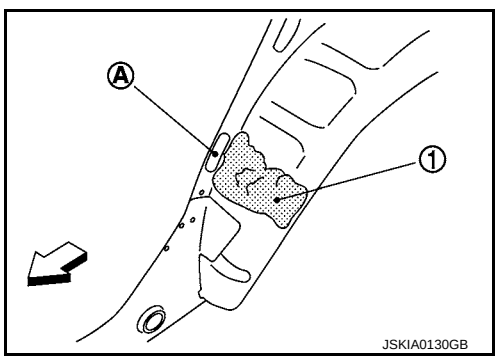
1. Urethane foam
A. Nozzle insert hole
⇦ Front

2. Fill procedures before installation of service part.

a. Eliminate foam material remaining on vehicle side.

b. Clean area after eliminating foam insulator and foam material.

c. Fill foam material on wheelhouse outer side.



1. Urethane foam
A. Fill while avoiding flange area
⇦ Front

NOTE:
Fill enough to close gap with service part while avoiding flange area.

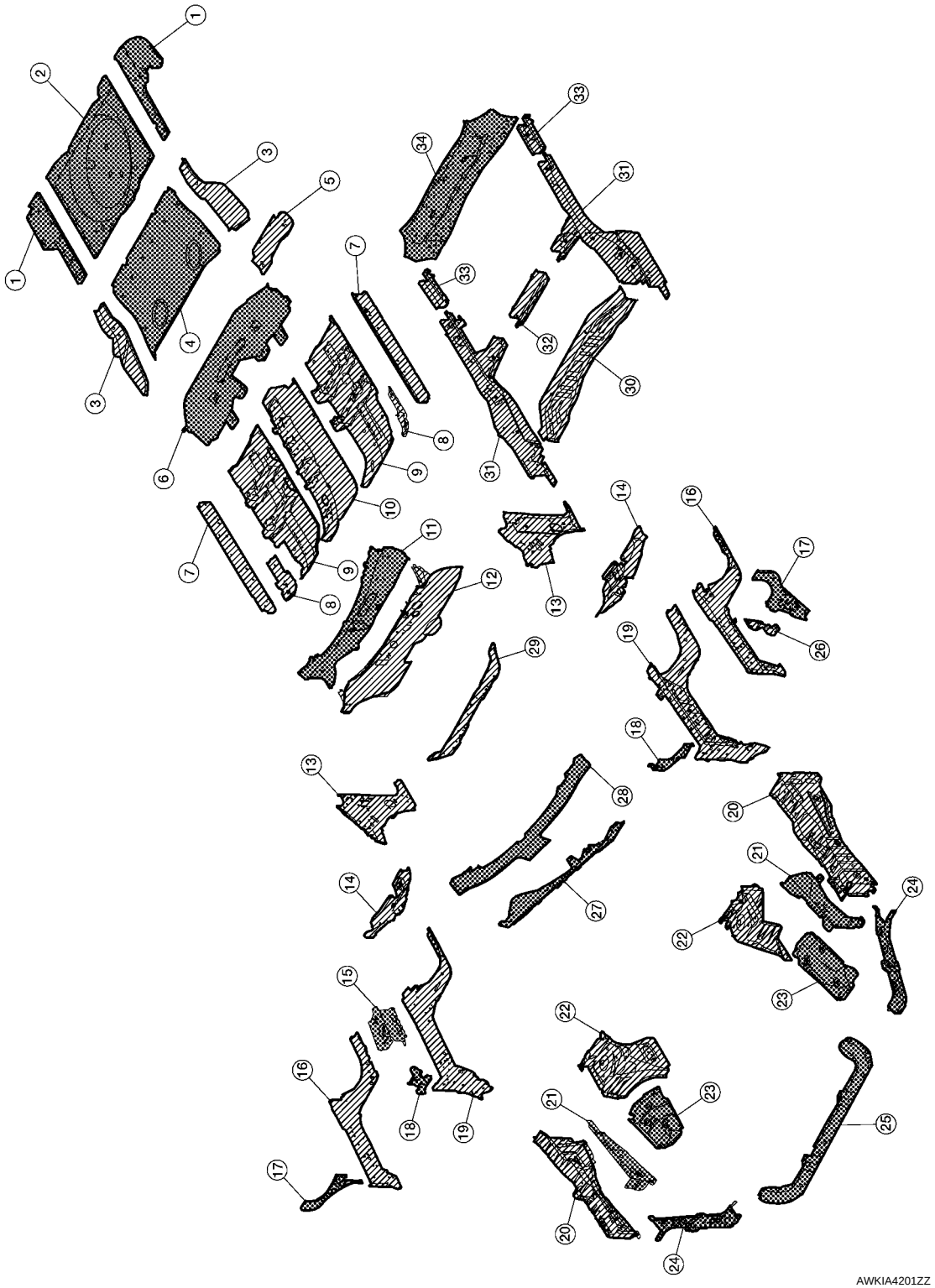
d. Install service part.

NOTE:
Refer to label for information on working times.

BODY COMPONENT PARTS

Underbody Component Parts

INFOID:0000000014625688



: Both sided anti-corrosive precoated steel portions

: Both sided anti-corrosive precoated steel and HSS portions

No.	Parts name	Tensile strength (MPa)	Both sided anti-corrosive precoated steel sections	Aluminum portion
1.	Rear floor rear side (LH/RH)	Under 440	x	—
2.	Rear floor rear	Under 440	×	—
3.	Rear floor front sides (LH/RH)	780	×	—
4.	Rear floor front	Under 440	x	—
5.	Rear floor seat belt reinforcement	590	×	—
6.	Rear floor front extension	440	×	—
7.	Inner sill (LH/RH)	980	×	—
8.	Front floor side reinforcement (LH/RH)	980	×	—
9.	Front floor (LH/RH)	590	×	—
10.	Center front floor	780	×	—
11.	Upper dash	Under 440	×	—
12.	Lower dash	980	×	—
13.	Side dash (LH/RH)	590	×	—
14.	Front suspension mounting bracket (LH/RH)	590	×	—
15.	Engine member mounting bracket	Under 440	×	—
16.	Front side member closing plate assembly (LH/RH)	980	×	—
17	Radiator upper side panel (LH/RH)	Under 440	×	—
18.	Radiator lower bracket (LH/RH)	Under 440	×	—
19.	Front side member (LH/RH)	980	×	—
20.	Hoodledge reinforcement (LH/RH)	590	×	—
21.	Upper hoodledge (LH/RH)	440	×	—
22.	Front strut housing (LH/RH)	590	×	—
23.	Front strut housing extension (LH/RH)	Under 440	×	—
24.	Radiator core support upper (LH/RH)	Under 440	×	—
25.	Lower radiator lower assembly (LH/RH)	Under 440	×	—
26.	Front side member extension (LH/RH)	980	×	—
27.	Cowl top extension	Under 440	×	—
28.	Cowl top	Under 440	×	—
29.	Lower dash crossmember	980	×	—
30.	Rear seat crossmember	590	×	—
31.	Rear side member assembly (LH/RH)	980	×	—
32.	Center rear crossmember	590	×	—
33.	Rear side member extension (LH/RH)	780	×	—
34.	Rear end panel	Under 440	×	—

CAUTION:

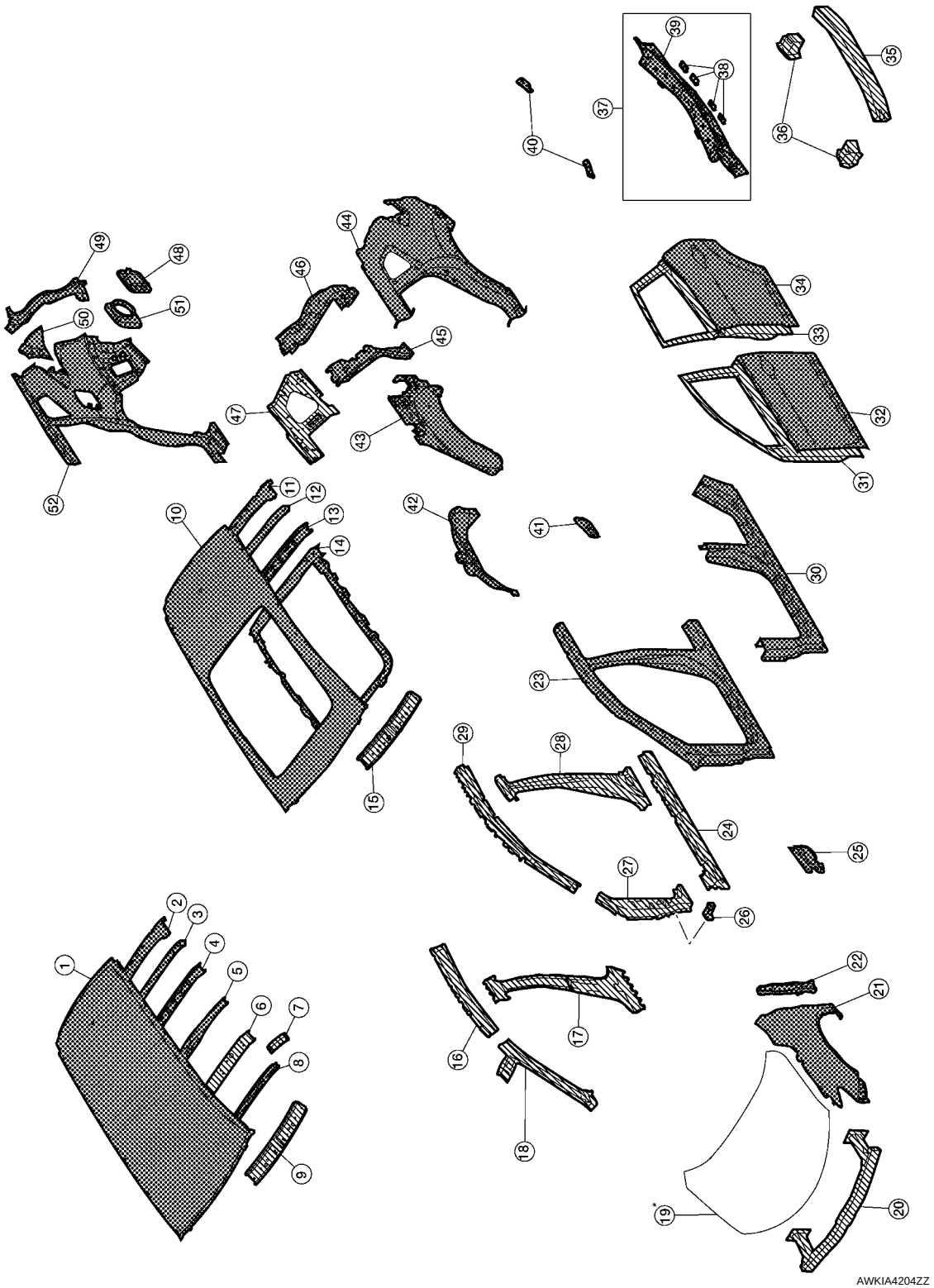
If the high strength steel (ultra high strength steel) of this is broken, replace by assembly for the supply part.

NOTE:

- For the parts without a number described in the figure, it is supplied only with the assembly part that the part is included with.
- Tensile strength column shows the largest strength value of a part in the component part.

Body Component Parts

INFOID:0000000014625689



: Both sided anti-corrosive precoated steel portions

: Both sided anti-corrosive precoated steel and HSS portions

* Aluminum portion

No.	Parts name	Tensile strength (MPa)	Both sided anti-corrosive precoated steel sections	Aluminum portion
1.	Standard roof	Under 440	X	—
2.	Rear roof rail	Under 440	X	—
3.	Roof bow No. 5	Under 440	X	—
4.	Roof bow No. 4	Under 440	X	—
5.	Roof bow No. 3	Under 440	X	—
6.	Roof bow No. 2	590	X	—
7.	Roof bow No.1 reinforcement (LH/RH)	590	X	—
8.	Roof bow No. 1	Under 440	X	—
9.	Front roof rail	980	X	—
10.	Moonroof	Under 440	X	—
11.	Rear roof rail	Under 440	X	—
12.	Roof bow No. 2	Under 440	X	—
13.	Roof bow No. 1	Under 440	X	—
14.	Moonroof reinforcement	Under 440	X	—
15.	Front roof rail	980	X	—
16.	Inner side roof rail (LH/RH)	590	X	—
17.	Inner center pillar (LH/RH)	980	X	—
18.	Upper inner front pillar (LH/RH)	590	X	—
19.	Hood	—	—	X
20.	Front bumper reinforcement assembly	1500	X	—
21.	Front fender (LH/RH)	Under 440	X	—
22.	Front fender brace (LH/RH)	Under 440	X	—
23.	Front side body (LH/RH)	Under 440	X	—
24.	Outer sill reinforcement (LH/RH)	590	X	—
25.	Front pillar lower reinforcement (LH/RH)	Under 440	X	—
26.	Front fender bracket (LH/RH)	Under 440	X	—
27.	Lower front pillar hinge brace (LH/RH)	980	X	—
28.	Center pillar reinforcement (LH/RH)	980	X	—
29.	Outer front pillar reinforcement (LH/RH)	980	X	—
30.	Outer sill (LH/RH)	Under 440	X	—
31.	Front door assembly (LH/RH)	1470	X	—
32.	Outer front door panel (LH/RH)	Under 440	X	—
33.	Rear door assembly (LH/RH)	1470	X	—
34.	Outer rear door panel (LH/RH)	Under 440	X	—
35.	Rear bumper reinforcement	1350	X	—
36.	Rear bumper stay (LH/RH)	590	X	—
37.	Rear panel assembly	Under 440	X	—
38.	Upper rear bumper retainer	Under 440	X	—
39.	Rear panel	Under 440	X	—
40.	Rear panel reinforcement	Under 440	X	—
41.	Outer rear wheelhouse extension (LH/RH)	Under 440	X	—
42.	Inner rear wheelhouse (LH/RH)	Under 440	X	—

No.	Parts name	Tensile strength (MPa)	Both sided anti-corrosive precoated steel sections	Aluminum portion
43.	Outer rear wheelhouse (LH/RH)	Under 440	X	—
44.	Rear fender (LH)	Under 440	X	—
45.	Inner rear pillar upper reinforcement (LH/RH)	Under 440	X	—
46.	Back pillar main assembly (LH/RH)	Under 440	X	—
47.	Inner rear pillar (LH/RH)	590	X	—
48.	Fuel filler lid	Under 440	X	—
49.	Back pillar outer (LH/RH)	Under 440	X	—
50.	Rear combination lamp base (LH/RH)	Under 440	X	—
51.	Fuel filler base	Under 440	X	—
52.	Rear fender (RH)	Under 440	X	—

CAUTION:

If the high strength steel (ultra high strength steel) is bent or broken, replace by assembly for the supply part.

NOTE:

- For the parts without a number described in the figure, it is supplied only with the assembly part that the part is included with.
- Tensile strength column shows the largest strength value of a part in the component part.

REMOVAL AND INSTALLATION

CORROSION PROTECTION

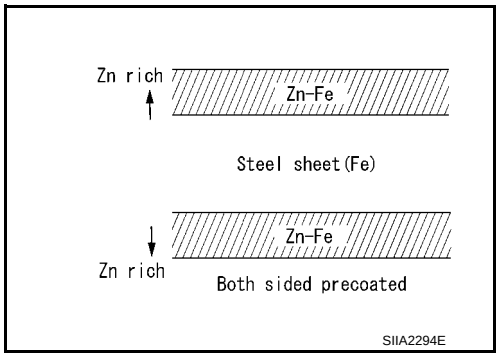
Description

INFOID:0000000014625690

To provide improved corrosion prevention, the following anti-corrosive measures have been implemented in NISSAN production plants. When repairing or replacing body panels, it is necessary to use the same anti-corrosive measures.

ANTI-CORROSIVE PRECOATED STEEL (GALVANNEALED STEEL)

To improve repairability and corrosion resistance, a new type of anti-corrosive precoated steel sheet has been adopted replacing conventional zinc-coated steel sheet.
Galvannealed steel is electroplated and heated to form Zinc-iron alloy, which provides excellent and long term corrosion resistance with cationic electrodeposition primer.



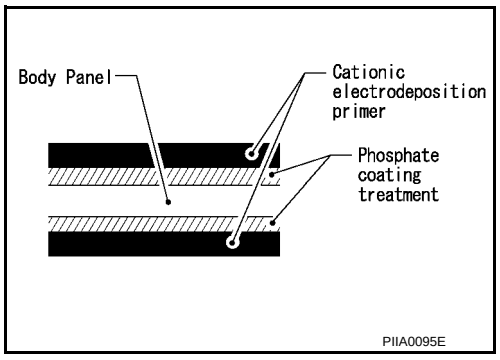
NISSAN Genuine Service Parts are fabricated from galvannealed steel. Therefore, it is recommended that GENUINE NISSAN PARTS or equivalent be used for panel replacement to maintain the anti-corrosive performance built into the vehicle at the factory.

PHOSPHATE COATING TREATMENT AND CATIONIC ELECTRODEPOSITION PRIMER

A phosphate coating treatment and a cationic electrodeposition primer, which provide excellent corrosion protection, are employed on all body components.

CAUTION:

Confine paint removal during welding operations to an absolute minimum.



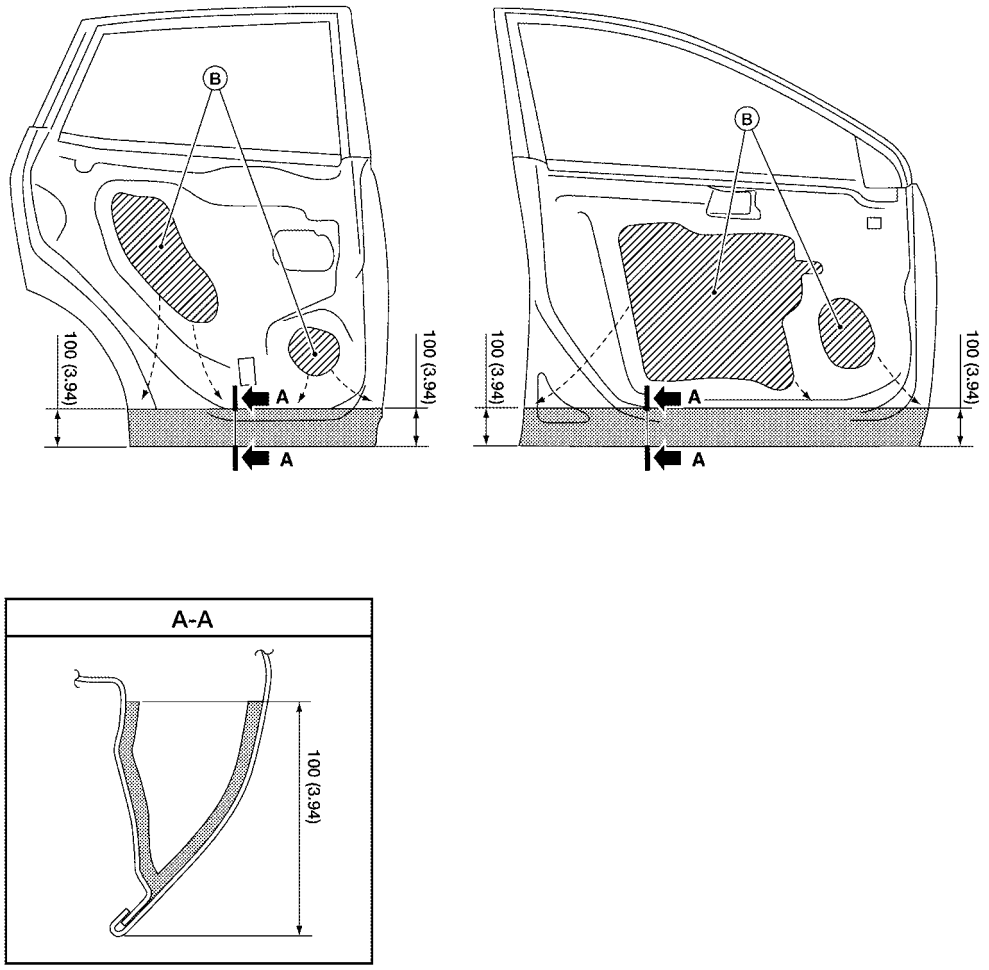
NISSAN Genuine Service Parts are also treated in the same manner. Therefore, it is recommended that GENUINE NISSAN PARTS or an equivalent be used for panel replacement to maintain anti-corrosive performance built into the vehicle at the factory.

Anti-corrosive Wax

INFOID:0000000014625691

To improve corrosion resistance, anti-corrosive wax is applied inside the body sill and inside other closed sections. Accordingly, when replacing these parts, be sure to apply anti-corrosive wax to the appropriate areas of the new parts. Select an excellent anti-corrosive wax which will penetrate after application and has a long shelf life.

DOOR



AWKIA2823ZZ

Unit: mm (in)

B. Nozzle insert hole ▨ Anti-corrosive wax coated portions

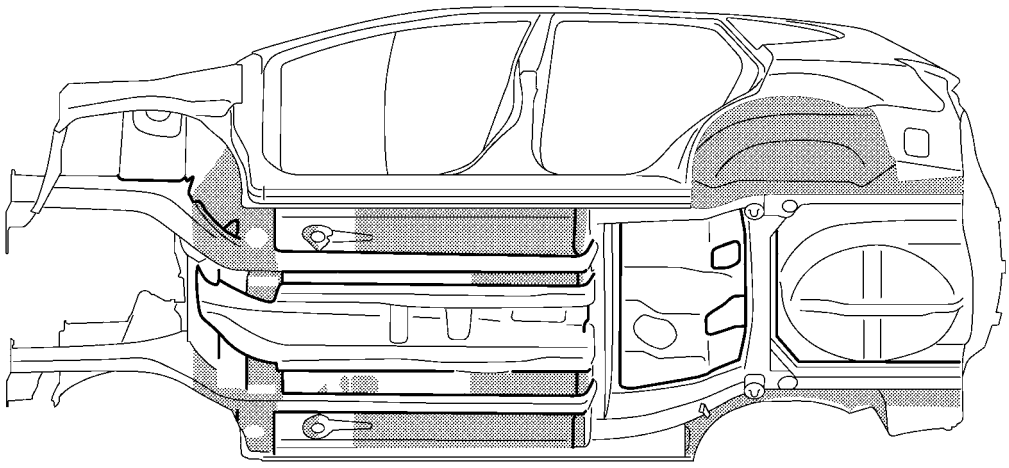
Undercoating

INFOID:0000000014625692

The underside of the floor and wheelhouse are undercoated to prevent rust, vibration, noise and stone chipping. Therefore, when such a panel is replaced or repaired, apply undercoating to that part. Use an undercoating which is rust preventive, soundproof, vibration-proof, shock-resistant, adhesive, and durable.

PRECAUTIONS IN UNDERCOATING

1. Never apply undercoating to any place unless specified (such as the areas above the muffler and three way catalyst which are subjected to heat).
2. Never undercoat the exhaust pipe or other parts which become hot.
3. Never undercoat rotating parts.
4. Apply bitumen wax after applying undercoating.
5. After putting seal on the vehicle, put undercoating on it.



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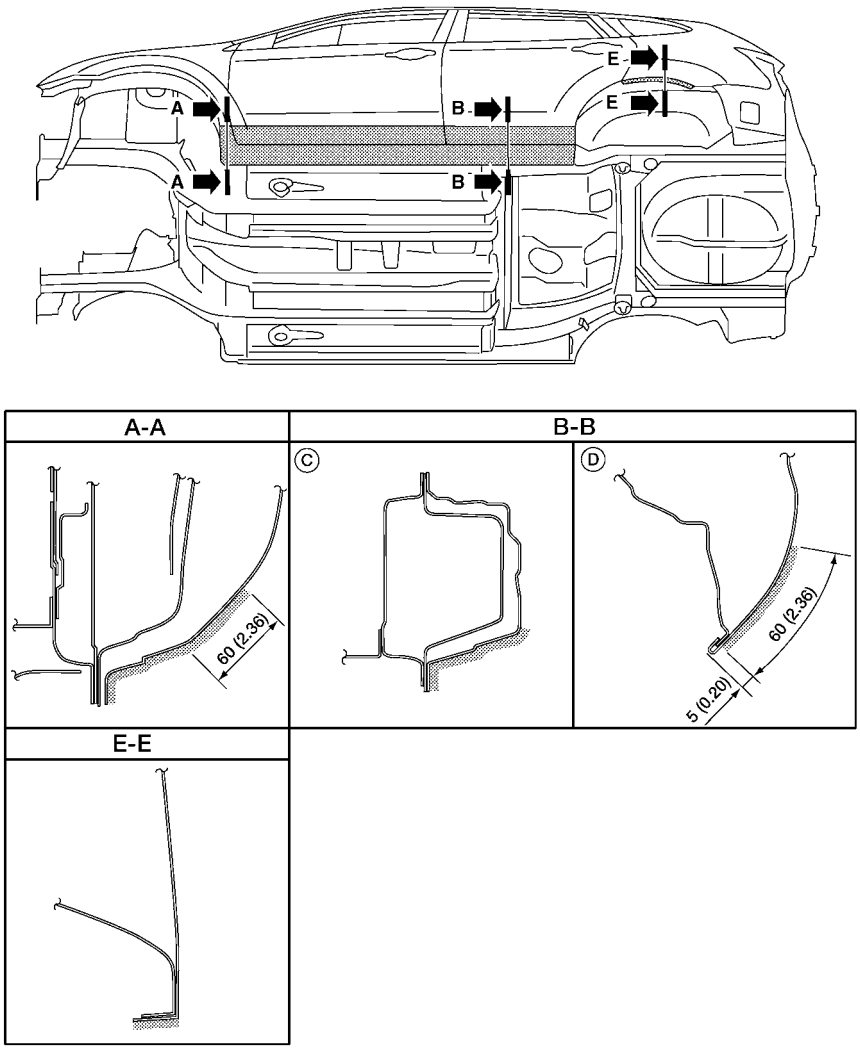
Undercoated portions (for all destination)

Sealed portions

Stone Guard Coat

INFOID:0000000014625693

To prevent damage caused by stones, the lower outer body panel (fender, door, etc.) have an additional layer of Stone Guard Coating over the ED primer coating. When replacing or repairing these panels, apply Stone Guard coating to the same portions as before. Use a coating which is rust preventive, durable, shock-resistant and has a long shelf life.



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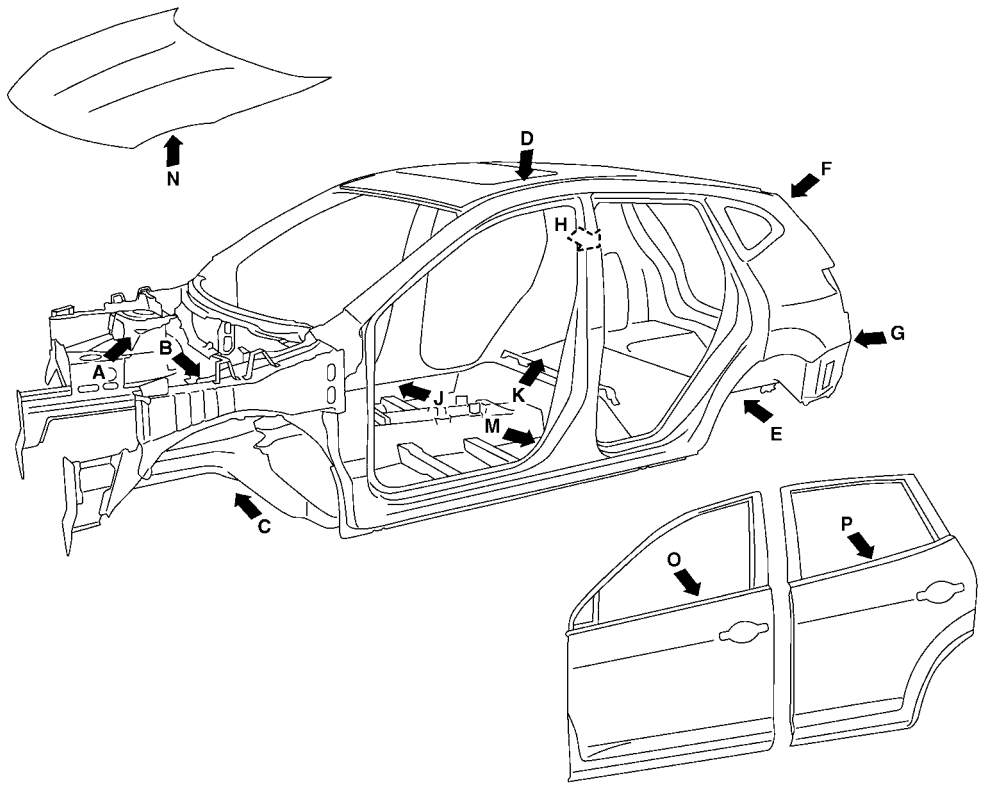
Unit: mm (in)

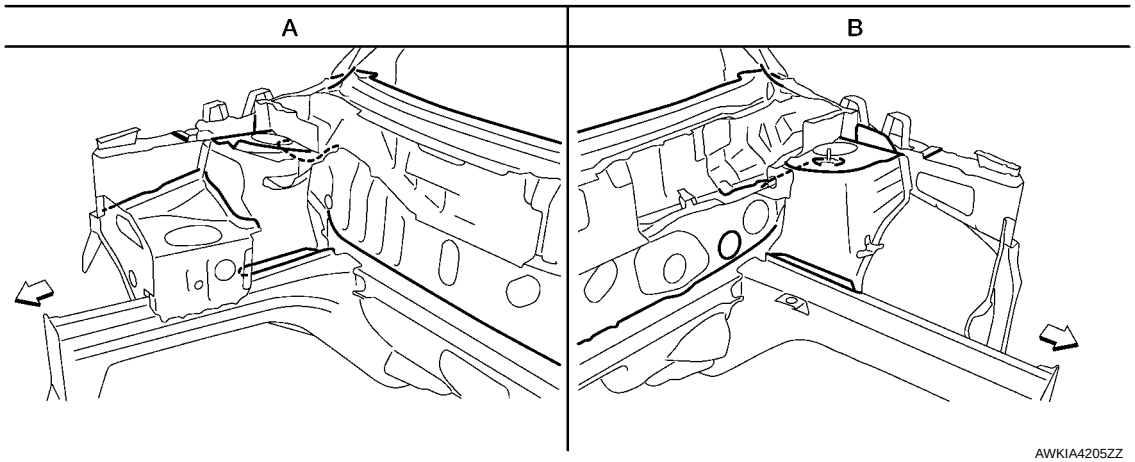
C. Outer sill portion D. Door outer portion Stone guard coated portions

Body Sealing

INFOID:0000000014625694

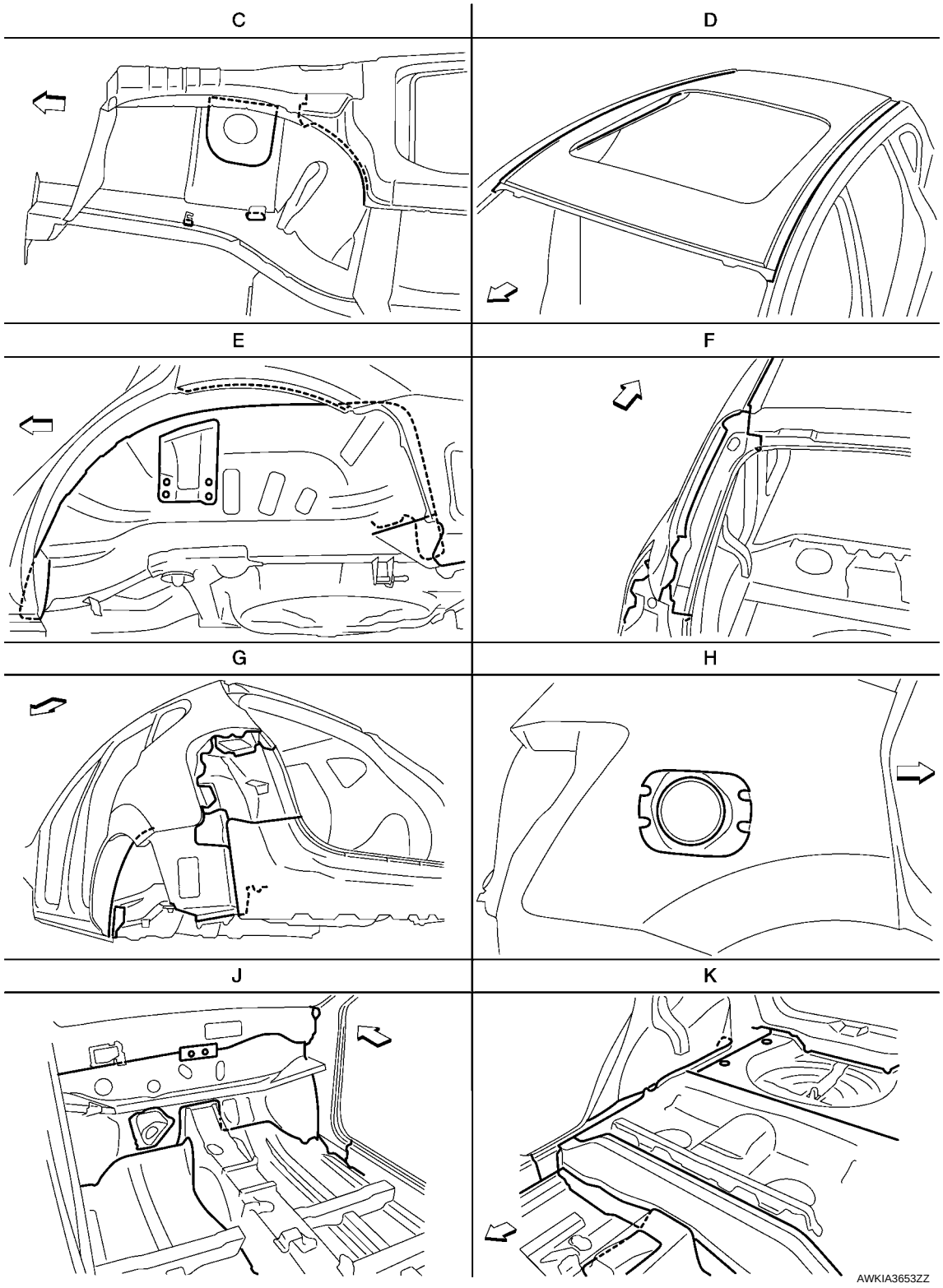
The following figure shows the areas which are sealed at the factory. Sealant which has been applied to these areas should be smooth and free from cuts or gaps. Care should be taken not to apply an excess amount of sealant and not to allow other unaffected parts to come into contact with the sealant.





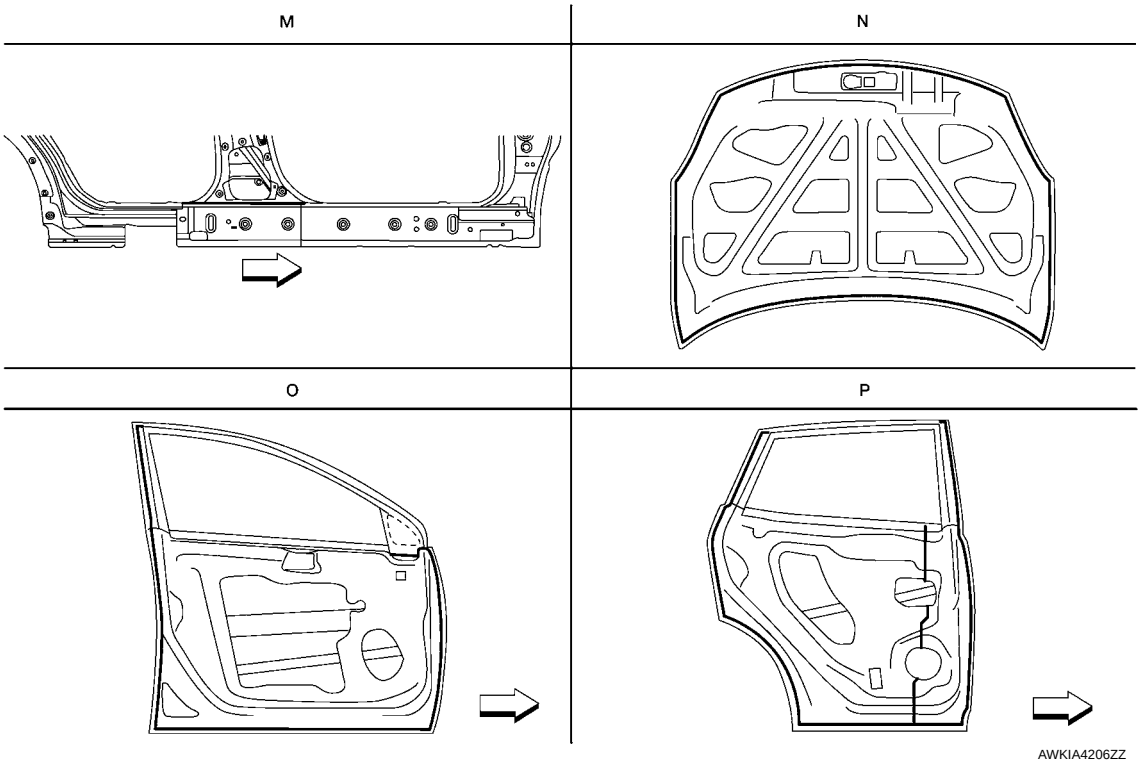
Front

Sealed portions



Front

Sealed portions



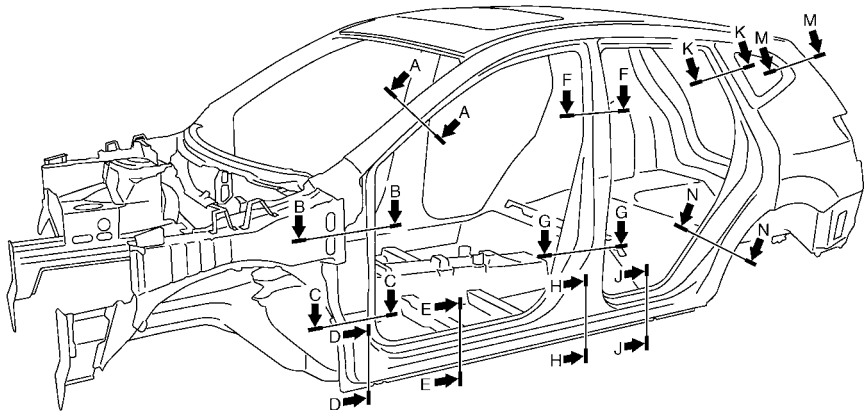
Front

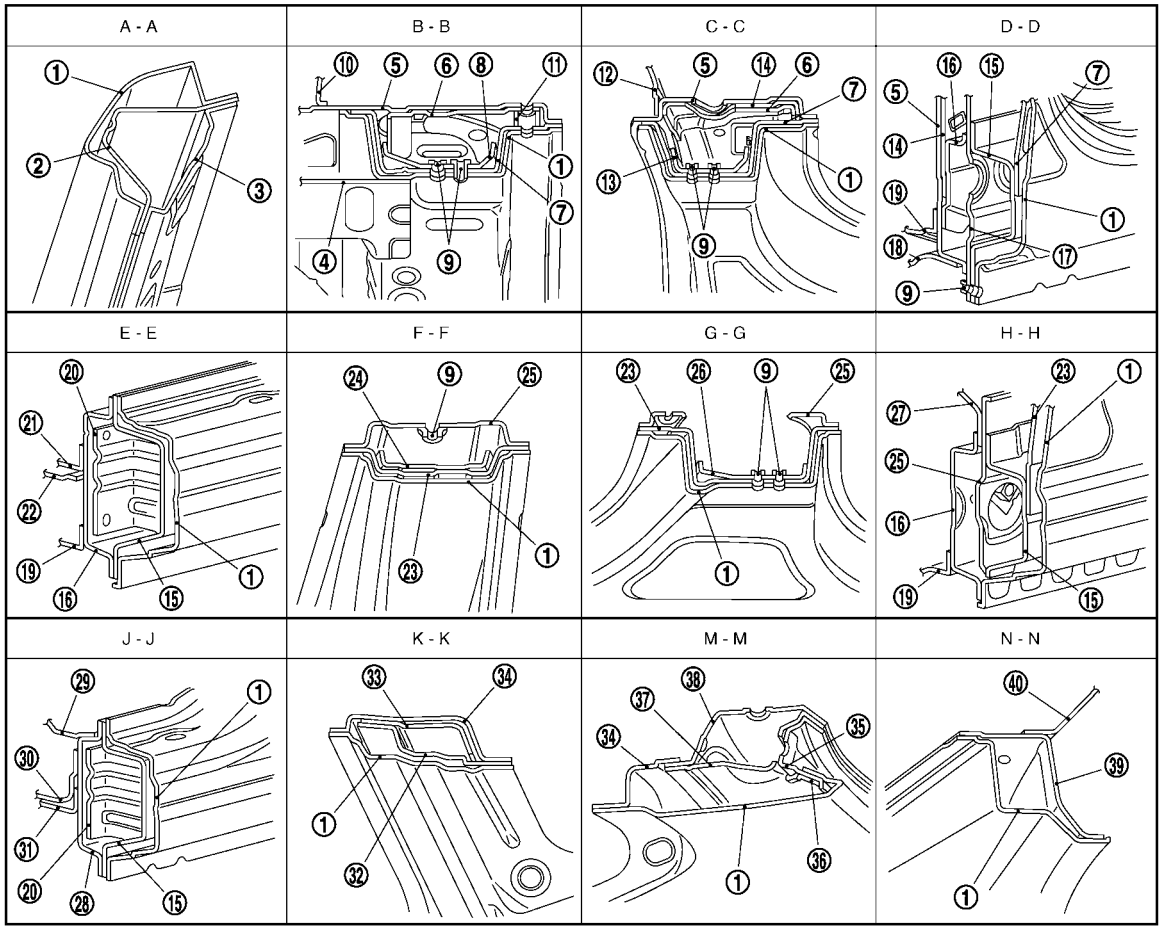
Sealed portions

BODY CONSTRUCTION

Body Construction

INFOID:0000000014625695





JSKIA0446GB

1. Outer body side
2. Outer front pillar reinforcement
3. Upper inner front pillar
4. Rear hoodledge reinforcement
5. Side dash
6. Inner front pillar reinforcement
7. Lower front pillar hinge brace
8. Upper hinge plate
9. Weld nut

10. Upper dash
11. Upper steering member bracket
12. Lower dash
13. Lower hinge plate
14. Side dash reinforcement
15. Outer sill reinforcement
16. Inner sill
17. Lower front pillar reinforcement
18. Front outrigger
19. Front floor
20. Outer sill brace
21. 2nd crossmember
22. 2nd crossmember reinforcement
23. Center pillar hinge brace
24. Center pillar reinforcement
25. Inner center pillar
26. Lower center pillar hinge brace
27. Seat belt anchor
28. Inner sill extension
29. Rear seat crossmember
30. Rear floor front extension
31. Rear side member
32. Inner rear pillar reinforcement
33. Rear pillar seat belt anchor
34. Inner rear pillar
35. Back pillar main
36. Back door stay reinforcement
37. Upper back pillar reinforcement
38. Rear roof rail brace
39. Outer rear wheelhouse
40. Inner rear wheelhouse

Rear Fender Hemming Process

INFOID:0000000014625696

1. A wheel arch is to be installed and hemmed over the left and right outer wheel houses.
2. In order to hem the wheel arch, it is necessary to repair any damaged or defaced parts around outer wheel house.

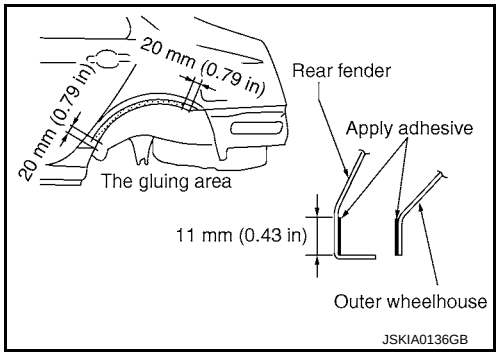
CAUTION:

Ensure that the area that is to be glued around the outer wheelhouse is undamaged or defaced.

PROCEDURE OF THE HEMMING PROCESS

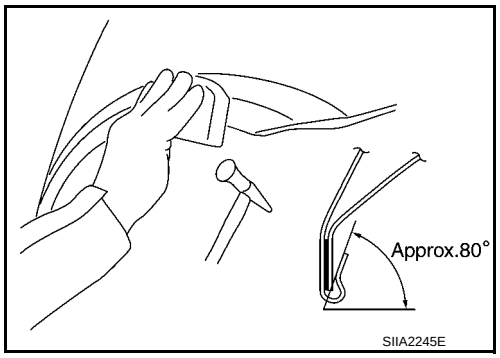
- Peel off old bonding material on the surface of the outer wheelhouse and clean thoroughly.
- Peel off a primer coat in the specified area where new adhesive is to be applied on rear fender (the replacing part).
- Apply new adhesive to both specified areas of the outer wheelhouse and rear fender.

<Adhesive> 3M™ Automix™ Panel Bonding Adhesive 08115 or equivalent

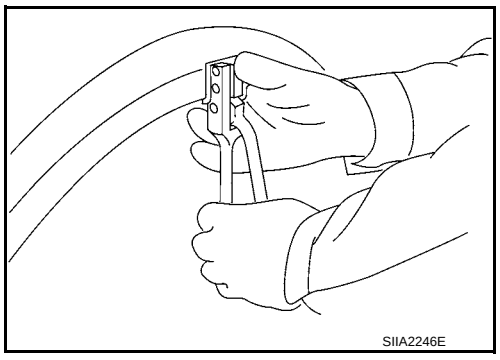


- Attach rear fender to the body of the car, and weld the required part except the hemming part.

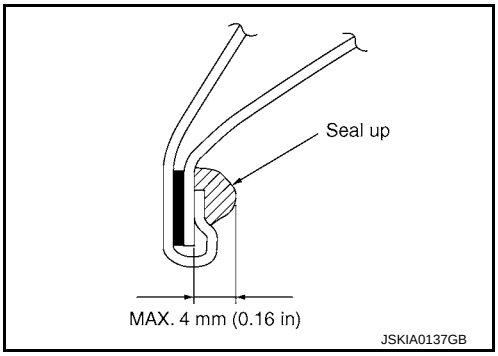
- Bend the welded part starting from the center of the wheel arch gradually with a hammer and a dolly. (Also hem the end of the flange.)
- Hemming with a hammer is conducted to an approximate angle of 80 degrees.



- Starting from the center, hem the wheel arch gradually, using slight back and forth motion with a hemming tool.



- Seal up the area around the hemmed end of the flange.



REPLACEMENT OPERATIONS

Precautions for Body Repair

INFOID:0000000014663807

WARNING:

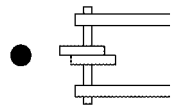
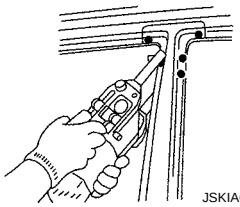
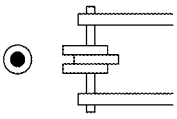
- **The repair information in this section is intended for trained body repair technicians who have attained a high level of skill and experience (e.g. ASE Collision Repair Certification, I-CAR Professional Development Program [PDP] training, etc.) in repairing collision damaged vehicles using appropriate tools and equipment. Performing repairs without the proper training, tools or equipment could damage the vehicle or cause personal injury or death to you or others.**
- **The information in this Body Repair Manual is a guideline for repairing collision damaged vehicles. However, this information cannot cover all possible ways that a vehicle can be damaged. As such, the body repair technician is responsible for making sure that the repair does not affect the structural integrity or safety of the vehicle. Improper repair of a damaged vehicle may result in a collision, property damage, personal injury or death.**
- **Nissan recommends using only new genuine Nissan replacement body parts. Use of used, salvaged or aftermarket body parts is not recommended by Nissan. Non-genuine Nissan components may affect the vehicle's structural integrity and crash safety performance, which could result in serious personal injury or death in an accident.**

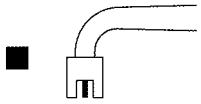
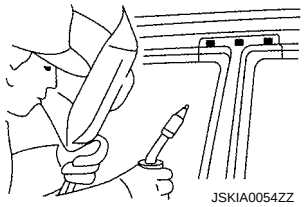
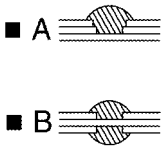
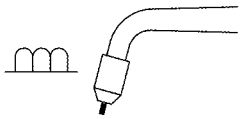
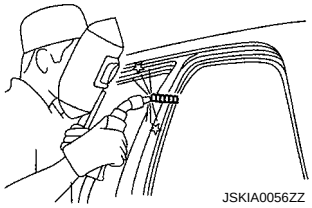
Description

INFOID:0000000014663808

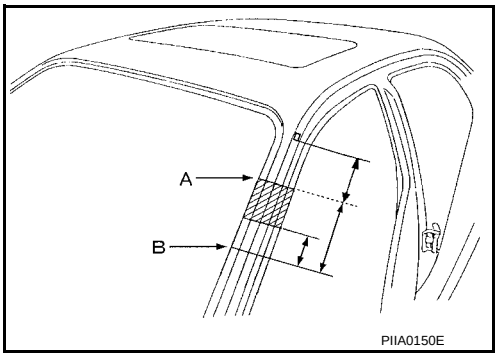
- Technicians are encouraged to read the Body Repair Manual (Fundamentals) in order to ensure that the original functions and quality of the vehicle are maintained. The Body Repair Manual (Fundamentals) contains additional information, including cautions and warnings, that are not included in this manual. Technicians should refer to both manuals to ensure proper repair.
- Please note that this information is prepared for worldwide usage, and as such, certain procedures might not apply in some regions or countries.

The symbols used in this section for welding operations are shown below.

<table>
<tr><th>Symbol marks</th><th colspan="2">Description</th></tr>
<tr><td>"Number"</td><td colspan="2">"Number" after symbol mark is the total number of welds to apply.
Example 1: ■"4"A = 4 MIG plug welds for 3-panel plug weld method.
Example 2: ⌓"1" x20 (0.79) = 1 MIG seam weld by length 20 mm (0.79 in).</td></tr>
<tr><td>
JSKIA0049ZZ</td><td>2-panel spot weld</td><td rowspan="2">
JSKIA0053ZZ</td></tr>
<tr><td>
JSKIA0050ZZ</td><td>3-panel spot weld</td></tr>
</table>

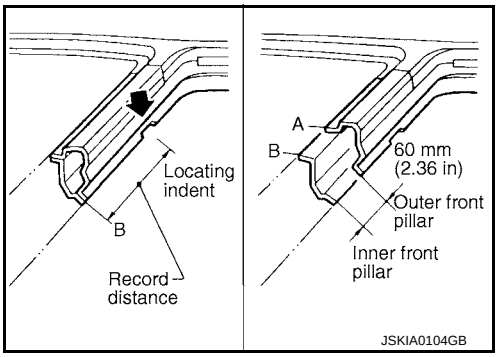
Symbol marks	Description	
 JSKIA0051ZZ	MIG plug weld	 JSKIA0054ZZ For 3-panel plug weld method  JSKIA0055ZZ
 JSKIA0052ZZ	MIG seam weld / Point weld	 JSKIA0056ZZ

- Front pillar butt joint can be determined anywhere within shaded area as shown in the figure. The best location for the butt joint is at position A due to the construction of the vehicle.



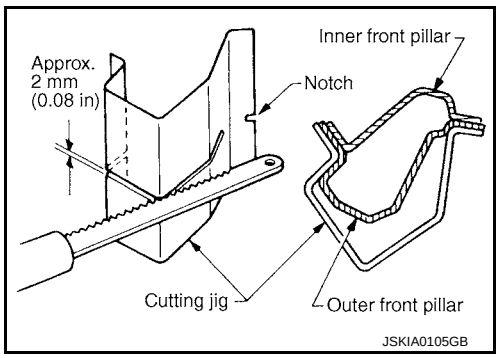
PIIA0150E

- Determine cutting position and record distance from the locating indent. Use this distance when cutting the service part. Cut outer front pillar over 60 mm (2.36 in) above the inner front pillar cut position.



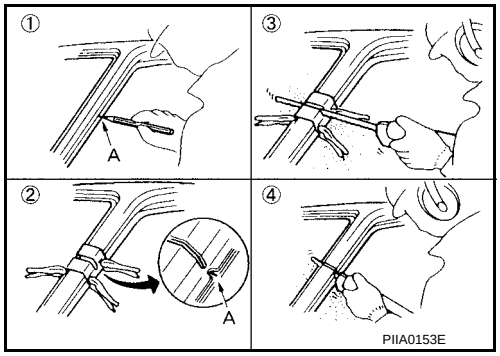
JSKIA0104GB

- Prepare a cutting jig to make outer pillar easier to cut. Also, this will permit the service part to be accurately cut at the joint position.



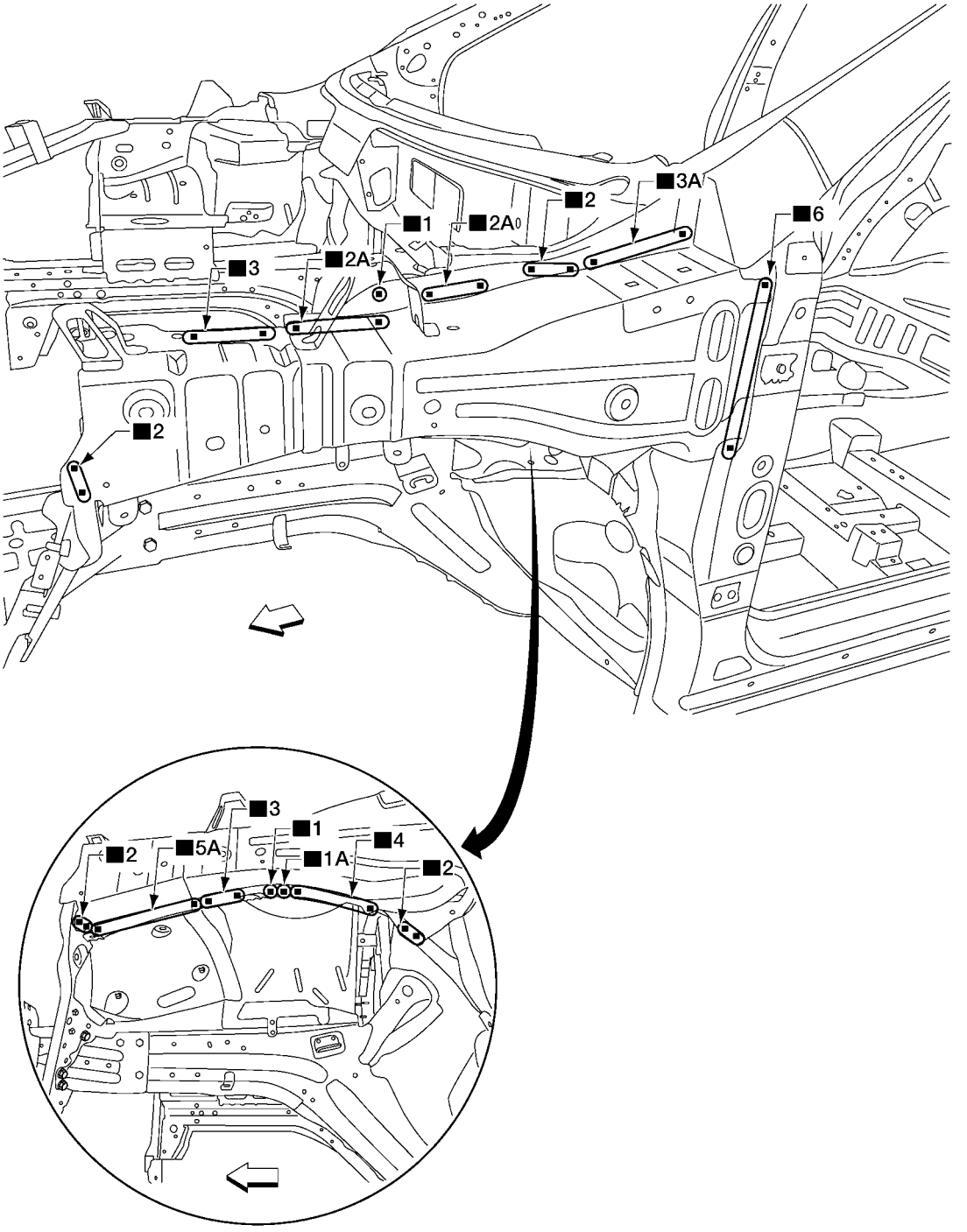
- An example of cutting operation using a cutting jig is as per the following.

1. Mark cutting lines.
   A: Cut position of outer pillar
   B: Cut position of inner pillar
2. Align cutting line with notch on jig. Clamp jig to pillar.
3. Cut outer pillar along groove of jig (at position A).
4. Remove jig and cut remaining portions.
5. Cut inner pillar at position B in same manner.



Hoodledge

INFOID:0000000014625698



AWKIA3645ZZ

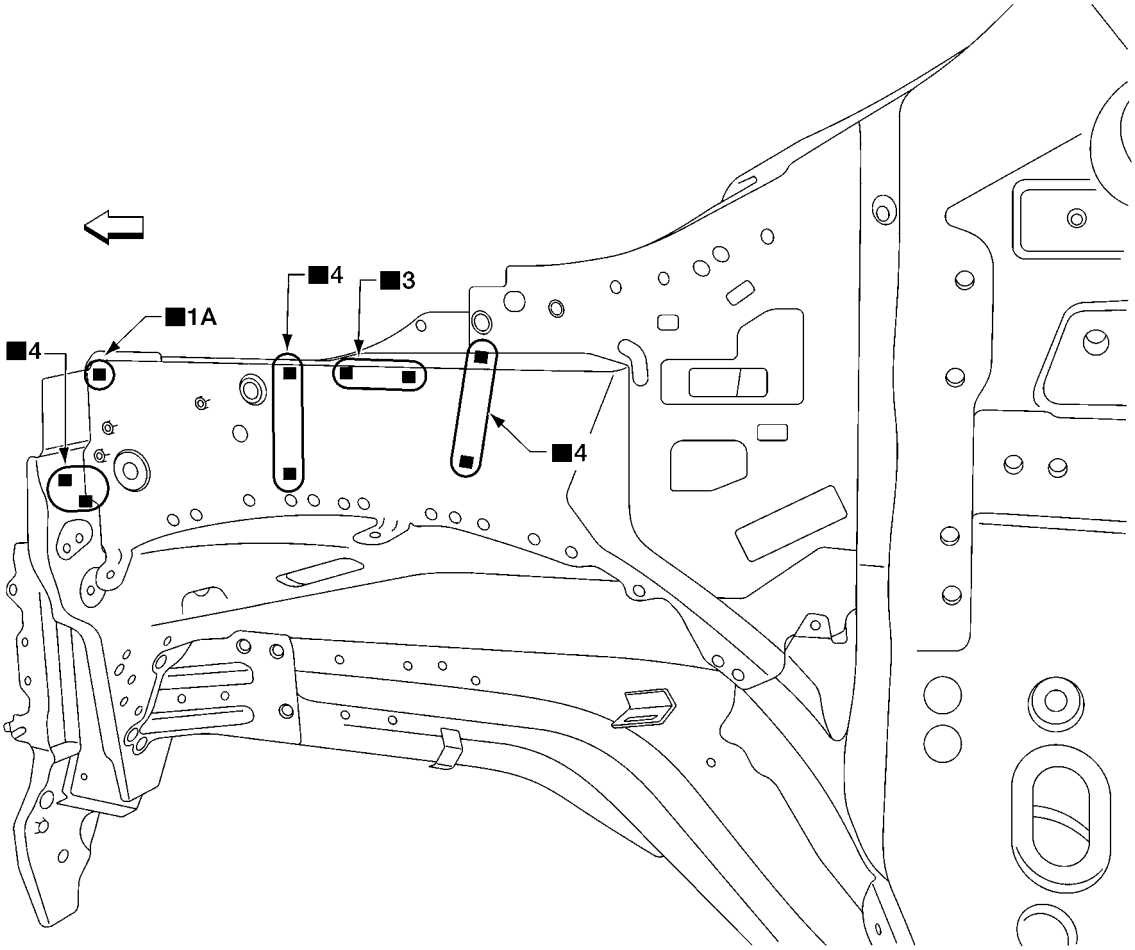
Replacement parts

- Upper hoodledge (LH) ⇦ Front

Hoodledge Reinforcement

INFOID:0000000014625699

.



ALKIA3278ZZ

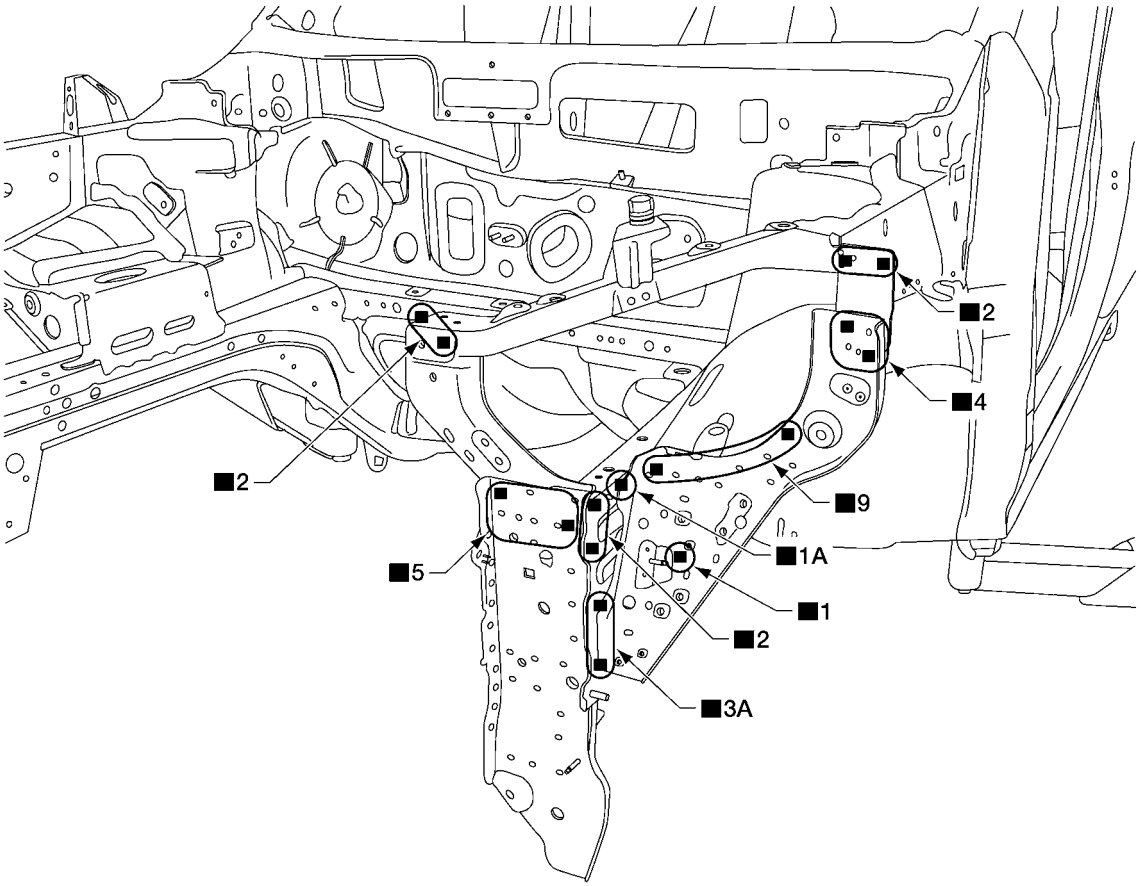
Replacement parts

- LH Hoodledge reinforcement

⇦ Front

Radiator Core Support Side

INFOID:0000000014625700



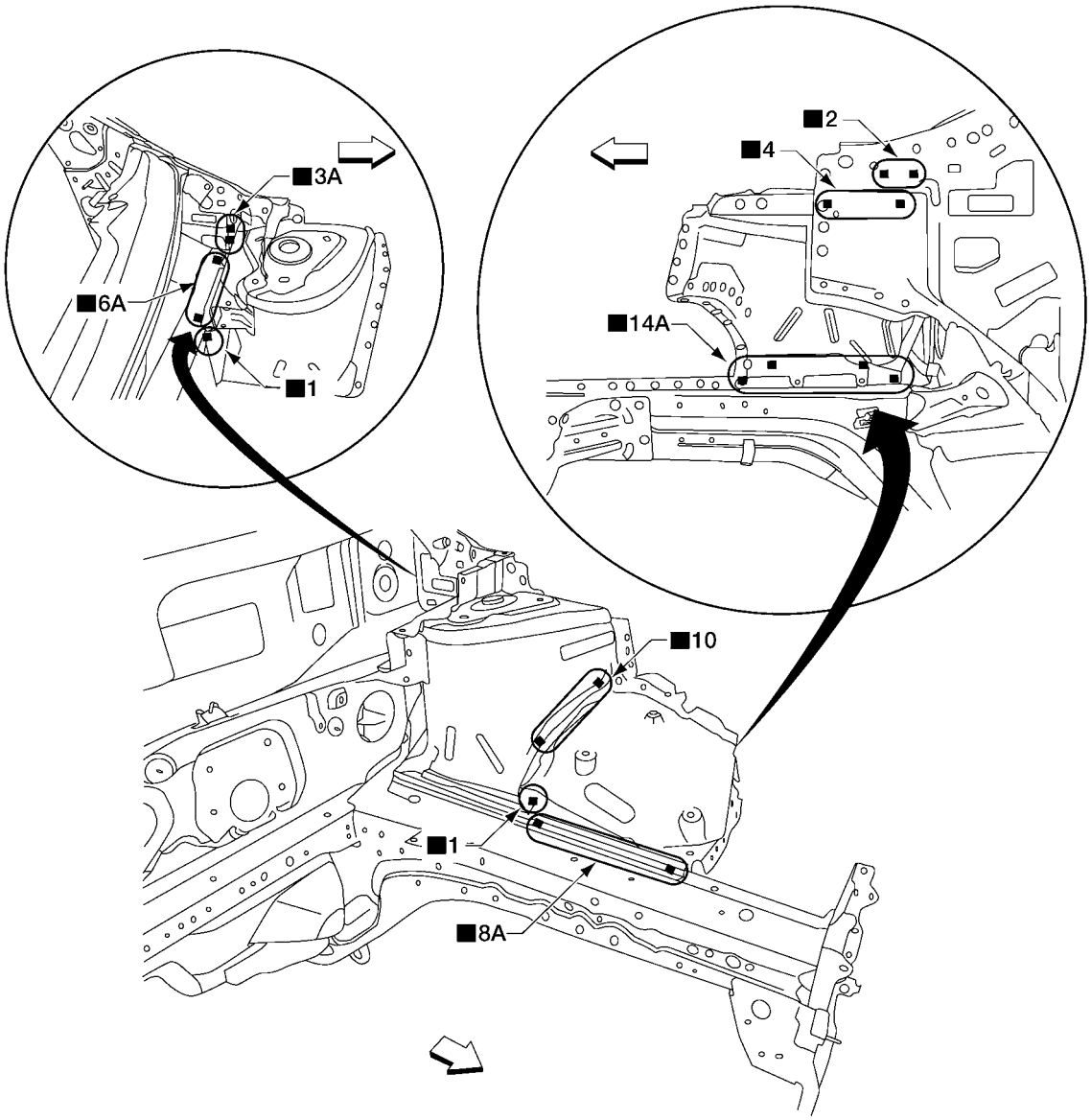
AWKIA3646ZZ

Replacement parts

- Radiator core support side

Strut Housing

INFOID:0000000014625701



AWKIA3648ZZ

Replacement parts

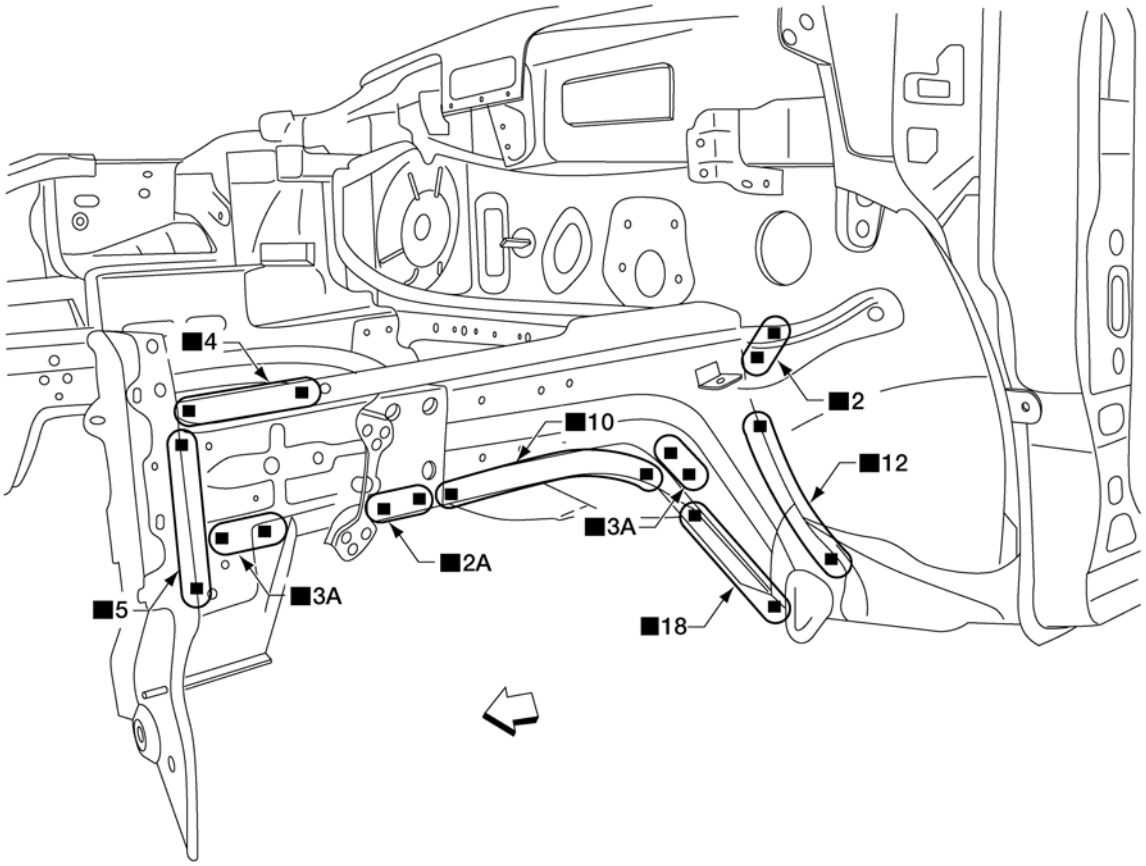
- Strut housing
- Strut housing extension

⇦ Front

Front Side Member Outer

INFOID:0000000014625702

Work after hoodledge has been removed.



ALKIA3308ZZ

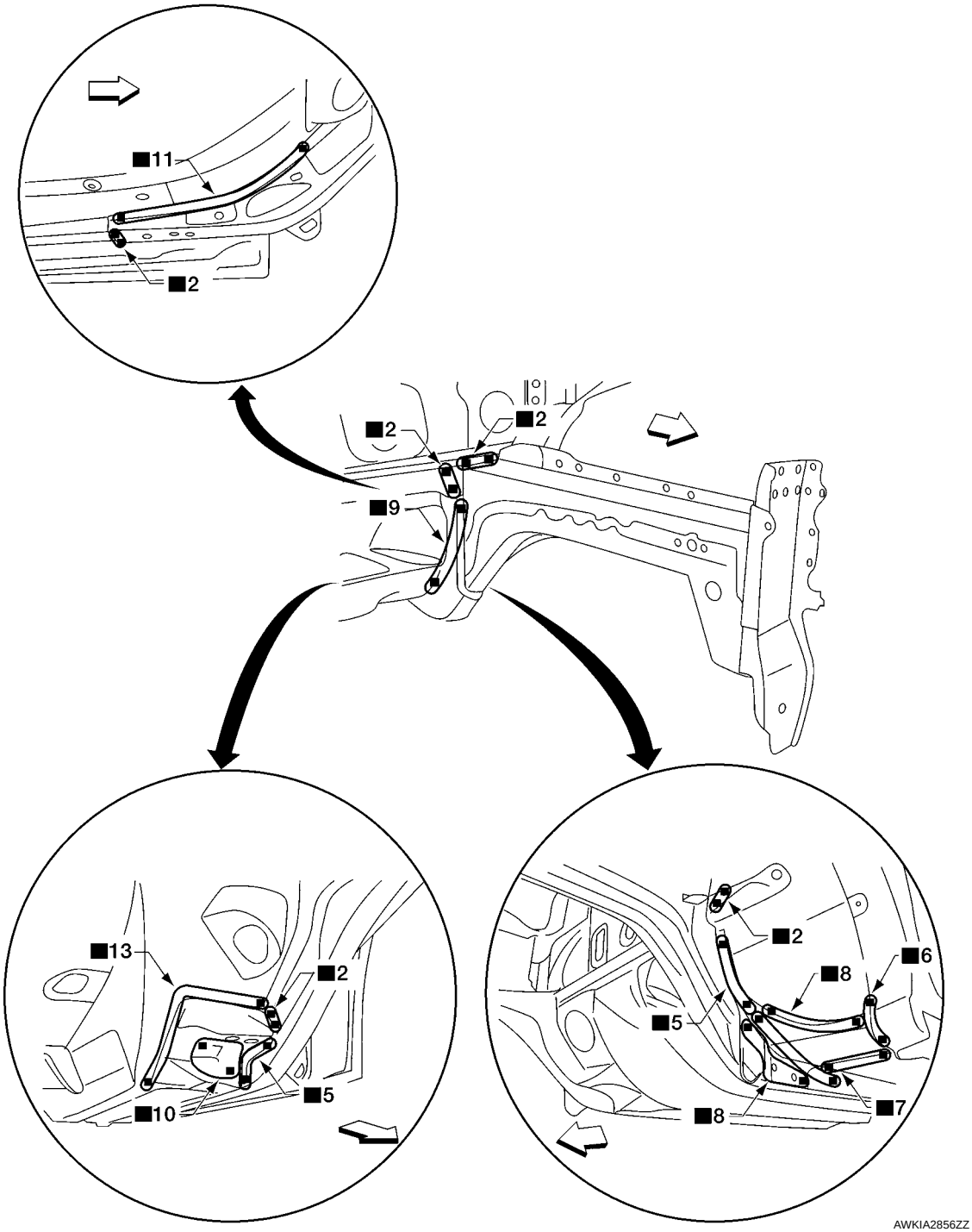
Replacement parts

- Front side member closing plate assembly (LH) ⇦Front

Front Side Member Inner

INFOID:0000000014625703

Work after hoodledge and strut housing has been removed.



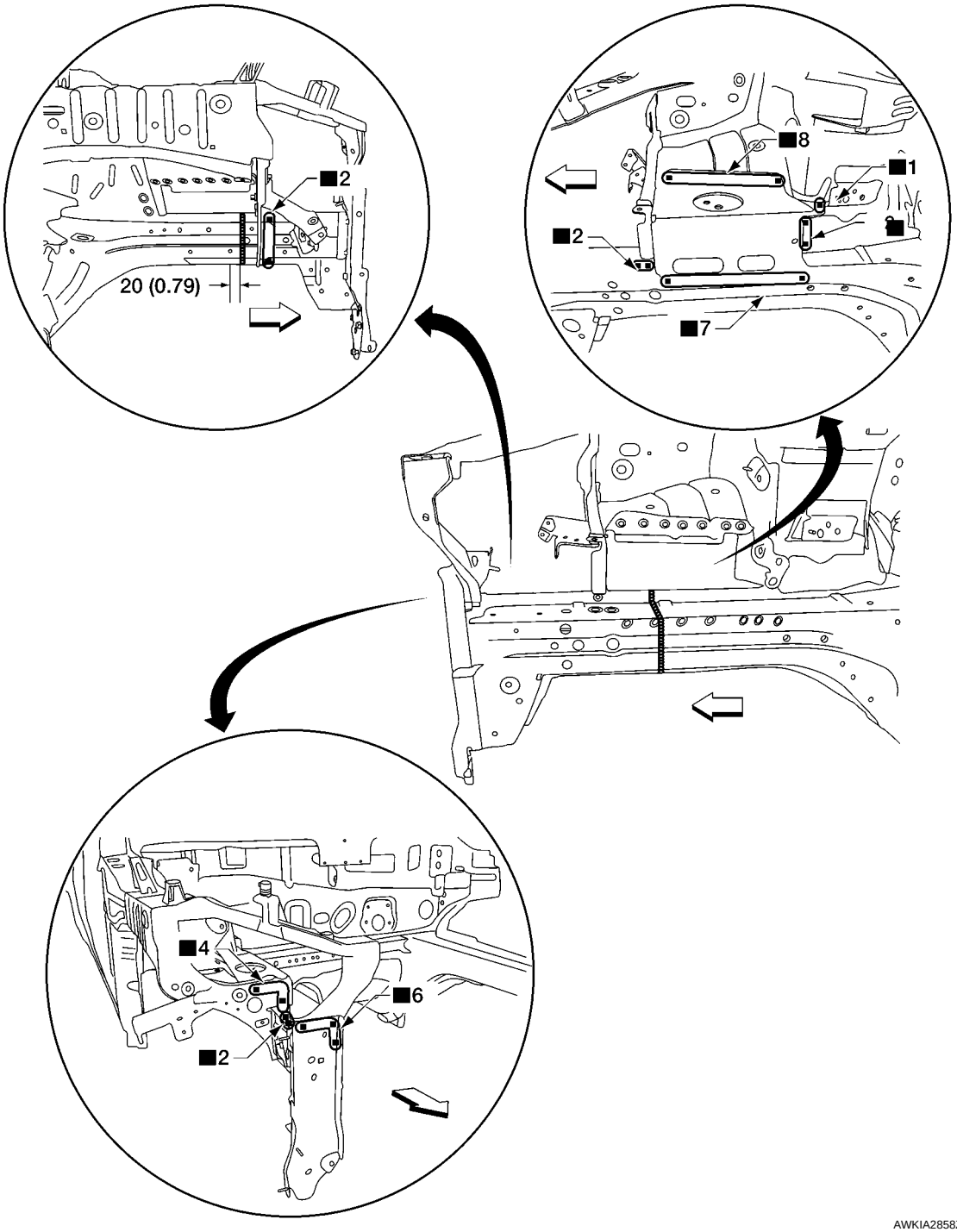
Replacement parts

- Front side member inner assembly (LH)

⇦Front

Front Side Member (Partial Replacement)

INFOID:0000000014625704



AWKIA2858ZZ

Unit: mm (in)

Replacement parts

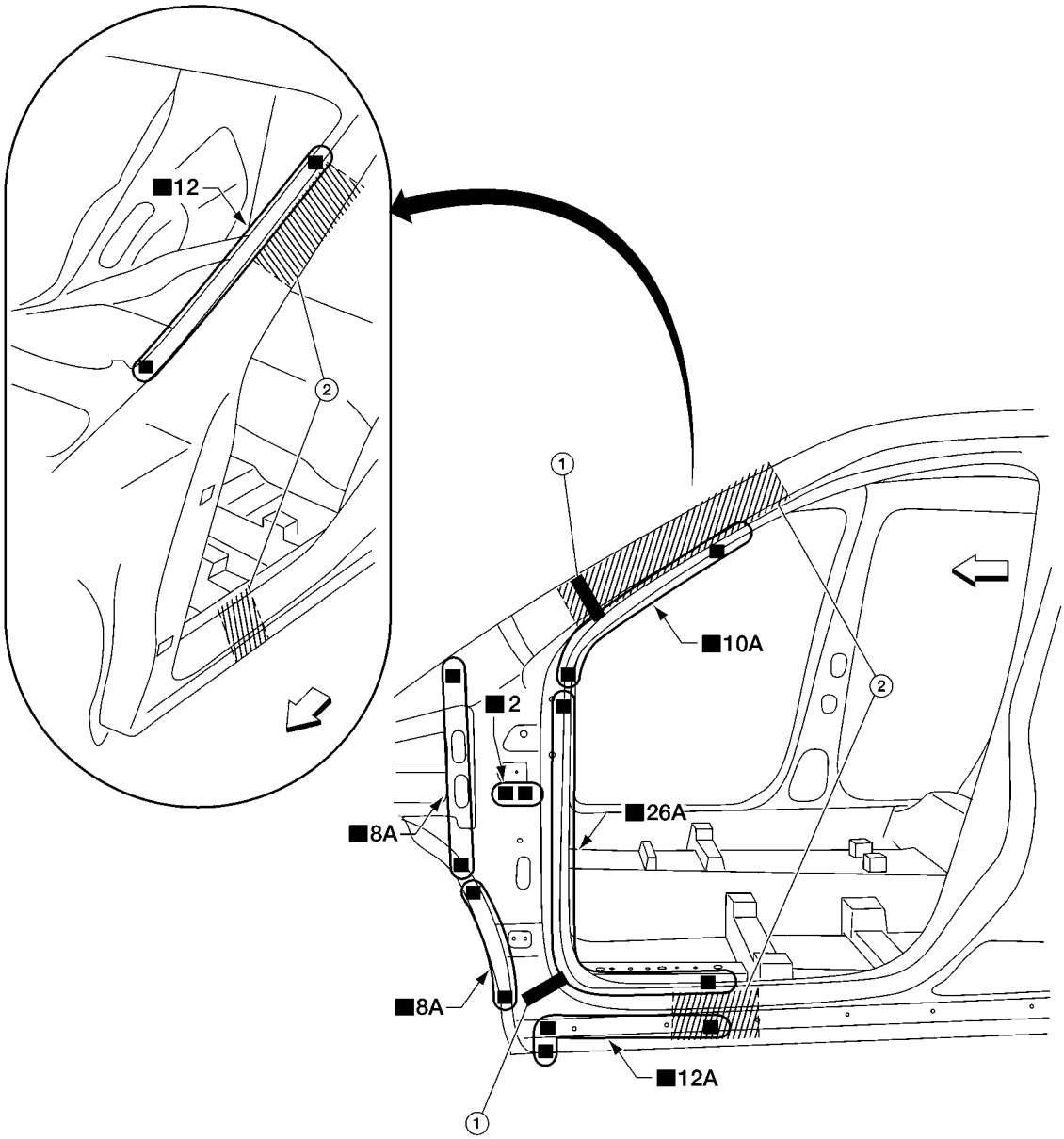
- Front side member (RH)
- Front side member closing plate assembly (RH)

⇦ Front

Front Pillar

INFOID:0000000014625705

Work after hoodledge reinforcement has been removed.



AWKIA2859ZZ

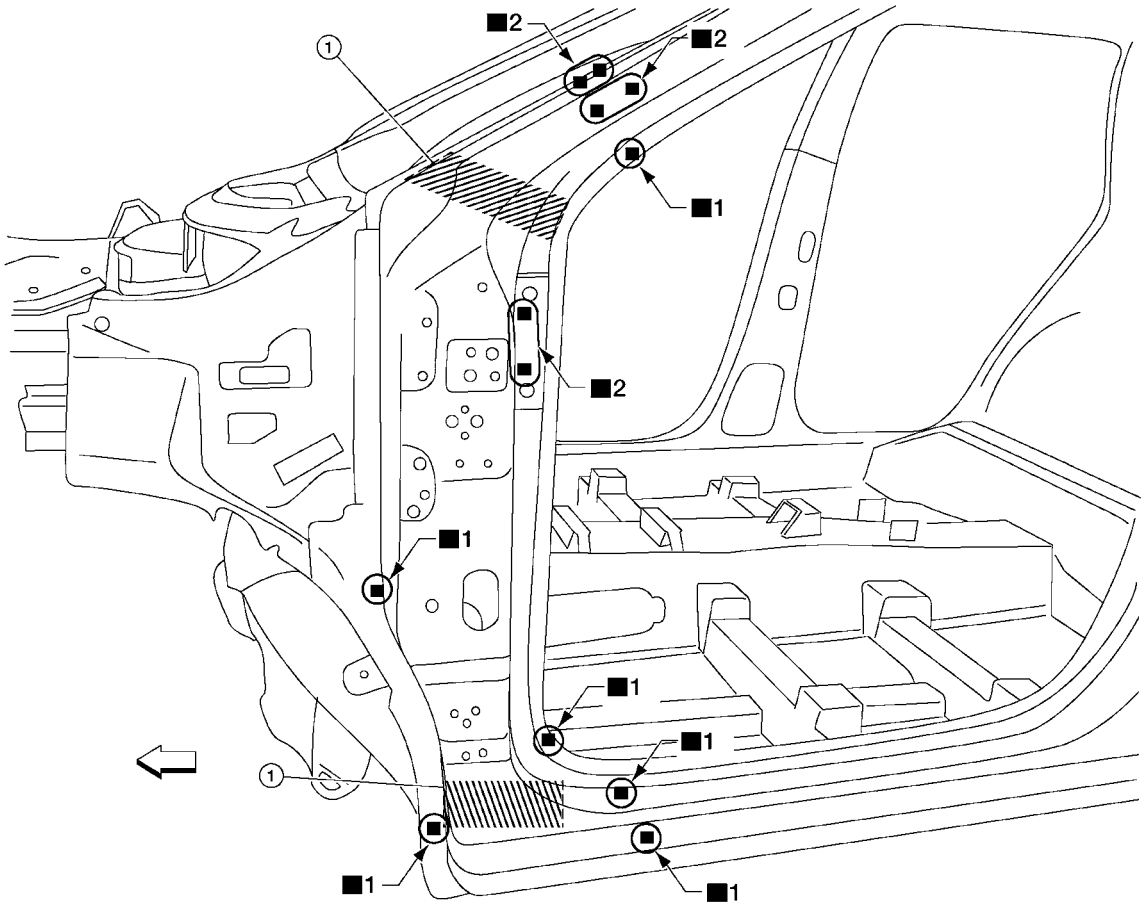
Replacement parts

- Front side body (LH)

1. Urethane foam
2. Sectioning location

⇦ Front

View B: Before installing outer front side body



ALKIA3314ZZ

Replacement parts

- Inner front pillar reinforcement

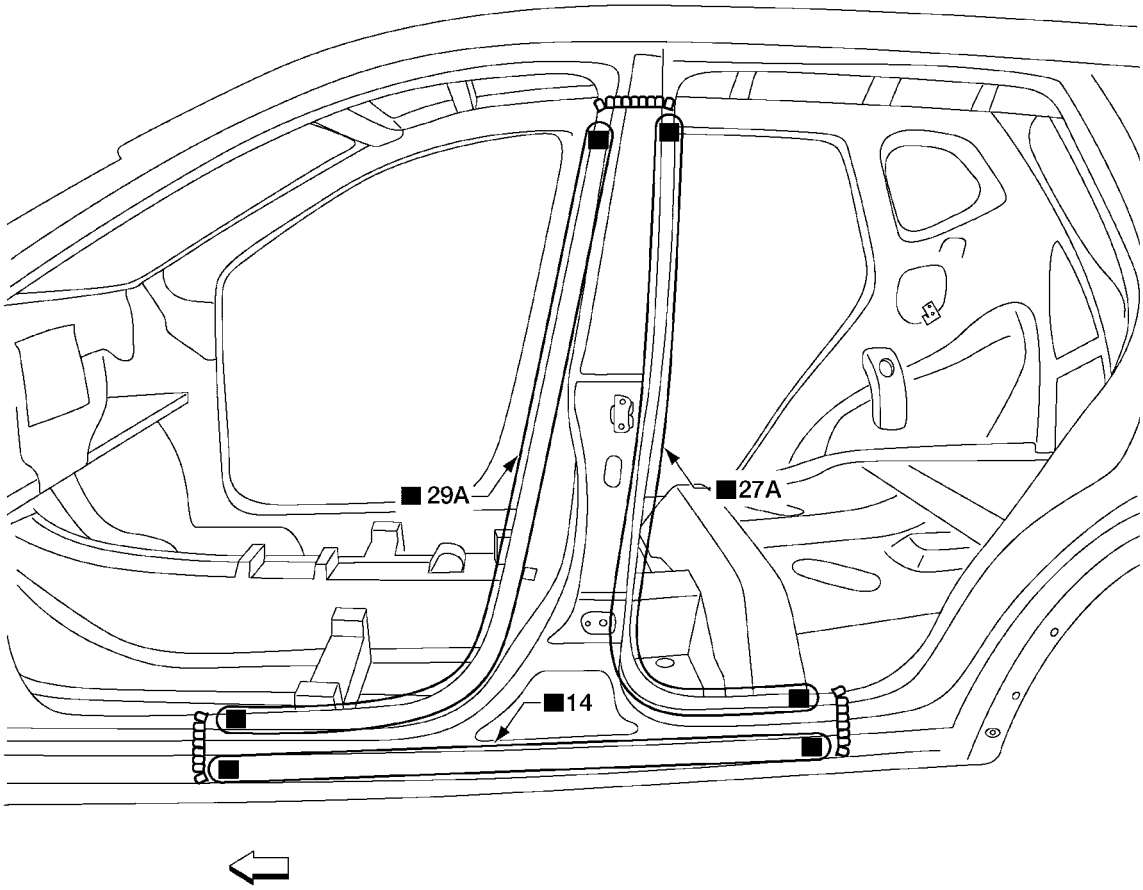
1. Urethane foam

⇦ Front

Center Pillar

INFOID:0000000014625706

.

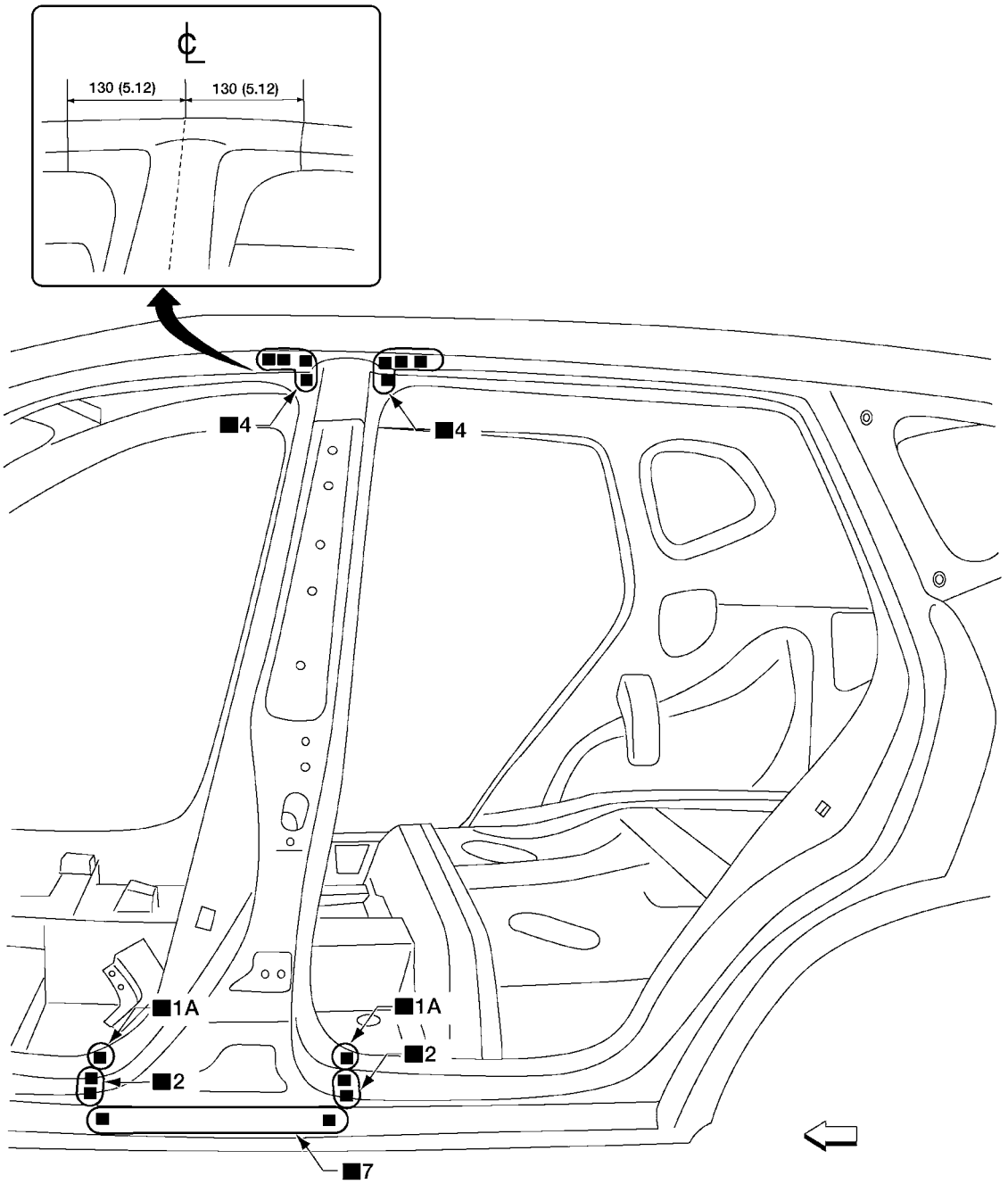


ALKIA3315ZZ

Replacement part

- Outer center pillar

⇦ Front



ALKIA3316ZZ

Unit: mm (in)

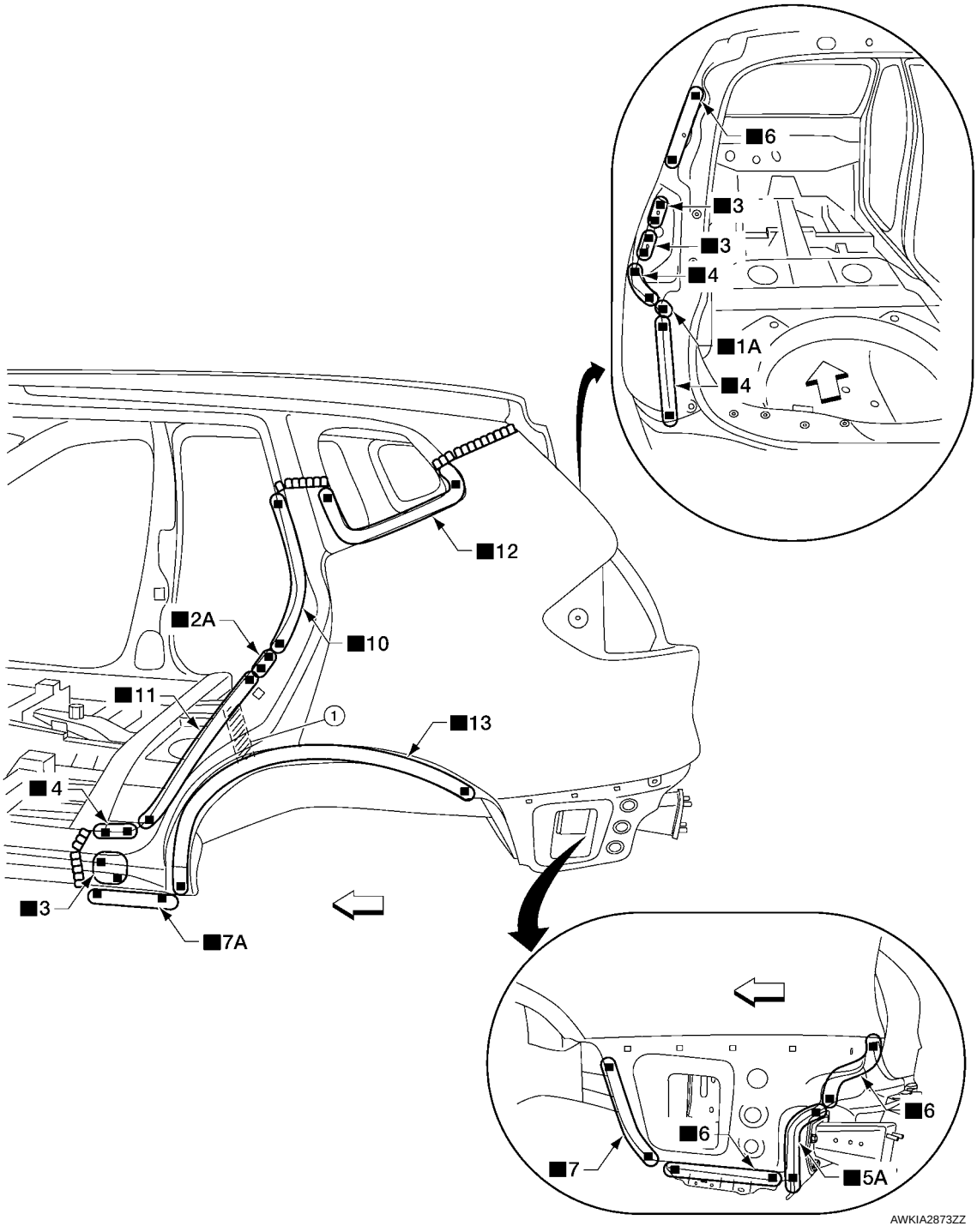
Replacement part

- Center pillar reinforcement

⇦ Front

Rear Fender

INFOID:0000000014625707



Replacement parts

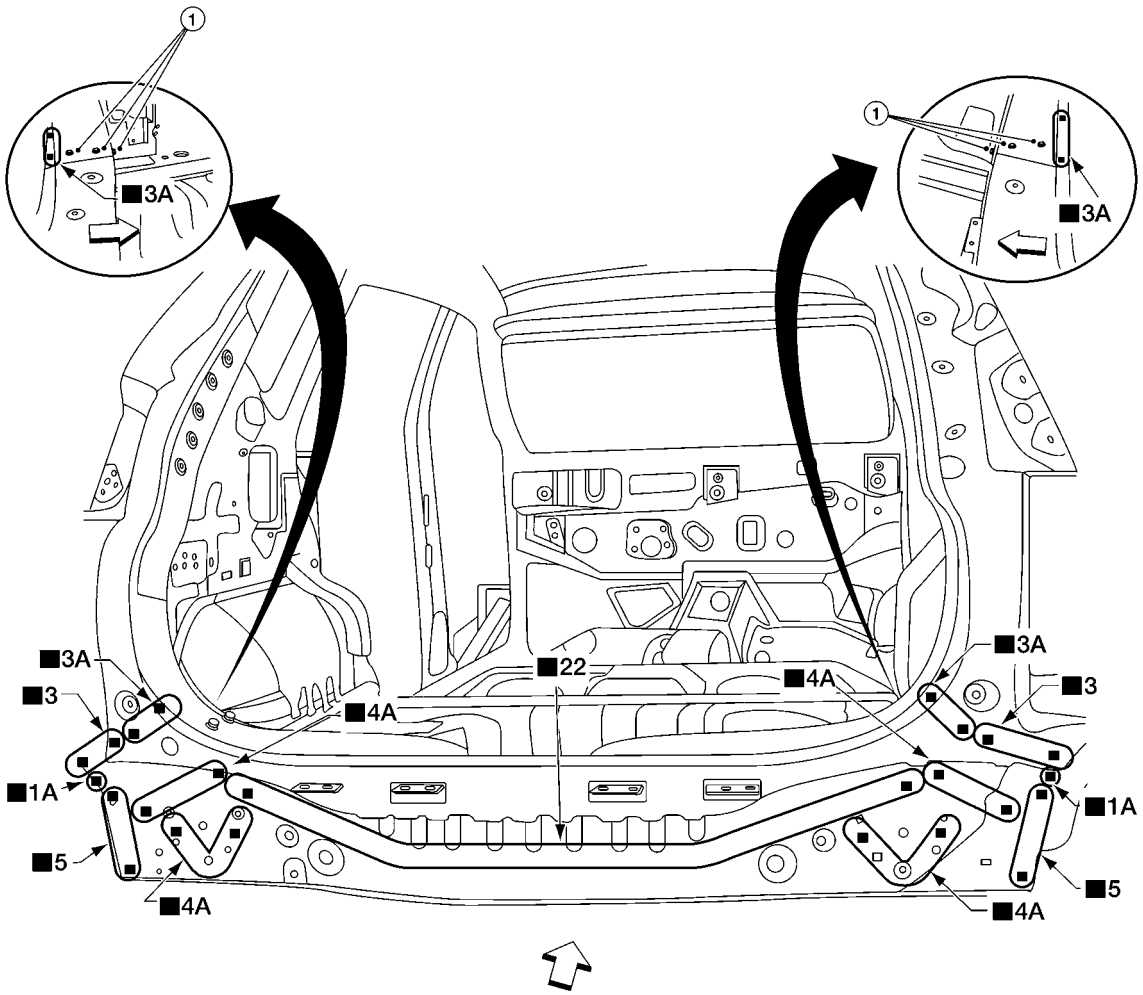
- Rear fender assembly (LH)

1. Urethane foam

⇦ Front

Rear Panel

INFOID:0000000014625708



ALKIA2861ZZ

Replacement parts

- Rear panel assembly

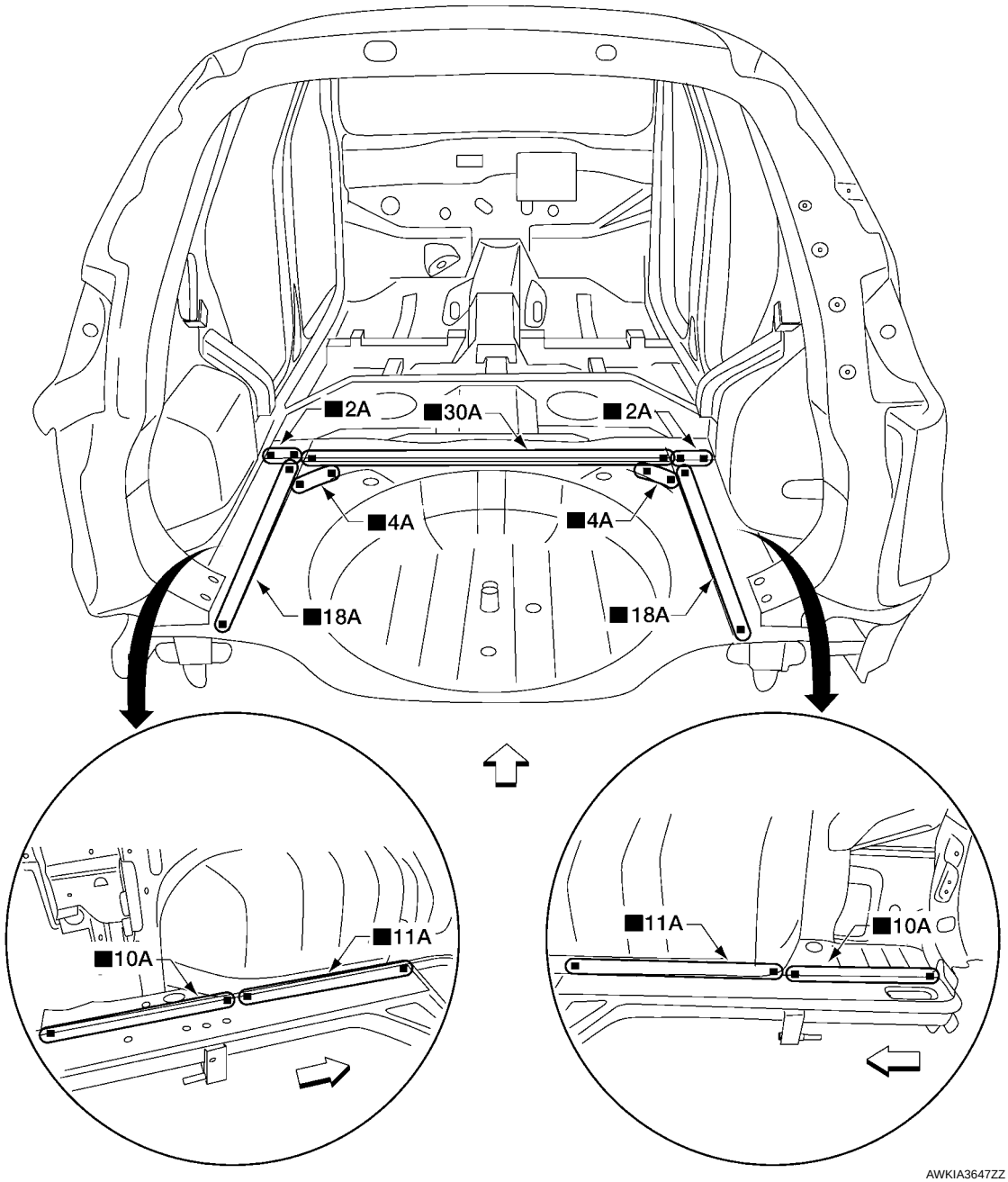
1. Bolt

⇦ Front

Rear Floor Rear

INFOID:0000000014625709

Work after rear panel has been removed.



Replacement parts

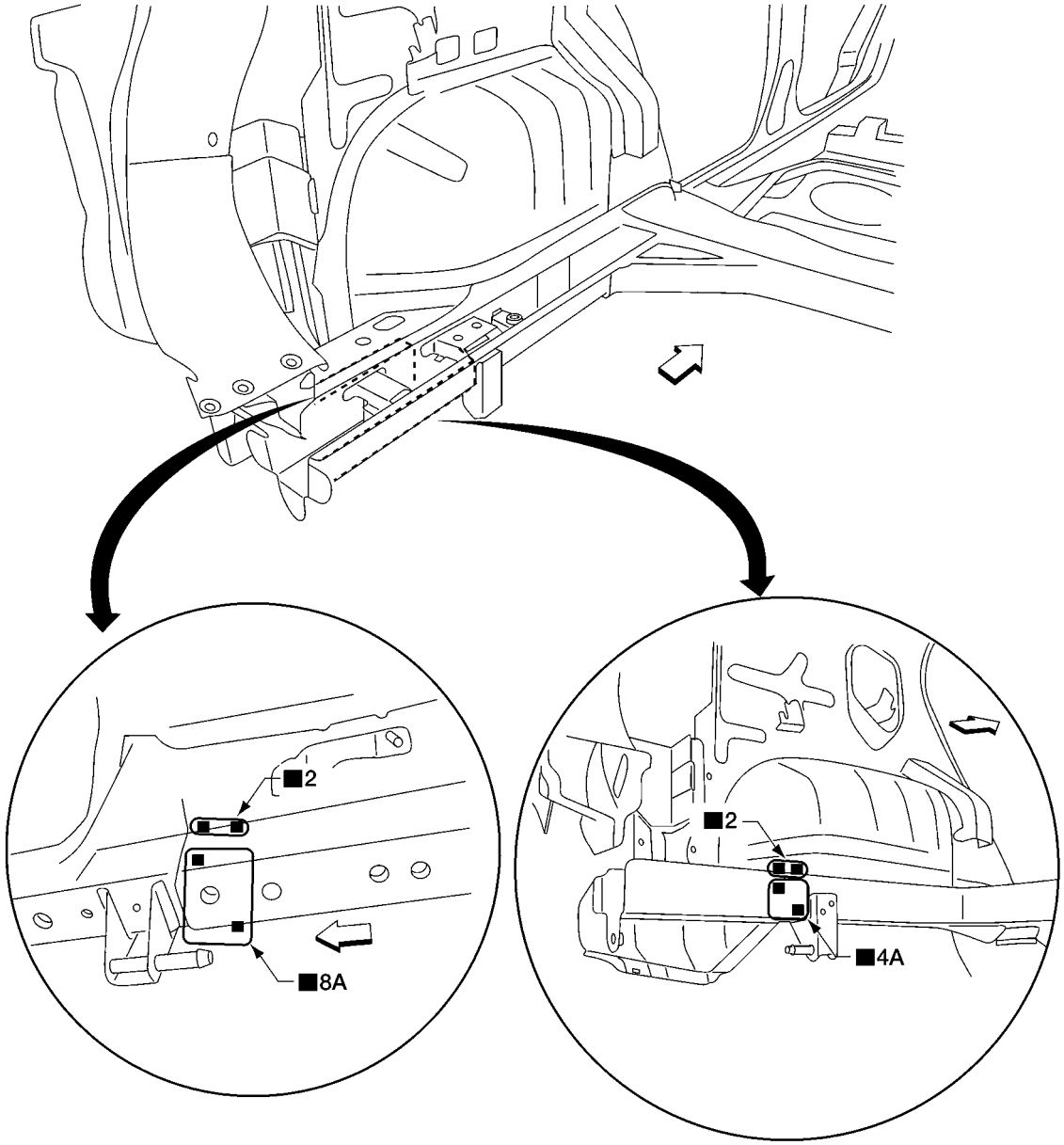
- Rear floor rear
- Rear floor rear side

⇦ Front

Rear Side Member Extension

INFOID:0000000014625710

Work after rear panel has been removed.



AWKIA2866ZZ

Replacement parts

- Rear side member extension (LH) ⇦ Front

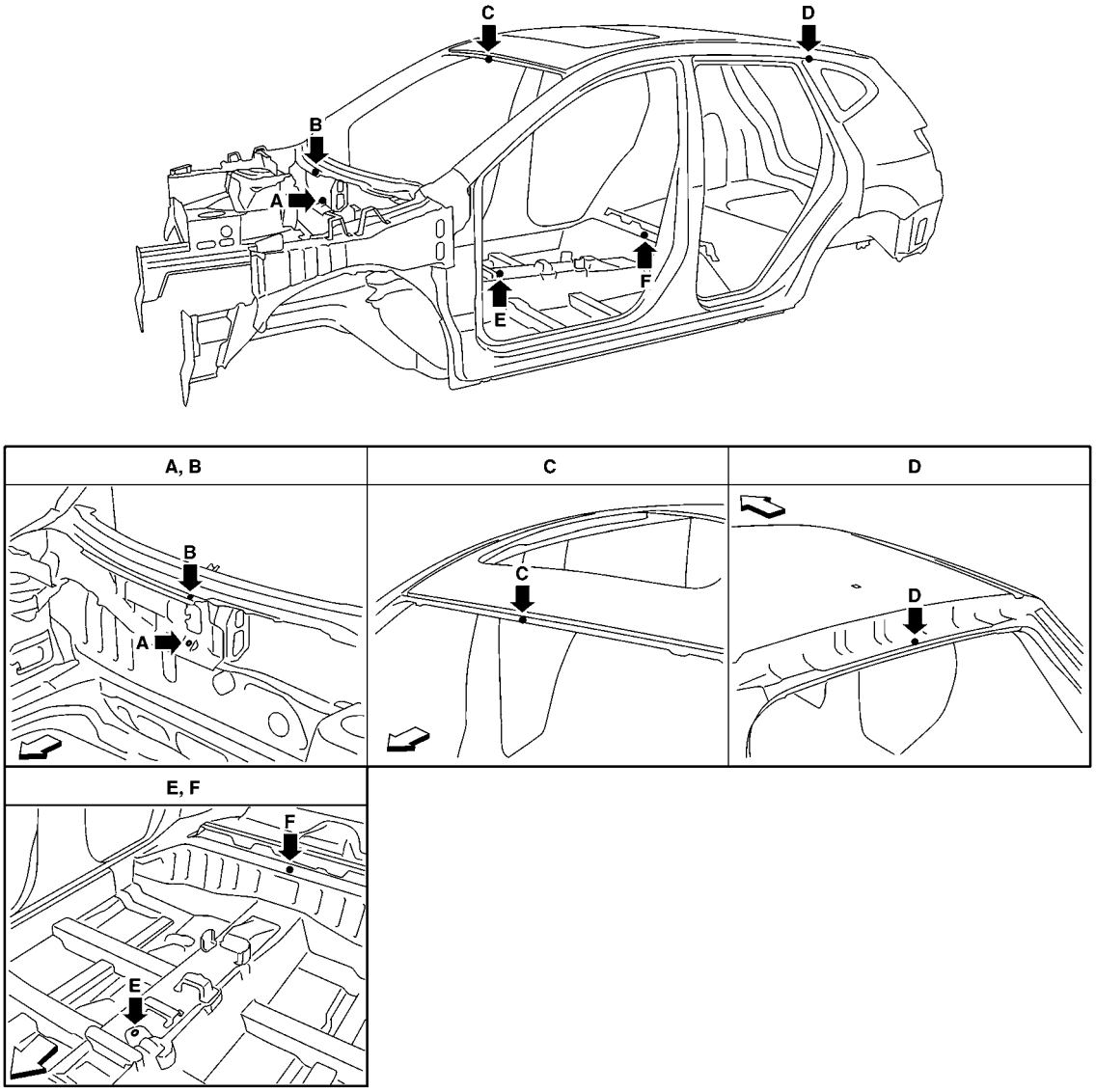
SERVICE DATA AND SPECIFICATIONS (SDS)

BODY ALIGNMENT

Body Center Marks

INFOID:0000000014625711

A mark has been placed on each part of the body to indicate the vehicle center. When repairing parts damaged by an accident which might affect the vehicle frame (members, pillars, etc.), more accurate and effective repair will be possible by using these marks together with body alignment specifications.



AWKIA2867ZZ

⇦ Front

Unit: mm (in)

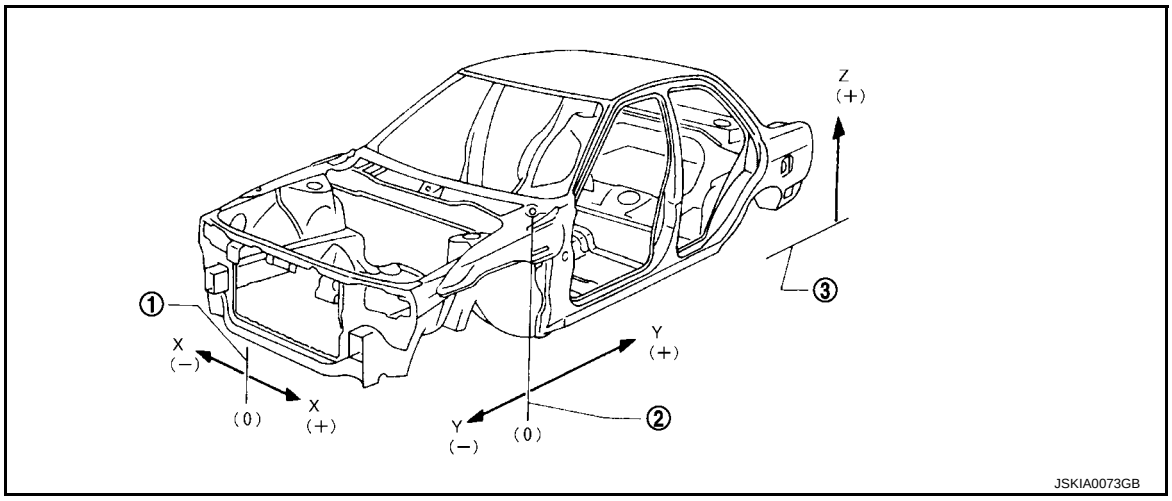
Points	Portion	Marks
A	Cowl top extension	Hole ϕ7 (0.28)
B	Center cowl top	Embossment
C	Front roof	Embossment
D	Rear roof	Embossment

Points	Portion	Marks
E	Trans control reinforcement	Hole 14×12 (0.55×0.47)
F	Rear seat crossmember	Embossment

Description

INFOID:0000000014625712

- All dimensions indicated in the figures are actual.
- When using a tracking gauge, adjust both pointers to equal length. Then check the pointers and gauge itself to make sure there is no free play.
- When a measuring tape is used, check to be sure there is no elongation, twisting or bending.
- Measurements should be taken at the center of the mounting holes.
- An asterisk (*) following the value at the measuring point indicates that the measuring point on the other side is symmetrically the same value.
- The coordinates of the measurement points are the distances measured from the standard line of ″X″, ″Y″ and ″Z″.
- ″Z″: Imaginary base line [200 mm (7.87 in) below datum line (″0Z″ at design plan)]



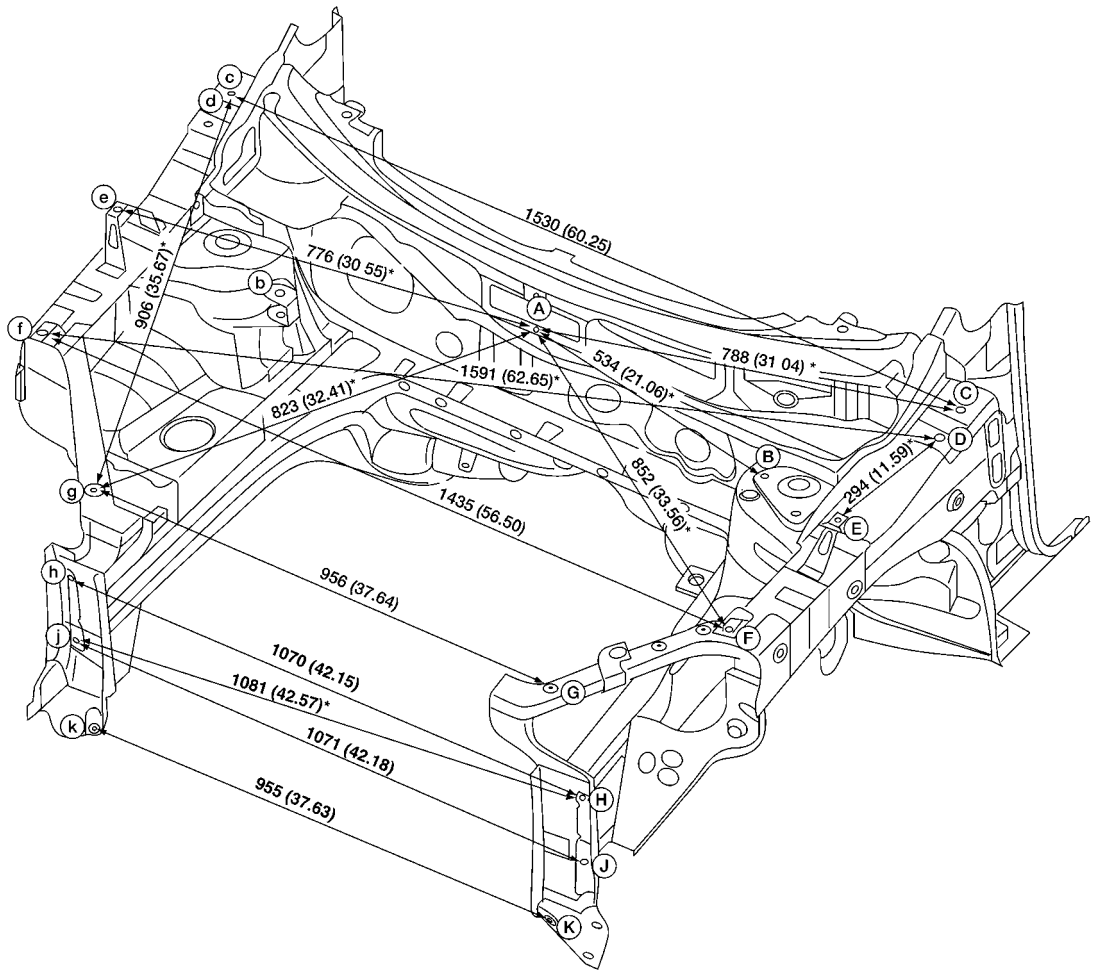
1. Vehicle center
2. Front axle center
3. Imaginary base line

Engine Compartment

INFOID:0000000014625713

MEASUREMENT

Dimensions marked with "*" indicate symmetrically identical dimensions on both the right and left hand of the vehicle.



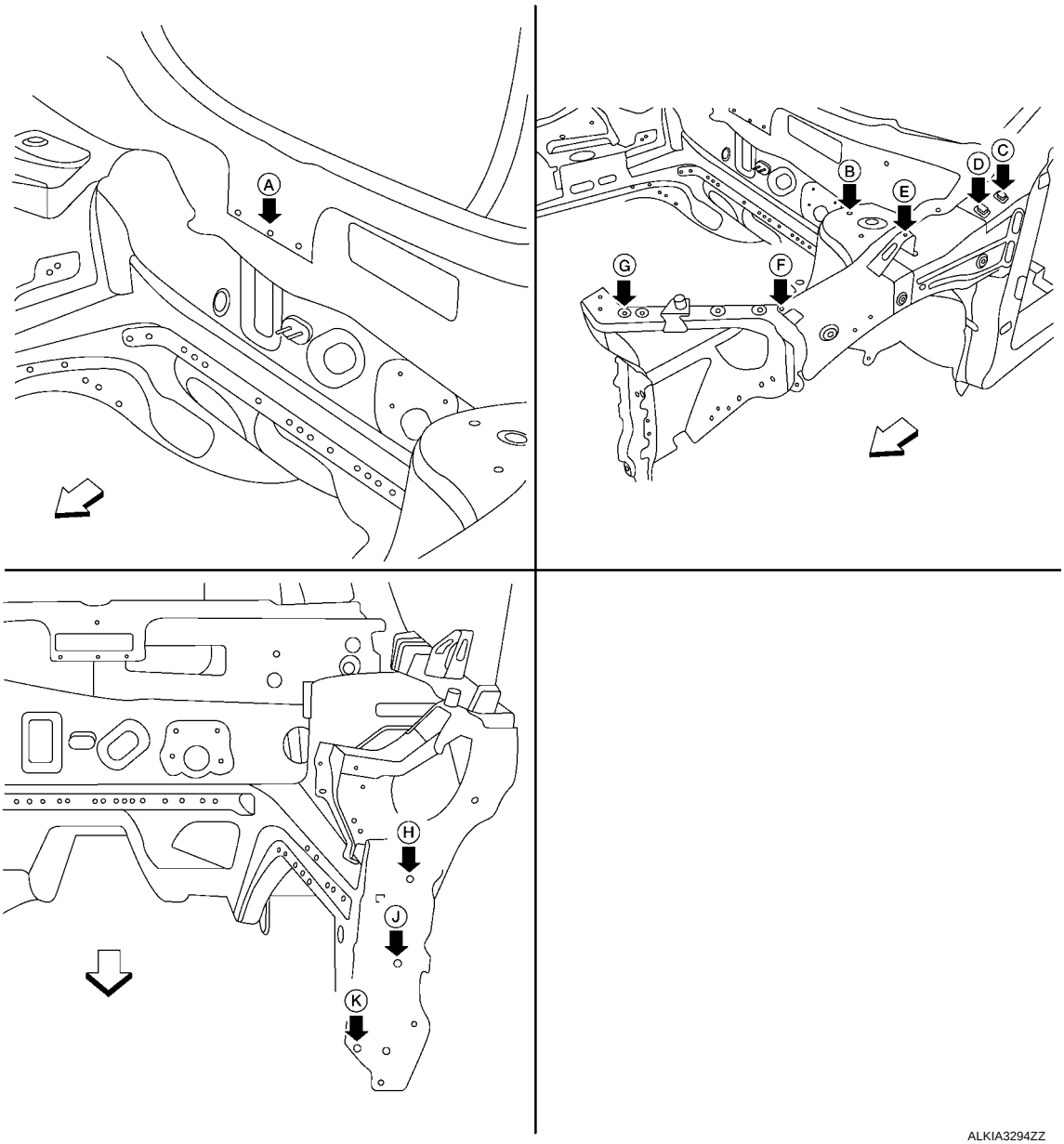
ALKIA3291ZZ

«The others»

Unit: mm (in)

Point	Dimension	Point	Dimension	Point	Dimension
A - D	774 (30.49)*	B - F	432 (17.04)*	C - G	906 (35.67)*
A - E	776 (30.49)*	B - f	1305 (51.41)*	C - g	1511 (59.50)*
A - G	832 (32.41)*	B - G	596 (23.48*)	D - g	1472 (57.98)*
B - b	1057 (41.64)	B - g	1189 (46.83)*	F - f	1435 (56.50)*
B - C	357 (14.06)*	C - D	70.0 (2.76)*	F - g	1216 (47.91)*
B - c	1321 (52.02)*	C - d	1520 (59.84)*	E - e	1509 (59.43)
B - D	308 (12.13)*	C - E	361 (14.22)*	E - f	1500 (59.07)*
B - d	1309 (51.54)*	C - e	1562 (61.50)*	G - e	1334 (52.54)*
B - E	263 (10.37)*	C - F	648 (25.53)*	H - J	152 (6.01)*
B - e	1290 (50.81)*	C - f	1617 (63.68)*	H - k	1081 (42.59)*

MEASUREMENT POINTS



ALKIA3294ZZ

⇦ Front

Unit: mm (in)

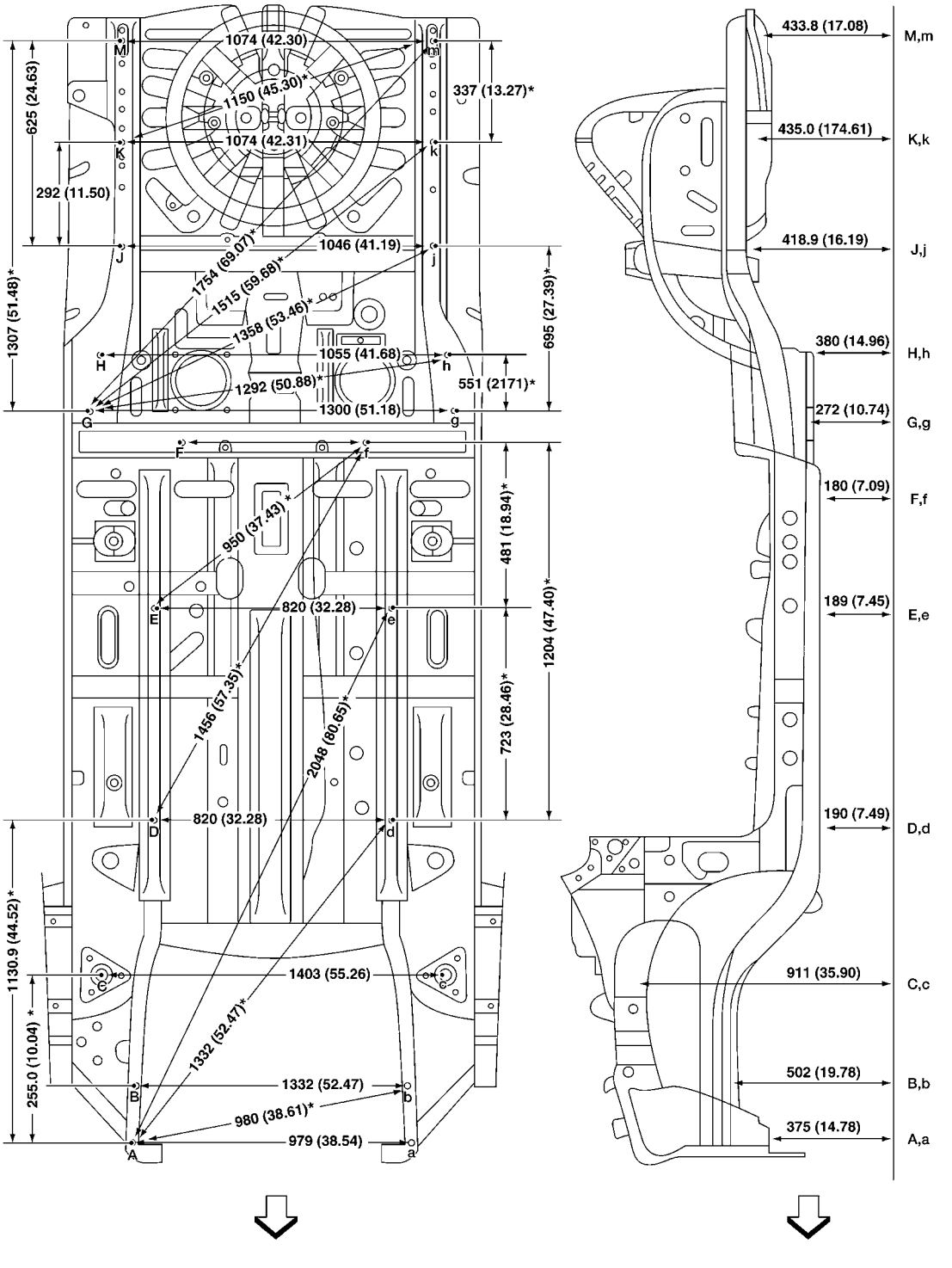
Point	Material	Point	Material
A	Cowl top extension hole center of center positioning mark ϕ8 (0.31)	G, g	Hole for headlight bracket ϕ7 (0.28)
B, b	Front strut installing hole center 16×10 (0.63×0.39)	H, h	Front side member hole center front bumper ϕ11 (0.43)
C,c D,d	Hood hinge installing hole center ϕ12 (0.47)	J, j	Front side member hole center front bumper ϕ13 (0.51)
E, e, F, f	Upper front fender bracket hole center ϕ7 (0.28)	K, k	Radiator lower bracket hole ϕ11 (0.43)

Underbody

INFOID:0000000014625714

MEASUREMENT

Dimensions marked with "*" indicate symmetrically identical dimensions on both the right and left hand of the vehicle.



ALKIA3295ZZ

⇦ Front

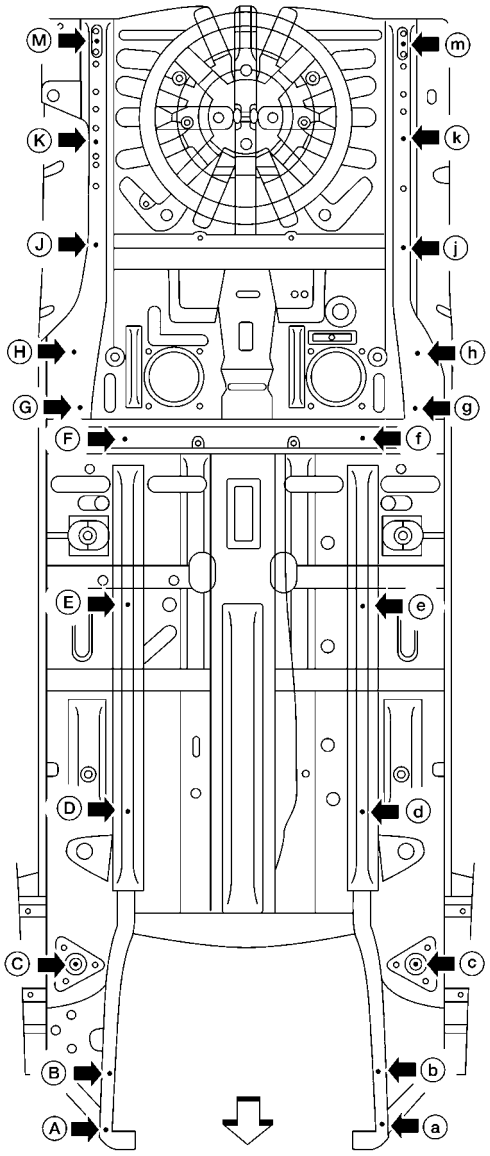
Unit: mm (in)

Point	Dimension	Point	Dimension	Point	Dimension
A - B	255 (10.04)	G - J	1358 (53.46)	J - k	1084 (42.68)
A - E	1847 (72.73)	g - k	975 (38.42)	K - M	337 (13.27)
D - e	1093 (43.04)				

MEASUREMENT Points

Dimensions marked with "*" indicate symmetrically identical dimensions on both the right and left hand of the vehicle.

MEASUREMENT POINTS



ALKIA3300ZZ

⇦ Front

Unit: mm (in)

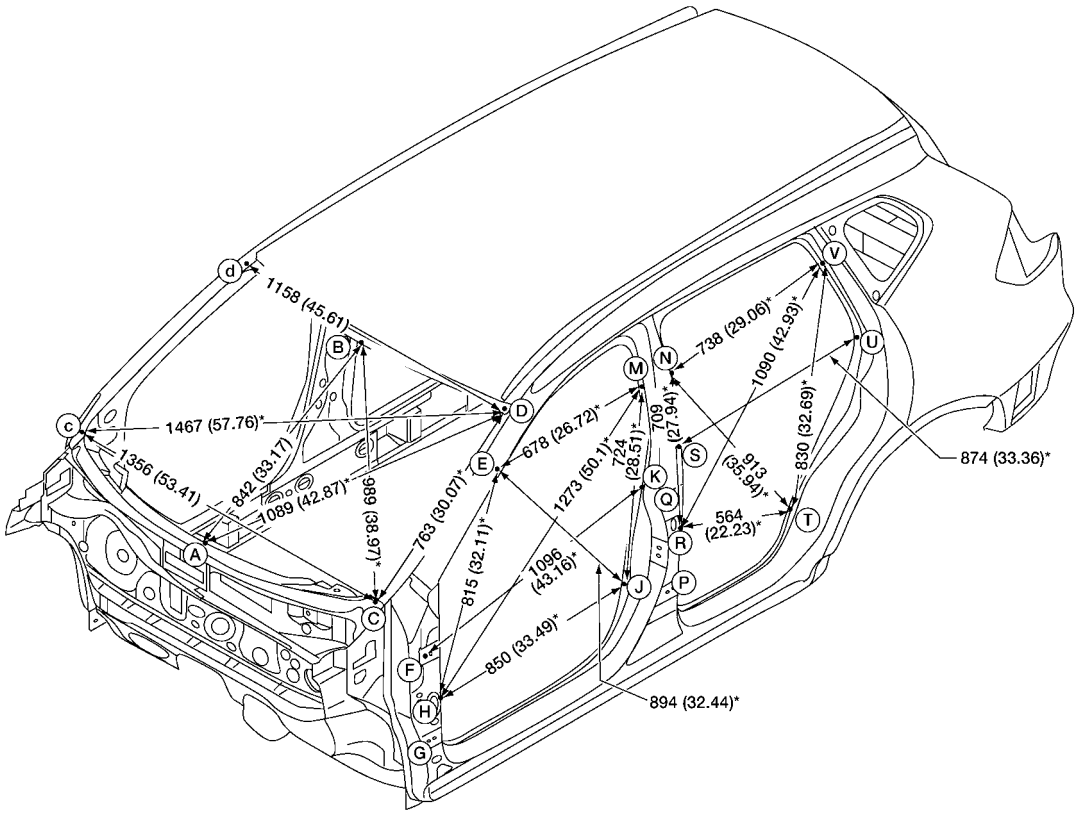
Points	Coordinates			Remarks
	X	Y	Z	
A	-566	-478	375	Hole ϕ18 (0.71)
a	-566	501	375	Hole ϕ18 (0.71)
B	-346	-462	502	Hole ϕ16 (0.63)
b	-372	474	502	Hole ϕ16 (0.63)
C, c	740	±598	911	Hole ϕ33 (1.30)
D, d	547	±410	190	Hole ϕ20x16 (0.79x0.63)
E, e	1270	±410	189	Hole ϕ12 (0.47)
F, f	1751	±410	180	Hole ϕ13 (0.51)
G, g	1954	±650	272	Hole ϕ16 (0.63)
H, h	2480	±525	380	Hole ϕ12 (0.51)
J, j	2622	±523	418	Hole ϕ09 (0.35)
K	2911	-549	435	Hole ϕ09 (0.35)
k	2897	525	435	Hole ϕ09 (0.35)
M	3248	-551	433	Hole ϕ20x14 (0.79x0.55)
m	3248	523	433	Hole ϕ20x14 (0.79x0.55)

Passenger Compartment

INFOID:0000000014625715

MEASUREMENT

Dimensions marked with "*" indicate symmetrically identical dimensions on both the right and left hand of the vehicle.

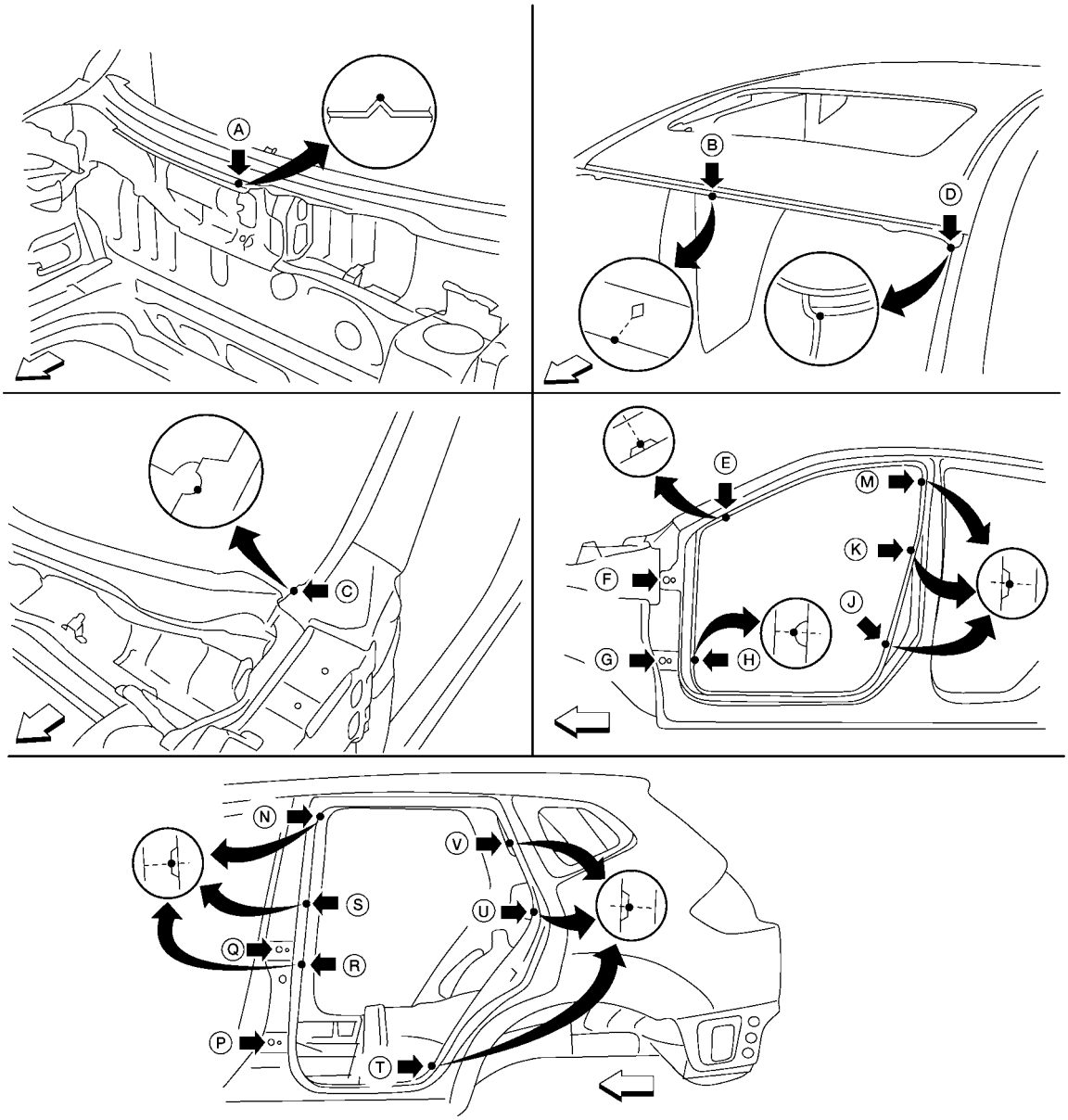


AWKIA2814ZZ

Unit: mm (in)

Point	Dimension	Point	Dimension	Point	Dimension	Point	Dimension
A - C	700 (27.56)*	F - Q	1172 (46.15)*	K - M	285 (11.25)*	S - U	847 (33.36)*
B - D	582 (22.94)*	G - P	1137 (44.77)*	M - F	1229 (48.40)*	U - N	863 (33.99)*
E - J	849 (33.44)*	G - Q	1235 (48.63)*	N - S	281 (11.08)*	U - V	297 (11.70)*
E - K	669 (26.37)*	J - E	849 (33.44)*	N - U	863 (33.99)*	V - S	820 (32.30)*
E - M	678 (26.72)	J - F	850 (33.46)*	S - N	281 (11.08)*	V - N	738 (29.06)*
F - P	1175 (46.28)*	K - J	443 (17.44)*	S - T	712 (28.06)*		

MEASUREMENT POINTS



ALKIA3285ZZ

⇦ Front

Unit: mm (in)

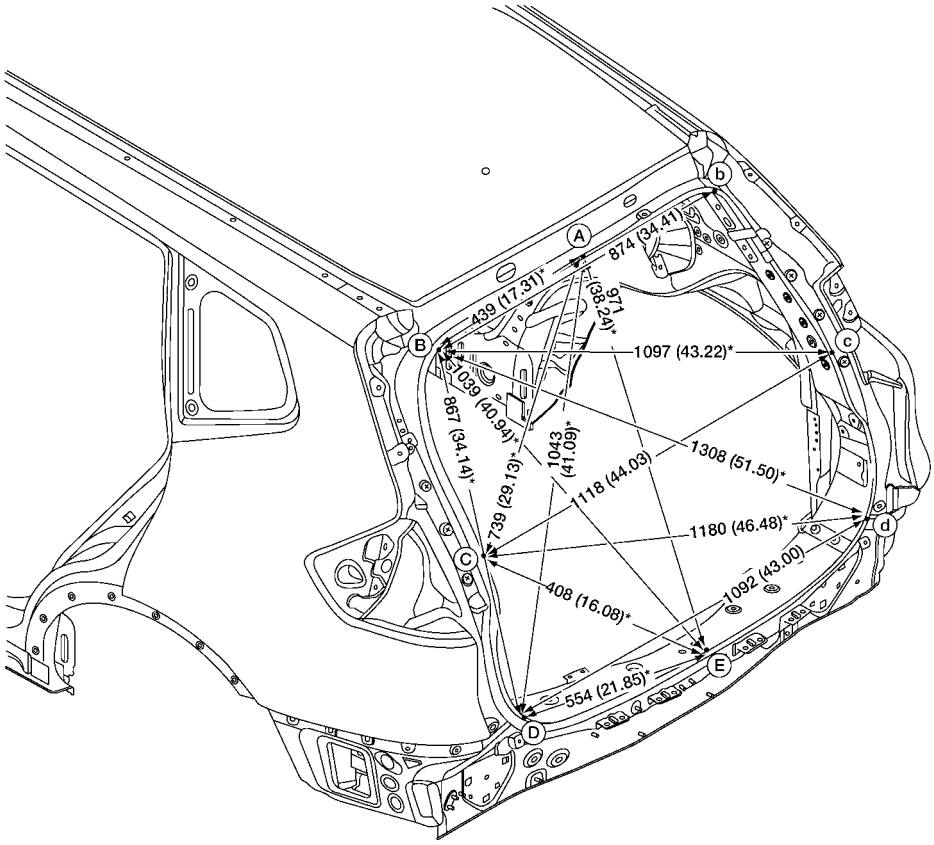
Point	Material	Point	Material
A	Center cowl top positioning mark of center positioning mark	J,,j, K,k, M,m, N,n, S,s, R,r	Center pillar indent
B	Roof flange end of center positioning mark	T,t U,u V,v	Rear fender indent
C, c	Front pillar joggle	F,f, G,g, Q, q, P, P	Door hinge installing hole center ϕ12 (0.47) W, w: ϕ9 (0.35)
E, e, H, h, G, g	Front pillar indent		

Rear Body

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MEASUREMENT

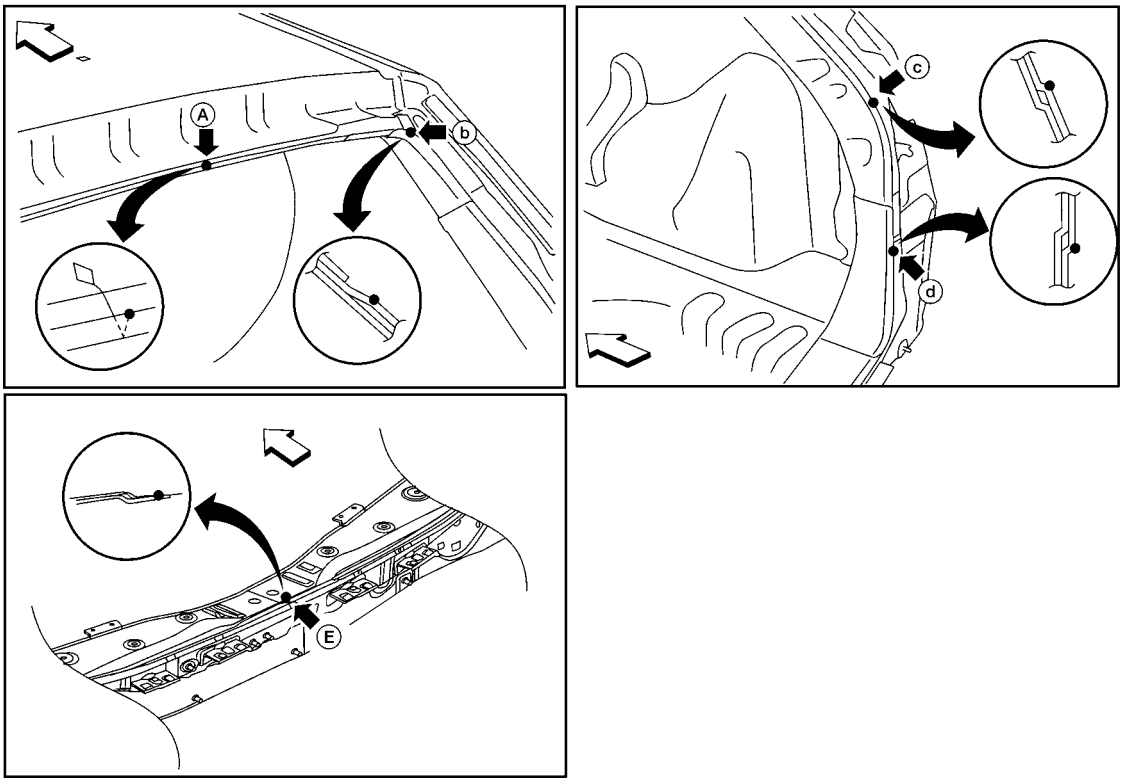
Dimensions marked with "*" indicate symmetrically identical dimensions on both the right and left hand of the vehicle.



AWKIA2815ZZ

Unit: mm (in)

MEASUREMENT POINTS



AWKIA2868ZZ

⇦ Front

Unit: mm (in)

Point	Material	Point	Material
A	Roof flange end of center positioning mark	C, c, D, d	Rear flange jog corner
B, b	Rear flange jog corner	E	Rear panel upper flange end