

Automotive Body Repair and Paint Work

Level IV

Based on October 2023, Curriculum Version II



Module Title: - Evaluating Vehicle Body and Paint Work

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Acronyms

TQC-----Total Quality Control

DC -----Direct Current

PC -----Personal Computer

CD----- Compact Disk

Introduction to the Module

This module describes the performance outcomes required to evaluate the body repair and Paint work of a vehicle for damage and to identify the materials, equipment and processes required to repair it. It involves using vehicle paint, body and mechanical technical knowledge; and locating, evaluating and documenting relevant information when selecting materials, equipment and processes.

This module covers the units:

- Overview to Vehicle Body and Paint Work
- Assesse Vehicle Bodywork for Damage
- Gather data and specifications
- Evaluate and Select Materials, Equipment and Processes

Learning Objective of the Module

- Overview to Vehicle Body and Paint Work
- Assessing Vehicle Bodywork for Damage
- Gathering data and specifications
- Evaluating and Selecting Materials, Equipment and Processes

Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

Unit One: Overview to Vehicle Body and Paint Work

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Purpose of evaluation
- Principle of evaluation
- Legal requirements of evaluation
- Checking tool equipment

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Understand the Purpose of evaluation
- Perform Principle of evaluation
- Apply Legal requirements of evaluation
- Check tool equipment

1.1. Purpose of evaluations

Evaluation provides a systematic method to study a program, practice, intervention, or initiative to understand how well it achieves its auto body and paint work. Evaluations help determine what works well and what could be improved in Auto body and paint work.

It enable a quick assessment of the quality of the paint finish and to verify that the condition of a vehicle matches its reported history, that is, determine if the vehicle has been in an accident or experienced other types of paint damage.



Figure1- 1 Coating Thickness Measurement Gages

The Measure of Quality

Regular film thickness measurement helps control material costs, manage application efficiency, maintain finish quality, and ensure compliance with contract specifications. Paint manufacturers recommend target ranges to achieve optimum performance characteristics and clients expect these parameters to be met.

1.2. Principle of Evaluations

Key areas for car paint Evaluations

There are lots of different things car paint needs to be good at, including:

Appearance

The general appearance of paint is essential when it comes to getting the kind of finish consumer like.

Gloss

The gloss levels of a car's paint need to be carefully measured. A high gloss factor can significantly improve the look of a paint job.

Corrosion

Corrosion can cause big problems for car manufacturers, as it can quickly affect the car's overall appearance. Paint adhesion testing is a great solution.

Salt Spray

Cars have to deal with all kinds of difficult conditions, including salt spray and grit which can chip or corrode paint over time.

Abrasion

Even minor scrapes can severely impact the overall look of a car and knowing that the paint job can withstand a certain level of abrasion is essential.

Top testing solutions for car paint

Just a few of our highlighted products perfect for making sure you have your paints and coatings right include:

TQC Sheen Coat master Flex

This handy gauge measures coating thickness immediately after application, ideal for documenting and controlling in-line coating processes. In turn, this can help in saving on coating material, improving coating quality, and reducing running-in time and scrap.

TQC Sheen Gloss meter

Suitable for paint and coatings, plastics and a whole range of automotive parts, this gloss meter has adjustable gloss limits with visual and acoustic alarm as well as an LCD colour display with wide viewing angle.

Cyclic Corrosion Cabinet

Enjoy a full range of environmental testing conditions to see how paint and coatings react in the kind of conditions vehicles are likely to encounter.

1.3. Legal Requirements of Evaluation

Health and safety legislation has made the vehicle body repair industry increasingly aware of the need to provide adequate facilities for employees, both as a legal duty and to improve the working environment. Within this framework of a safe working environment the employer must also promote efficient work methods, which together should result in improved productivity.

The following is a sample of the list of statutory regulations which the vehicle repair body shop **MUST COMPLY** with.

Abrasive Wheel Regulations

Classification, Packaging and Labeling of Dangerous Substances Regulations

Control of Pollution (Special Wastes) Regulations & Act

Control of Substances Hazardous to Health (COSHH) Regulations

Electricity at Work Regulation

Environmental Protection Act

Factory Act

Fire Precautions (Factories, Offices, Shops and Railway Premises) Order

Fire Precautions Act

Health and Safety at Work Act

Highly Flammable Liquids and Liquefied Petroleum Gases Regulations

Management of Health and Safety at Work Regulations

Manual Handling Operation Regulations

Motor Vehicle Construction and Use Regulations

Personal & Workplace safety Protection Equipment at Work (PPE) Regulations

Petroleum (Consolidation) Act

Petroleum (Mixtures) Orders

Protection of Eyes Regulations

Provision and Use of Work Equipment Regulations

Road Traffic Act (MOT)

Weights and Measures Act

1.4. Checking Tools Equipment's Measuring Devices

Load testers

Load tester is used in measuring the battery voltage under given load conditions. Whereas Multimeters measures battery voltage and helps gauge the battery's health. By setting a Multimeter to DC volts and connecting it to the positive and negative terminals of a battery, the Multimeters will measure its voltage.

Multimeters

A digital Multimeters is a test tool used to measure two or more electrical values principally voltage (volts), current (amps) and resistance (ohms). It is a standard diagnostic tool for technicians in the electrical/electronic industries.

Protective Covers

The car cover is often used when a vehicle is stored away for a certain amount of time, or when being left unused for a while. It can also be used to protect a vehicle against snow, tree juice, dirt, paint and other contaminants. There are several different types of car covers to suit different needs.

Specialist Tooling Including

Key cutters

Keys are cut with a machine called a key duplicator. Your original key is placed in a vice on one side of the key duplicator, lined up with the cutting tool (or blade), and a blank key is placed in a vice on the side of the machine that contains the alignment tool.

Removal and Adjustment Tools

Colour spectrometer

A Spectrophotometer is a scientific piece of equipment that breaks down a colour's spectral characteristics (whether transparent, translucent, opaque or clear) within a specific range

within the electromagnetic spectrum. The information can then be shared to ensure colour consistency.

Paint mixers

Paint mixers are a device that used to stir the paint until fully recombines or mix appropriately.

Vehicle

Diagnostic Equipment

Automotive Diagnostic Testing & Scanning Inspection Cameras Multi-meters, Probes & Testers Compression & Pressure Testers Code Readers & Scanners Thermometers All Automotive

Measuring equipment

Frame repair technicians specialize in repairing and aligning the structural frames of vehicles that have been involved in accidents. They use specialized equipment to measure and straighten the frame to restore its original shape and ensure the vehicle's safety and stability.

Self-Cheek - 1

Directions: Answer all the questions listed below

Part I: Choose the appropriate answer from the given alternatives

1. _____Is a device used to stir the paint until fully recombines?
 - A. Load testers
 - B. Paint mixers
 - C. Key cutters
 - D.Colour spectrometer
2. _____ provides a systematic method to study a program?
 - A. Load testers
 - B. Multimeters
 - C. evaluation
 - D.Colour spectrometer

Part II Match Each Words Of Definitions

Column A

1. Appearance
2. Gloss
3. Corrosion
4. Salt Spray
5. Abrasion
6. Top testing solutions for car paint

Column B

- A. A high gloss factor can significantly improve the look of a paint job.
- B. as it can quickly affect the car's overall appearance
- C. Cars have to deal with all kinds of difficult conditions
- D. Even minor scrapes can severely impact the overall look of a car
- E. For making sure you have your paints and coatings right include
- F. It comes to getting the kind of finish consumer like.

Part III Give Short Answer

1. what is paint mixer device ?
2. write at list five diagnostic equipment ?

Unit Two: Assessing Vehicle Bodywork for Damage

This unit to provide you the necessary information regarding the following content coverage and topics:

- Determining inspection methods
- Inspecting body damage and paintwork

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Determine inspection methods
- Inspect body damage and paintwork

2.1. Determining Inspection Methods

When you're driving your car, it's important to always be aware of the surroundings and the people around you. But what if something happens while you're driving that you don't know about? This is where car damage assessment comes in, a process whereby you can find out the extent of damage that has been done to your car. There are a few steps you need to take to get this information, and after that you'll need to decide what to do next.

All the steps involved in car damage assessment and explain what happens after each step is complete.

Step 1: Visually Inspect the Vehicle

Even if you're not the car owner, it's still important to know how to find out what damage was done to a car. This is especially true if you're not the car's original owner or if the car is not registered in your name. If your titles are damaged or lost you can fix this easily by visiting swift-tags.com. The first step is to visually inspect the car to determine the extent of damage? If there are any obvious signs of collision or vandalism, make an insurance claim right away. If you can't see any damage, or the damage is minor, try using a camera to take pictures from different angles. Finally, use your hands and a flashlight to check for dents, scratches, and other signs of collision or vandalism. Knowing the extent of the damage will help you file the insurance claim and get your car back as quickly as possible.

Step 2: Take it to an Auto Repair Shop

Damage to a car can happen in a million different ways and can often be difficult to determine.

That's where the help of an auto repair shop comes in. They will be able to tell you exactly what needs to be fixed and at what cost. Additionally, if you're not sure whether or not damage was done to your car, take it to them for a second opinion. By doing this, you'll have all the information you need to make an informed decision. Make sure to get multiple estimates so that you can be as accurate as possible with your costs. And last but not least, don't go with the first estimate you receive – get multiple estimates so that you can be sure you're getting the best deal for your car.

Step 3: Get Estimates from 3 Different Auto Repair Shops

After your car was damaged, you may be wondering what damage was done and how much it will cost to repair. To find out, you'll need to take it in for an estimate from 3 different auto repair shops. All of these estimates will be based on the same facts – the condition of the car and any damages that were found. Compare the cost and quality of each shop's estimate and make a decision about which one to go with. Be sure to ask for a written estimate so there is no misunderstanding about what work has been done. If you have any questions or concerns, don't hesitate to contact one of the shops listed. We hope this guide has helped you in some way.

Step 4: Get an Estimate from a Body Shop

It can be difficult to know when or how to approach car repairs, especially if you're not entirely familiar with the process. That's why it's important to know the basics of car damage assessment. In this step, you'll be prepared to provide information about your car, like make, model, year and colour. Next, head to a body shop and request an estimate for the repairs. The body shop will then Take pictures and measurements of your car and begin the repair process.

Keep in mind that the cost of repairs may vary depending on the severity of damage caused to your vehicle. If you're unsure of what to do or where to turn, doesn't worry – our team at the car repair shop can help guide you through the process.

Step 5: File Your Claim with Your Insurance Company

If you were in an accident and your car was damaged, it's important to take action as soon as possible. Make a written statement of what happened, gather any related evidence, and contact your insurance company as soon as possible. Keep copies of all documents involved in the accident in case something goes wrong later on. If you're in an accident and your car is damaged, it's best to leave the scene and find a safe place to stay until the police arrive. Doing so will help avoid any potential legal complications. In the meantime, make sure to keep your car safe by locking all the doors, removing any valuables, and turning off the ignition.

Finally, be sure to have your insurance policy in place in case of an accident.

Insurance Company Procedures Listed and Followed

Under the Road Traffic Act the car owner is obliged to insure his vehicle either under third party insurance cover or fully comprehensive insurance cover and as a direct result of this fact most accident damaged is covered by insurance or therefore repaired in body work establishments. The adopted procedure for dealing with repairs carried out under and insurance claim is as follows:

1. The claim form
2. The itemised estimate
3. The authority to repair
4. The clearance certificate

The Claim Form

When involved in an accident which has resulted in vehicle damage, the owner should obtain and complete an insurance claim form and immediately return it to his insurance company, or make a written report on the accident and damaged received.

The Itemised Estimate

According to the extent of the damage, and if the vehicle is still road worthy, the owner takes the vehicle for the inspection of the repairer who will do a visual inspection of the assessed damage, and from the knowledge gained, complete a written, itemized estimate which he will submit as a tender to the insurance company. This estimate will show the total cost of repairs, and where the estimated amount is under a certain figure set by the insurance company, the owner has the right to authorise the repairer to do the work. However, in most

repair cases this figure is exceeded and the insurance company's assessor is the only person authorised to allow the repairs to proceed.

One of the important factors when estimating for insurance claim damage is to examine carefully every section of the vehicle, especially those parts which are a known weakness in the construction and therefore liable to be affected directly or indirectly by a collision. A methodical system of estimating is essential to avoid missing any damage and is usually carried out by noting in order all removal and replacement items, all repair items, all re-spray items and all items to be supplied new at cost, including mechanical parts and any trim. Supply items are usually difficult to price because of the makers' fluctuating prices, and therefore they should be listed 'at cost'. Spray painting can be quoted either by itemising each part separately or by a complete price for the total spray operation. While in the owners' presence, the repairer should point out any rusted sections which may affect the repair work, or any previous un-repaired damage which is not covered under this insurance claim.

The Authority to Repair

It is essential to obtain the authority to repair from the insurance company involved before any work is started on the damaged vehicle. One receiving the repairer's estimate the insurance company will instruct their own engineer assessor or an independent assessor to examine the vehicle and satisfy himself that the claim is in order and that the estimate submitted by the repairer does not include any labour or material necessary as a result of any other than the accident report. The engineer assessor then agrees the cost of repairs, particularly the labour charges, with the repairer while inspecting the vehicle, and decides whether or not damaged parts shall be repaired or replaced. After this inspection the assessor will send written instructions on behalf of the insurance company, and these are the authority to repair. A condition of these instructions is that the repairer is restricted to repairing the damage as seen and estimated for. Any additional damage disclosed when dismantling the vehicle must have a separate estimate submitted, and work cannot be carried out on this damage until the extra estimate has been agreed and the necessary work authorised by the insurance company.

The Clearance Certificate

This certificate is provided by the insurance company for the vehicle owner to sign when he has seen that all the agreed repairs have been completed satisfactorily, and the damage reinstated to its original condition. The signing of this certificate by the vehicle owner frees the insurance company from any obligation in connection with the claim for damage caused by this particular accident. It is to the repairers advantage for him to ascertain that the clearance certificate has been duly signed before the vehicle is returned to the owner.

The duty of the repairer is to see the damaged part re-instated to its original condition. When garaged safely and when executing the repair he is expected to make full use of his skill and knowledge to affect the best possible repair, as the owner relies on his reputed skill.

2.2. Inspecting Body Damage and Paintwork

Inspecting Body Damage Diagnosis:

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 correct

Damage Diagnosis:

Determining Various Conditions of the Collision

- 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

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

Observation of overall vehicle

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- 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

Example

- Cracked or stressed paint
- Cracked or broken glass

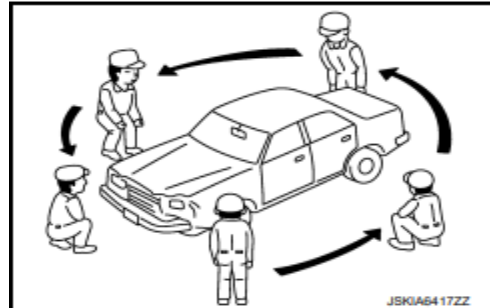


Figure 2- 1 Observation of overall vehicle

- 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.

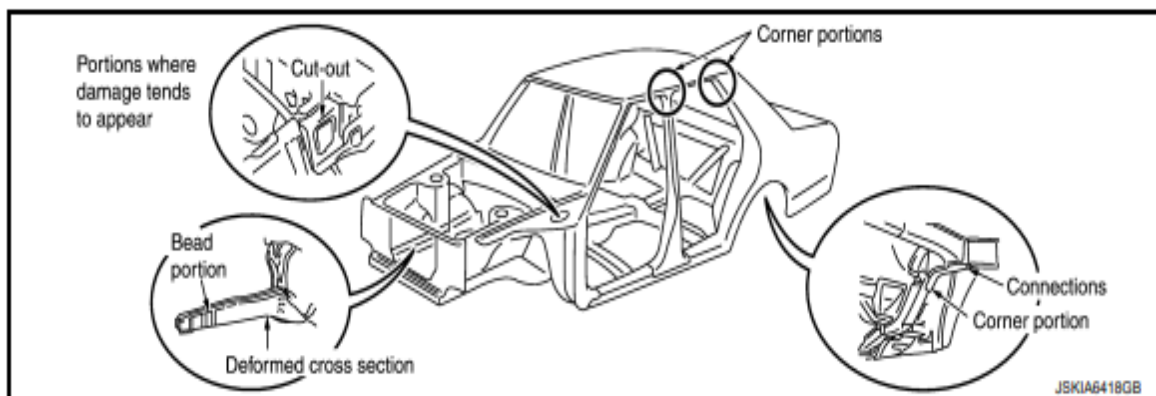


Figure 2- 2 checking for any gaps

- Observation Of Fitting

Examine the fit of various portions without lifting them. Estimate the damage in the pillar and hinge portions.

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

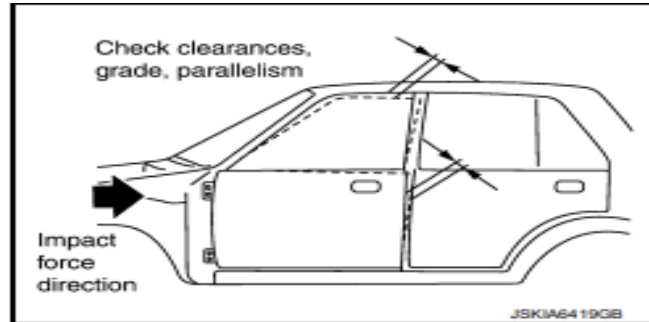


Figure 2- 3 Example for Smooth operation of windows

- 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

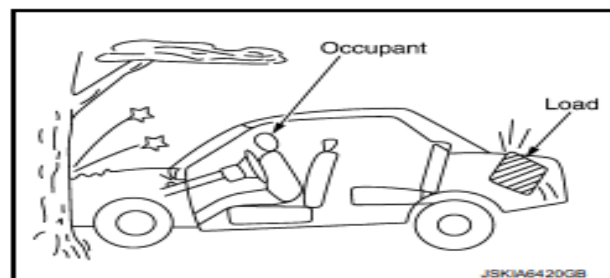


Figure 2- 4 Checking For Mechanical Damage

- 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:

- Do not reduce strength when repairing panels. Avoid excessive hammering which may lead to extending the panel. Also avoid prolonged heating.

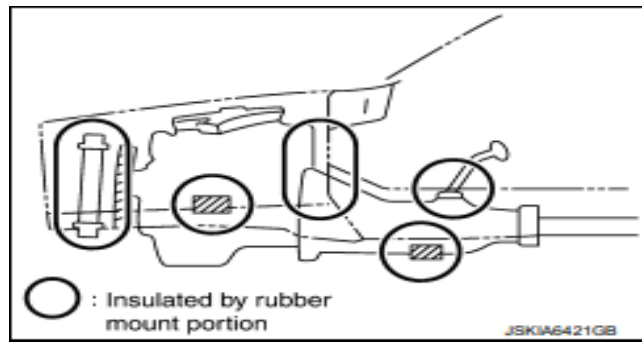


Figure 2- 5 The portion of rubber mount

- 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
- 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.

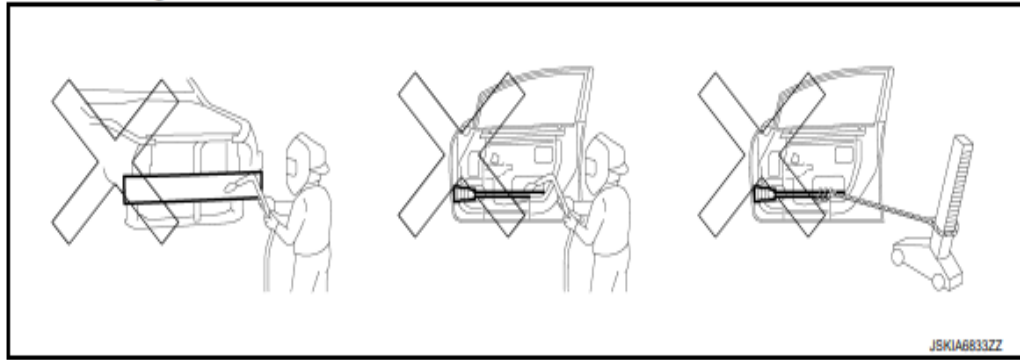


Figure 2- 6 when performing repair work necessary safety

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

Self-check 2.1

Directions: Answer all the questions listed below

Part I Match Each Words of Definitions

Column A

1. External Appearance
2. Observation of Fitting
3. Damage by Inertia

Column B

- A. Overlook indirect damage
- B. Examine the fit of various portions without lifting
- C. Damage such as a concave roof in frontend collisions

Part II Fill the Blank Question

1. -----is provided by the insurance company for the vehicle owner?
2. -----involved in an accident which has resulted in vehicle damage?

Part II Give Short Answer

1. Write car damage assessment and explain?
2. Write body damage diagnosing criteria.

UNIT THREE: Gather Data and Specifications

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying body and paint work process
- Comparing specifications of materials and equipment

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify body and paint work process
- Compare specifications of materials and equipment

3.1. Identifying Body and Paint Work Process

General Process of Body Repairs & Painting

The Automobile Body Shop is where cars are sent for when they need body damage repairs and painting.

Have you ever wondered what it takes, after your car has been damaged, to make it look so good again? There's a fair amount of skill and craftsmanship that is required to carry out bodywork repairs and painting on cars so that they end up looking as good as new.

In this article, I've highlighted the important steps involved in the process of dent removal and painting. But first, what is a dent? And what is a scratch?

A dent is a damage caused to the body panel where the shape of the panel has been changed or disfigured. Even the slightest irregularity in the shape of the panel warrants dent removal. If the panel is not shaped properly, the paint will reflect light oddly off the surface, thereby taking away the finish and aesthetics of the car's body surface. In most cases where two vehicles make contact or a vehicle makes contact with an object (wall, pillar etc) the end result is a dented car body panel. Dents require more effort and great skill to be rectified as its trying to reproduce the same effect of a panel stamping process in the factory.



Figure 3- 1 BMW with big gaping dent in the bumper

A **scratch**, on the other hand, is a much less severe damage to the car's body but, like dent removal, it requires a fair amount of skill to cover up and paint over such that the newly painted surface blends in with the rest of the car. Scratches, in most cases, are accompanied by dents. Unless you're a victim children scribbling on your beloved ride with stones and keys. When scratches are formed without much damage to the surface of the car's body, dent removal is not required.



Figure 3- 2 Small scratches on expensive cars can drive you crazy

Here's a step by step breakdown of the dent removal and painting process –

Step #1: Inspection — once the car is in the workshop, the technician inspects the car thoroughly and confirms the scope of damage and repair work. In the case of excessive damages, the technician needs to inspect the panel carefully to confirm whether the panel can be repaired or not and what is the procedure necessary to repair said panel. He also confirms

whether the inner panels require repairs. Inner panels aren't visible without dismantling other panels so it's crucial for the technician to carry out a thorough inspection



Figure 3- 3 Such damages require thorough inspections to confirm the scope of work

Step #2: Dent Removal — dents are removed by employing a variety of methods. The most commonly used tool to remove dents is a dent puller. The technician uses the dent puller by welding its tip to the body of the car and pulling on the dented portion of metal such that it retracts, as close as possible, to its original shape. Once the majority of the shape is restored, the technician employs other methods of tinkering such as tapping, grinding and hammering to restore the shape as much as possible to the original. Grinding is done to remove the welds caused as a result of using the dent puller.



Figure 3- 4 A dent puller in use

Step #3: Body filler application

the technician applies metal body filler to the tinkered portions of the car. This process requires patience and precision. Its by this process that the technician restores maximum shape to the panel. He smoothens the surface multiple times to bring it as close to the original shape as possible. Afterwards, the technician allows the body filler to cure for a couple of hours. This is by far one of the most critical phases of dent removal since the finish of the paintwork is dependent on the surface finish of the body filler. If there is any irregularity or inconsistency in the surface preparation, it could result in blistering or pinholes occurring after painting.



Figure 3- 5 Body filler applied to the right doors of a Honda BR-V

Step #4: Surfacer application — the technician inspects the tinkered surface one last time to ensure that the body filler is cured and there aren't any pinholes or irregularities in the surface finish. He then sprays surfacer which forms the base layer upon which the paint will be applied. The execution of this stage is crucial to the overall paint appearance once the panel has been completely painted. The surface requires additional time to cure after which the technician inspects it before the next step, i.e. painting.



Figure 3- 6 Surface applied to the right hand quarter panel and rear door

Step #5: Painting — Once he’s convinced with the inspection, the technician drives the car into the paint booth. To get the desired color shade of the car, the technician first looks up the paint code of the said car. Each shade of car has its own unique paint code. The deduction of this code tells the technician exactly in what proportions different colors and other compounds like thinner etc need to be mixed to obtain the desired shade. Once the paint is prepared, the technician pours it into the spray gun bottle, connects it to the spray gun and sprays paint on the respective body panels. Painting is an extremely skilled process, as you must be well aware of. Holding the spray gun at a safe distance from the panel, the technician moves his hands steadily across the surface of the panel, spraying paint. 2 layers of paint is applied to the surface. The car is then left in the paint booth and the heaters in the booth are turned on so that the paint can bake and cure properly. Once the paint is cured, the technician applies a final layer called the Clear Coat to the surface of the panel. This coat is what gives the panel a good glossy finish



Figure 3- 7 A paint booth



Figure 3- 8 Spray painting

Step #6: Dulling and Polishing — Once the car is out of the paint booth, it is parked in the polishing/detailing bay. Here, the technicians use wet sandpaper and gently rub on the surface of the panel until the paint is dulled. After the paint is “dulled” the technician uses a rotary polishing machine and polishes the “dulled” surface until the brightness of the painted panel matches the rest of the car. This ensures continuity in the finish and the customer will never know that his/her car was painted.



Figure 3- 9 Notice how the paint looks dull on the rear bumper



Figure 3- 10 Rotary Polishing Machine used to polish the surface



Figure 3- 11 The finished product

3.1 Comparing specifications of materials and equipment

To compare specifications of materials and equipment, you can follow these steps:

1. **Identify the specifications:** Determine the specifications that are important for your project. For example, if you are comparing two types of equipment, you may want to compare their power output, efficiency, and cost.
2. **Gather information:** Collect information about the materials or equipment you are comparing. This may include data sheets, product manuals, or other technical documents.
3. **Create a comparison chart:** Organize the information you have gathered into a chart or table that allows you to easily compare the specifications of each material or equipment.

4. **Analyze the data:** Once you have created your comparison chart, analyze the data to determine which material or equipment is best suited for your project.
5. **Make a decision:** Based on your analysis of the data, make a decision about which material or equipment to use for your project

Paint Materials and Processes from an Automotive OEM Perspective

Different Paint for Different Parts



Figure 3- 12 Paint for Different Parts

Automotive Body Paint System

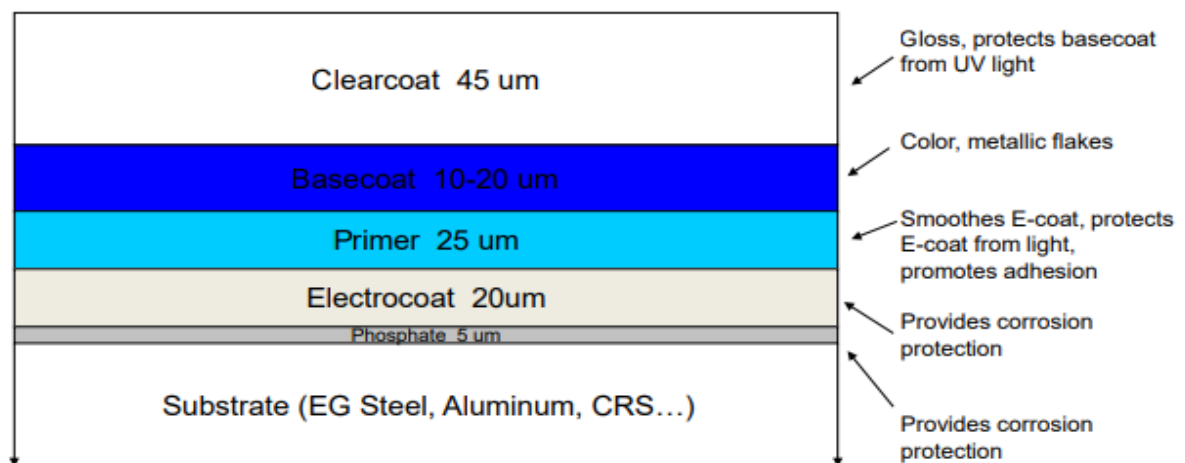


Figure 3- 13 vehicles use paint coat systems

Note: Some commercial vehicles use mono coat paint systems for solid colors.

Automotive Trim Paint System

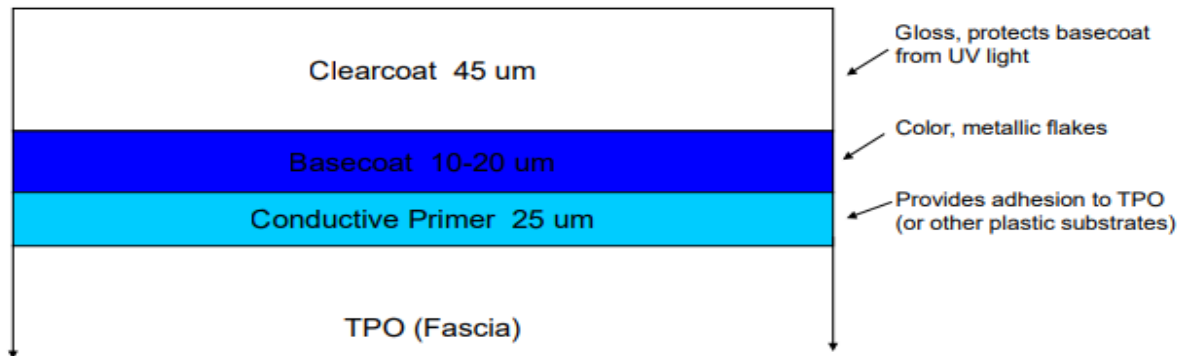


Figure 3- 14 Automotive Trim Paint System

Processing Exceptions

- Lower body (rocker panels) sometimes gets an extra layer of anti-chip primer. PVC based material.
- Tinted clear coats: Mostly on reds, some blue or yellow.
- Tri-coats: Basecoat layer separated into ground coat (pigment) and effect flakes (mica). Pearlescent effect on whites and neutrals.
- Repaints: First time through varies but is 90-95% in good paint shops. 5-10% of vehicles get repainted (basecoat & clear coat only or primer, basecoat and clear coat). A small fraction gets repainted twice.
- Tu-tones: Less popular now than in the past. Lower body sides on trucks. A few vehicles on roof.
- Moldings can be either painted or mold-in-color plastic

Differences between Body and Trim Paint

Body Paint

- Topcoat cures at 140°C
- Hard, Less Flexible
- Clear coat Tg ~80°C

Trim Paint

- Topcoat cures at 80°C
- Softer, More Flexible
- Clear coat Tg ~20°C

Self-check 3.1

Directions: Answer all the questions listed below

Part I choose the correct answer from the given alternatives

- _____the specifications that are important for your project For compare their power output, efficiency, and cost?
 - Gather information
 - Identify information
 - A & B
 - All
- _____Collect information about the materials or equipment you are comparing. This may include data sheets, product manuals, or other technical documents?
 - Decisions making
 - Gather information
 - equipment's
 - B & C
- _____Organize the information you have gathered into a chart or table that allows you to easily compare the specifications of each material or equipment?
 - Load testers
 - Decision Making
 - comparison chart
 - All
- _____Once you have created your comparison chart, analyze the data to determine which material or equipment is best suited for your project?
 - Gather information
 - Analyze data
 - comparison chart
 - A & C
- _____Based on your analysis of the data, make a decision about which material or equipment to use for your project?
 - Load testers
 - Decisions making
 - Key cutters
 - Colour spectrometry

Part II Fill the Blank Question

- _____on the other hand, is a much less severe damage to the car's body?
- _____is damage caused to the body panel?
- _____the technician i the car thoroughly and confirms the scope of damage and repair work?

Part II Give Short Answer

- Write auto body and paint work process?

Unit FOUR: Evaluating and Selecting Materials, Equipment and Processes

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Selecting materials, equipment and processes
- Evaluate materials, equipment and processes

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Select materials, equipment and processes
- Evaluate materials, equipment and processes

4.1 Selecting Materials, Equipment and Processes

How to Select Body Equipment

Numerous types of body equipment with different features are currently available. General considerations for selecting body equipment are explained below.

Requirements for Body Equipment

Body straightening equipment has three equally important functions: pulling, securing and measuring. As well as the hardware, ergonomic factors such as ease of handling must also be considered.

Other important factors to consider are:

- Availability of shop space
- Number of vehicles to be repaired
- Proportion of heavy, medium and light repair work
- Proportion of body panel replacement to repairing
- Skill level of repair technician
- Budget

Today's motor vehicles are built to exacting standards using varied manufacturing methods, which results in different methods of repair. Because it is impossible to memorize all of the service details needed to properly rebuild damaged vehicles, it is imperative that you know

how to use vehicle-specific (year, make, and model) service information efficiently. This chapter describes how to utilize both printed and computer-based service data.

It summarizes the various kinds of service information available and explains the purpose of each type. You will learn how to use service charts, symbols, abbreviations, and technical illustrations. The chapter also reviews most of the basic types of measurements you will have to make when employed in collision repair.

This chapter will prepare you for more advanced repair topics. A good technician must have a complete understanding of commonly used terms that identify parts and assemblies of a vehicle. The technician who is not familiar with this language will have difficulty ordering parts and reading repair orders. Measurements are number values that help control repair processes in collision repair. For example, measurements are needed to measure structural damage, straighten frame damage, mix paint, adjust spray gun pressure, do a wheel alignment, torque a bolt, and numerous other repair tasks.

Vehicle manufacturers give specifications (measurements) for numerous repair procedures: body straightening dimensions, bolt or nut torque values, material thicknesses, electrical values, and other critical information. When working, you will have to refer to factory specifications to ensure competent repairs.

Service Information

Service information includes written instructions and technical illustrations to help you properly repair a damaged vehicle. Service information is published by vehicle manufacturers (Jaguar, Chrysler, General Motors, Toyota, and so on) and aftermarket publishers (Mitchell Manuals, Motor Manuals, and Chilton Manuals, for example).

Printed Service Information

Printed service information places service instructions, vehicle dimensions, estimating data, and technical illustrations on paper in bound books. Books and professional magazines are another excellent way to retrieve service instructions and to improve repair knowledge and skills.

Computer-Based Service Information

Computer-based service information places service manuals, dimension manuals, estimating manuals, refinish material guides, mechanical repair procedures, and other data on compact discs (CDs). This allows using a personal computer (PC) to quickly look up and print the desired service repair information. Most PCs used in the collision repair industry are Windows-based. There are various kinds of software or computer programs used in the collision repair industry.

As a technician, or perhaps someday a shop owner, you should understand the purpose of these useful shop tools. Most high-volume shops now access their service manuals with a PC. A huge volume of service data can be kept on CDs or retrieved online over the Internet. A PC allows more efficient handling of all shop operations.

Estimating, parts ordering, bookkeeping, finding vehicle-specific service instructions, and the whole shop business operation can be more closely monitored and controlled by computer. A PC can quickly access thousands of illustrations for fast and easy identification. By ordering new CDs every year, the computer-based information you have can be kept current, which means you'll never be at a loss for the most up-to-date parts and service information. Electronic media or computer-based service information provides potential advantages over print media by enabling the technician to:

- More quickly look up parts and labor information
- More efficiently cross-reference and validate parts and prices
- More easily create, store, and e-mail parts and labor worksheets and part orders
- Print customized parts, assemblies, and repair illustrations for shop use.

Shop Publications

There are several publications, both printed and computer based, that all body shop personnel should become familiar with. All automobile companies publish yearly service manuals that describe the construction and repair of their vehicles. These manuals give important details on repair procedures and part construction-assembly. Also called shop manuals, they give instructions, specifications, and illustrations for their specific cars, trucks, vans, and SUVs. Service manuals have both mechanical and body repair information. The contents page of a service manual lists the broad categories in the manual and gives page

numbers. Each service manual section concentrates on describing one area of repair: body parts, interior parts, suspension system, brakes.

The index in the back of the service manual contains the page numbers for hundreds of repair topics. It is used instead of the contents when you want information on a specific part of a vehicle. Because it would be too expensive to purchase factory service manuals from every auto maker, most collision repair shops purchase aftermarket service information in both book and computer formats. Aftermarket repair manuals, such as Mitchell Manuals, Motor Manuals, and Chilton Manuals, are sold by publishing companies. They are not as detailed as factory service materials but can give enough information for most body shop repairs.

4.2 Evaluating Materials, Equipment and Processes

Regarding the above manuals, can be selecting materials and evaluating equipments processes, by checking auto body and paint works manuals.

Checking Damage

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.

Operation sheet 4.1

Operation Title: Determining State Of Deformation

Instruction: 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.

Purpose: To Determining state of deformation

Required tools and equipment:

- A steel tape, tram
- tracking gauge
- centering gauge
- universal jig type
- universal measuring type
- laser type
- computer measuring type
- ultrasound type

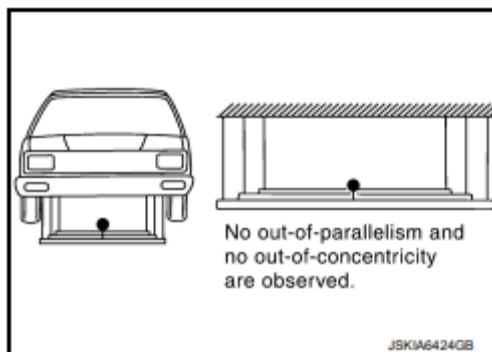
Precautions:

- Wearing proper clothes, eye glass, glove
- Make working area hazard free
- Read and interpret manual which guide you how to use tools and equipment

Procedures:

Step 1 Determining state of deformation

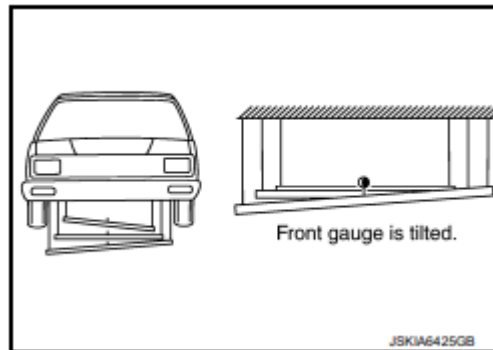
Normal state the horizontal bar and center target are in their correct positions.



Step 2 Twist

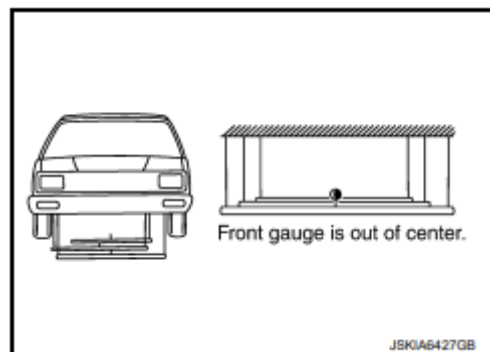
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Twist The horizontal bar is tilted on both ends



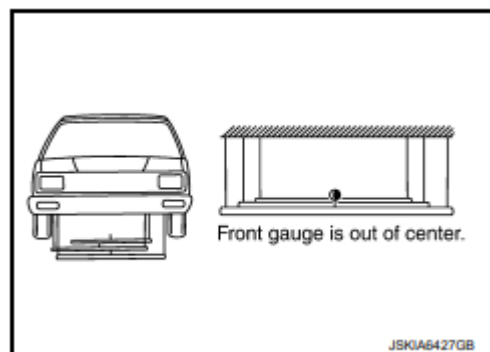
Step 3 Sag

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



Step 4 Side-sway

The horizontal bars are correctly aligned, but the center target is displaced



Quality criteria: Assured performing of all the activities according to the procedures

Operation sheet-4.2

Operation Title: Tracking Gauge and Steel Tape

Instruction: 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.

Purpose: To know evaluate automotive body and paint Materials, Equipment and Processes

Required tools and equipment:

- A steel tape, tram
- tracking gauge
- centering gauge
- universal jig type
- universal measuring type
- laser type
- computer measuring type
- ultrasound type

Precautions:

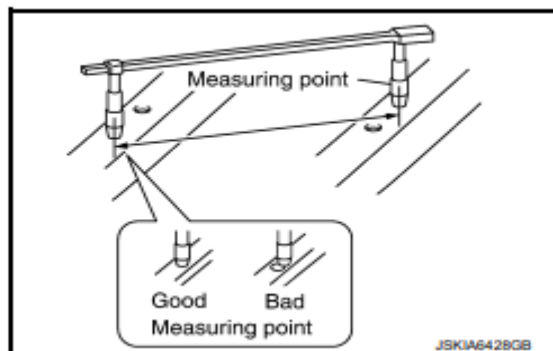
- Measure the distance between two points. Before using the tracking gauge,
- check the measuring points with the steel tape

Procedures:

Step 1 Tracking Gauge

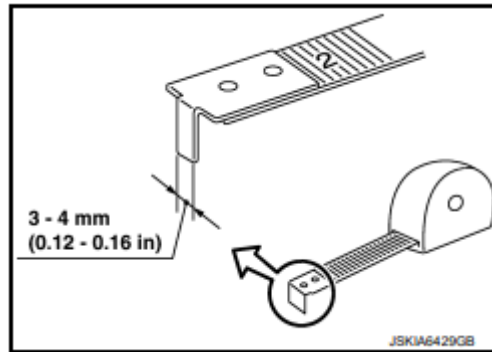
- Fit the tracking gauge correctly to the measuring point.
- The dimension is indicated between the hole center.

If measurement is unavailable, use the method shown below.



Step 2 Steel Tapes

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



$A \div B$

Note: Avoid measuring short distances using a measuring tape as error will be larger due to inclination of measuring tape.

$$A \div B \pm \left(\frac{D_1}{2} \div \frac{D_2}{2} \right)$$

Note: If 0 point is on smaller diameter side (D_2), value becomes minus.

L: Scale reading

(D_1), (D_2), hole diameter

Operation sheet-4.3

Operation Title: Three-dimensional Measuring Equipment

Instruction: 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.

Purpose: The equipment has function of the measurement to display the vehicle measuring points in three dimensions: height, width and length.

Required tools and equipment:

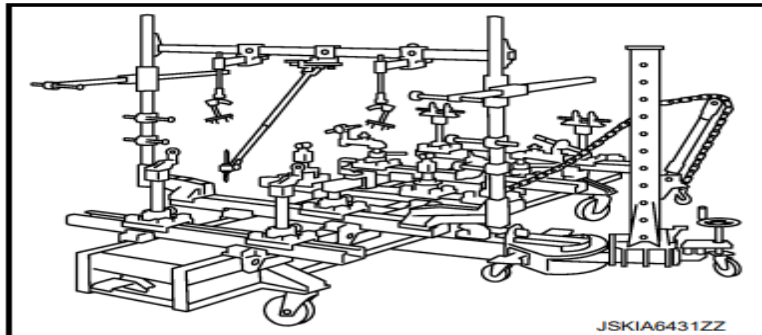
- A steel tape, tram
- tracking gauge
- centering gauge
- universal jig type
- universal measuring type
- laser type
- computer measuring type
- ultrasound type

Precautions:

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

Procedures:

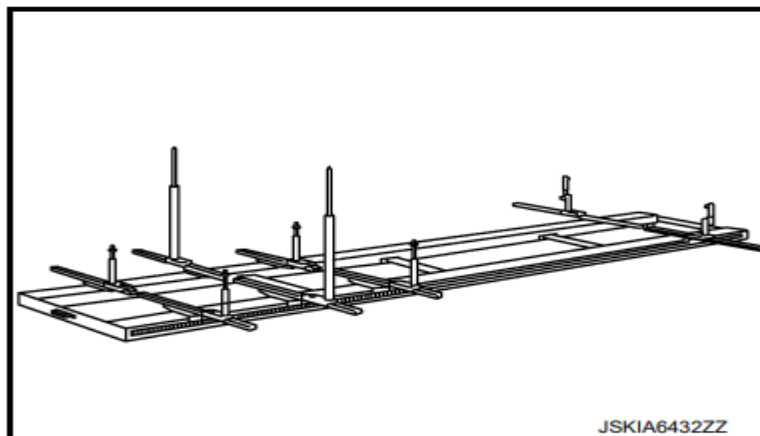
Step1. Checking Damage: Universal Jig Type



This is one of the universal jig type body straightening equipment functions. The jig is assembled according to the instruction card specific to each vehicle model. The jig, which can move forward/backward, left/right, and up/down, is anchored to each location on the underbody. The three-dimensional coordinates for the anchored point are read from the scale at the sliding base and jig head positions.

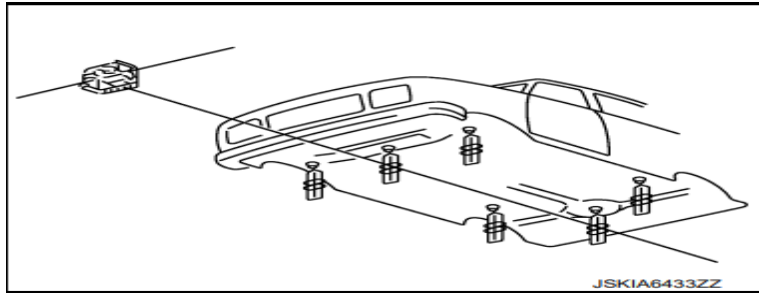
Step2. Universal Measuring Type

The probe, which can move forward/backward, left/right, and up/down, is positioned on the frame. The three-dimensional coordinates at the measurement point and the distance between measurement holes can be measured by bringing the probe into contact with a locating hole on the bodes. It is set on the straightening equipment for use.

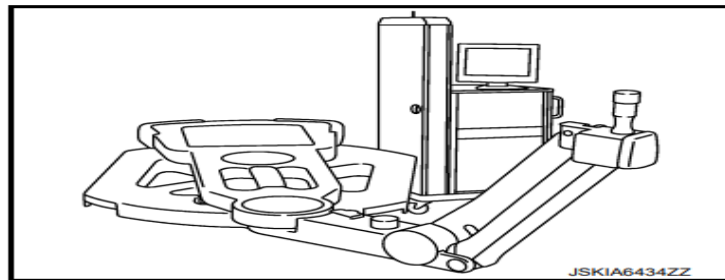


Step3. Laser Type

The three-dimensional coordinates are read using convergence and straight-line stability of a laser beam. A laser beam is used for measurement. Once set, repair work can be performed during measurement.



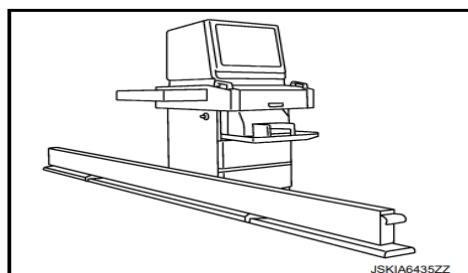
Step4. Computer Measuring Type



This is set on the straightening equipment. The probe which is mounted on flexible arm is positioned at each point of the vehicle body for measurement. The computer compares the vehicle model data and the actual measurement data to identify the damage range and determine acceptability.

Step5. Ultrasound Type

Ultrasound is transmitted from the probe, installed at the measurement point on the vehicle body, to the beam placed under the body in order to measure the three-dimensional coordinates at each measurement point



Lap Tests

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction I. Use the appropriate evaluating methods for the damage should be selected.

Task 1 External Appearance

Task 2 perform Checking Damage

Task 3 perform by using Tracking Gauge and Steel Tape

Task 3 perform by using Three-dimensional Measuring Equipment

Task 4 perform by using the above methods evaluate auto body and paint work

Task 5 record every and each evaluation point

Reference

1. . Powloski J, “Vehicle Body Engineering”, Business Books Ltd., London 1989.
2. . John Fenton, “Vehicle body layout and analysis”, Mechanical Engg. Publication ltd, London, 1982.
3. Kohli P. L, “Automotive Chassis & Body”, Papyrus Publishing House, New Delhi, 2010.
4. Wolf-Heinrich Hucho, “Aerodynamics of Road Vehicles” SAE International, USA, 1998.
5. Robinson A., Livesey W. A, “The Repair of Vehicle Bodies”, Butterworth - Heinemann Ltd, 1989
6. Sumantran V. and Gino Sovram, “Vehicle Aerodynamics”, SAE International, USA, 1994.
7. John Fenton, “Vehicle Body Layout & Analysis”, Hutchinson, London, 1998

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