IV. Visual Inspection

IV. Visual Inspection

- Purpose Of Visual Inspection
- Basic Principles Of Visual Inspection
- Locations To Inspect
- Diagramming Of Visual Inspection
- Limitations Of Visual Inspection
- Perform Visual Inspection

IV. Visual Inspection

- **PURPOSE OF VISUAL INSPECTION**
- Basic Principles Of Visual Inspection
- Locations To Inspect
- Diagramming Of Visual Inspection
- Limitations Of Visual Inspection
- Perform Visual Inspection

During a **visual inspection** we look for clues indicating the possibility of structural misalignment. The four types of collision damage (front, rear, side, rollover) usually cause predictable structural misalignment. Bumper misalignment, exterior body panel misalignment and buckles, etc. are good indicators.

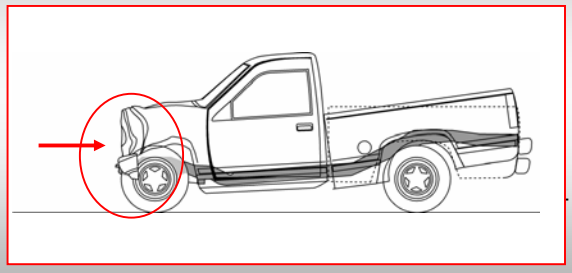
IV. Visual Inspection

- Purpose Of Visual Inspection
- **BASIC PRINCIPLES OF VISUAL INSPECTION**
- Locations To Inspect
- Diagramming Of Visual Inspection
- Limitations Of Visual Inspection
- Perform Visual Inspection

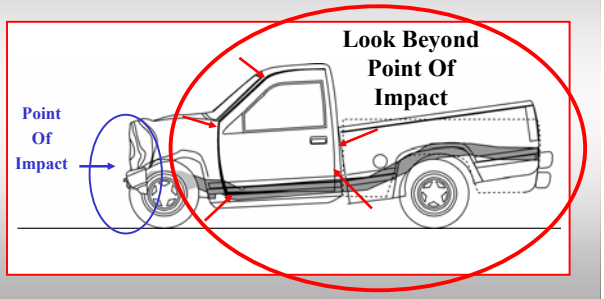
• Basic Principles Of Visual Inspection

- Locate Points Of Impact
- Use Collision Theory Knowledge
- Systematically Inspect Vehicle

Locate Point Of Impact

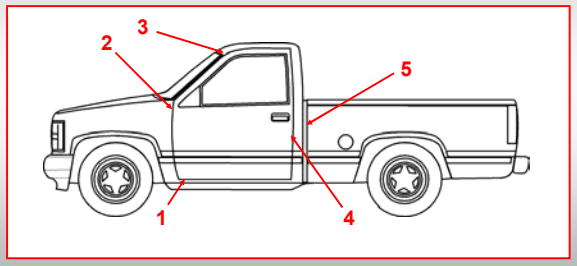


Use Collision Theory Knowledge



Systematically Inspect Vehicle

Examine Points 1, 2, 3, 4, 5……..

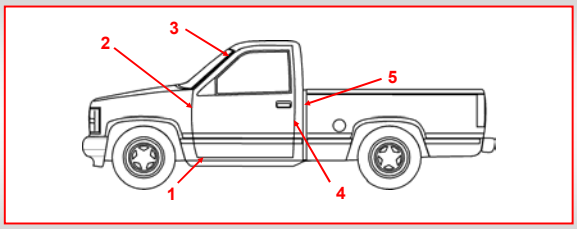


IV. Visual Inspection

- Purpose Of Visual Inspection
- Basic Principles Of Visual Inspection
- **LOCATIONS TO INSPECT**
  - PICKUP TRUCK
  - SPORT UTILITY VEHICLE
  - PICKUP AND SUV (LOWER STRUCTURE)
- Diagramming Of Visual Inspection
- Limitations Of Visual Inspection
- Perform Visual Inspection

Pickup Truck

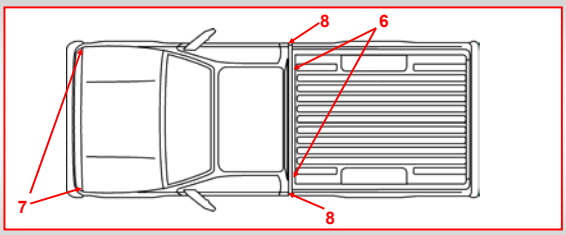
Front, Rear, Side, And Rollover Collisions



1 Door To Rocker
2 Door To Fender
3 Windshield Pillar To Door
4 Rear Edge Of Door
5 Cab To Bed (Vertical)

Pickup Truck.....continued

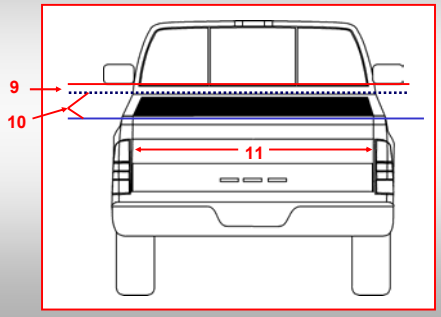
Front, Rear, Side, And Rollover Collisions



6 Cab To Bed (Horizontal)
7 Hood To Fender
8 Cab To Bed (Lateral Positioning)

Pickup Truck.....continued

Front, Rear, Side, And Rollover Collisions



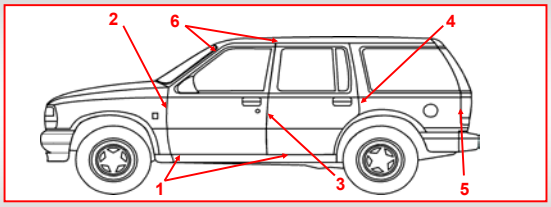
9 Cab To Front Of Bed

10 Front Of Bed To Tailgate

11 Tailgate Vertical Gaps

Sport Utility Vehicle

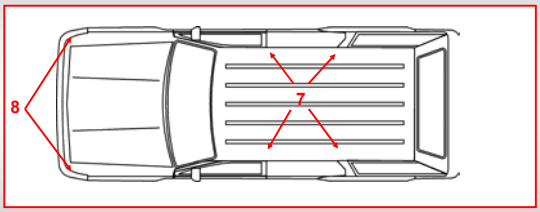
Front, Rear, Side and Rollover Collisions



1 Doors To Rocker
2 Door To Fender
3 Front Door To Rear Door
4 Rear Door To Quarter
5 Quarter To Rear Gate
6 Top Of Doors To Roof

Sport Utility Vehicle.....continued

Front, Rear, Side, And Rollover Collisions



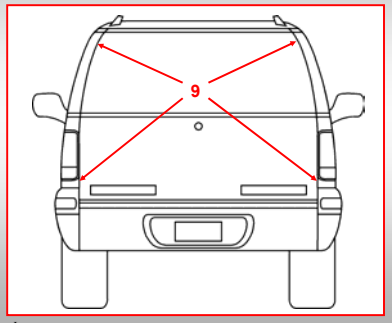
7 Buckles In Roof

8 Hood To Fender Gaps

Sport Utility Vehicle.....continued

Front, Rear, Side, And Rollover Collisions

9 Rear Gate Gaps



Pickup And SUV

Front, Rear, Side And Rollover Collisions

Check Lower Structure For:

- Buckles In Rails
  - Center Section
  - Suspension Areas
  - End Of Rails
- Body Bolt And Mount Misalignment
- Bumper Misalignment

Pickup And SUV.....continued

Front, Rear, Side And Rollover Collisions

Check Lower Structure For:

- Tracking
- Rear Suspension
- Front Suspension
- Steering Components

Pickup And SUV.....continued

Front, Rear, Side And Rollover Collisions

Check Lower Structure For:

- Driveline Alignment
- Driveline Mounts
  - Brackets

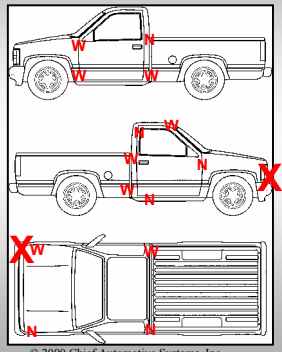
IV. Visual Inspection

- Purpose Of Visual Inspection
- Basic Fundamentals Of Visual Inspection
- Locations To Inspect
- **DIAGRAMMING OF VISUAL INSPECTION**
- Limitations Of Visual Inspection

Diagramming the visual indicators of the frame and body, organizes all of the structural misalignment onto one sheet where it can be interpreted.

(See Following Examples)

Example - Pickup Visual Inspection Worksheet



Structural Damage Expected

Front Section:

swayed right, high, higher on right

Center Section: diamond, twist

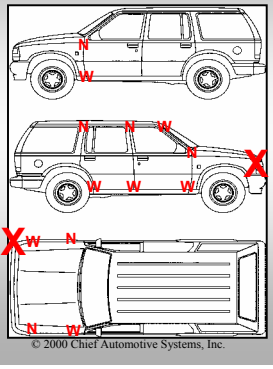
Rear Section:

high on left, swayed left (possibly result of diamond)

Additional:

front suspension high, short right front rail, damaged front frame horns, cab mounts misaligned

Example - SUV Visual Inspection Worksheet



Structural Damage Expected

Front Section:

swayed right, high on both sides

Center Section:

twist

Rear Section:

high on right side

Additional:

front suspension high, short right front rail, damaged front frame horn, body mounts misaligned

IV. Visual Inspection

- Purpose Of Visual Inspection
- Basic Fundamentals Of Visual Inspection
- Locations To Inspect
- Diagramming Of Visual Inspection
- **LIMITATIONS OF VISUAL INSPECTION**
- Perform Visual Inspection

A visual inspection seldom gives a complete picture of the misalignment. Collision theory explained just how complex structural misalignment can be even when forces follow a typical path through a vehicle. In addition…

- Structural misalignment does not always follow a typical damage pattern because of the wide variations in body and frame design.

- Since vehicles seldom get hit straight on, most structural misalignment is a complex combination of both vertical and lateral misalignment.

- Often, structural misalignment spreads gradually over the entire length of a section or total vehicle. As a result it's difficult to detect using only visible clues.

- Buckles do not always indicate the types of misalignment present.

IMPORTANT:

In addition to the visual inspection, measurements of the vehicles structure and an analysis of those measurements leads to a comprehensive understanding of the structure's condition .

IV. Visual Inspection

- Purpose Of Visual Inspection
- Basic Fundamentals Of Visual Inspection
- Locations To Inspect
- Diagramming Of Visual Inspection
- Limitations Of Visual Inspection
- **PERFORM VISUAL INSPECTION**

Perform Visual Inspection

Using appropriate Visual Inspection Worksheet identify the project vehicles misalignment.

Remember to:

- **Locate Point(s) Of Impact**
- **Use Collision Theory Knowledge**
- **Systematically Inspect Vehicle**

Chief Automotive Systems, Inc.

V. Measuring And Analyzing

V. Measuring And Analyzing

- **Basic Principles Of Measuring For Structural Alignment.**
- **Sequence For Checking Structural Misalignment**
- **Measuring Vehicle's Center Section**
- **Measuring Vehicle's End Sections**
- **Measuring Main Crossmember Area**
- **Analyzing Multiple Misalignment**
- **Body Misalignment**
- **Diagramming / Analyzing Structural Misalignment**

V. Measuring And Analyzing

- **BASIC PRINCIPLES OF MEASURING FOR STRUCTURAL ALIGNMENT**
- Sequence For Checking Structural Misalignment
- Measuring Vehicle's Center Section
- Measuring Vehicle's End Sections
- Measuring Main Crossmember Area
- Analyzing Multiple Misalignment
- Body Misalignment
- Diagramming / Analyzing Structural Misalignment

The **basic principles of measuring** for structural alignment include:

- Locating structural control points.
- Establishing a base for measuring.
- Dividing the vehicle into three sections.

Locating Structural Control Points

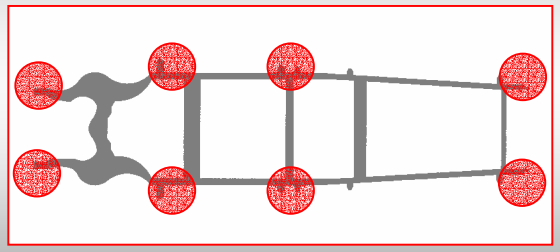
- Identify Control Points
- Control Point Areas
- Control Points Relationship To Structural Realignment

Let's Examine These Individually

• Identify Control Points

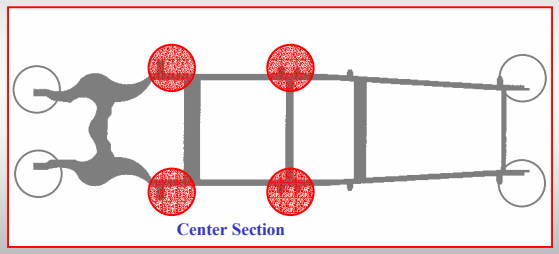
- – Eight Basic Control Points
  - Four Center Section Control Points
  - End Section Control Points
- – Additional Control Points
  - Front Section
  - Rear Section

Eight Basic Control Points



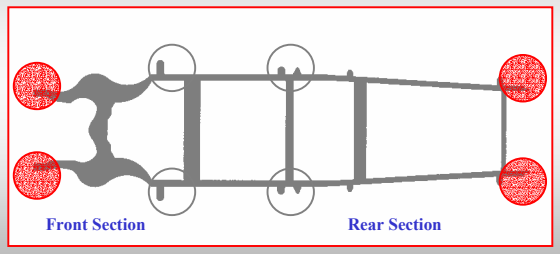
Eight Basic Control Points

Four Center Section Control Points



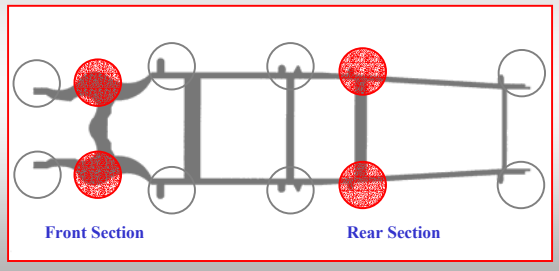
Eight Basic Control Points

Four End Section Control Points



Additional Control Points

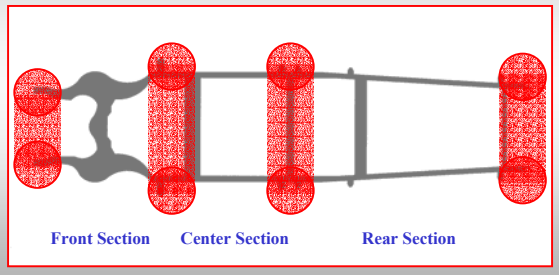
Front And Rear Sections



- **Control Point Areas**

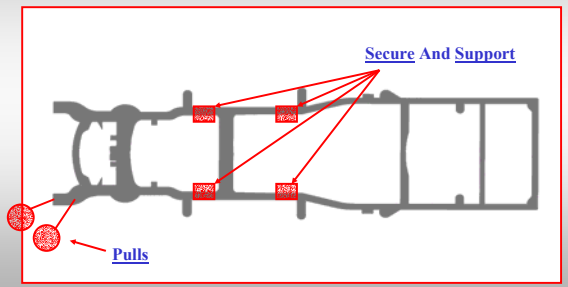
Control Point Areas

Areas Between Two Control Points



- **Control Points Relationship To Collision Repair**

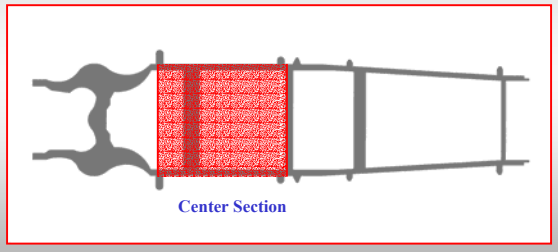
Control Points Relationship To Collision Repair



Establish Base For Measuring

- **Center Section Control Points Form The Base For Measuring**

Base For Measuring



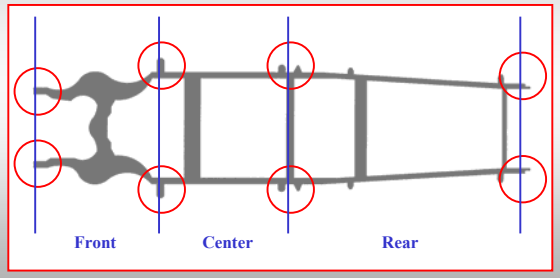
Divide Vehicle Into Three Sections

- Three Section Principle
  - Eight Basic Control Points Identify The Vehicle's Three Sections: Front, Center, Rear
- Why Three Sections?
  - Vehicle Design
  - Vehicle Reaction During Collision

Let's Examine These Individually

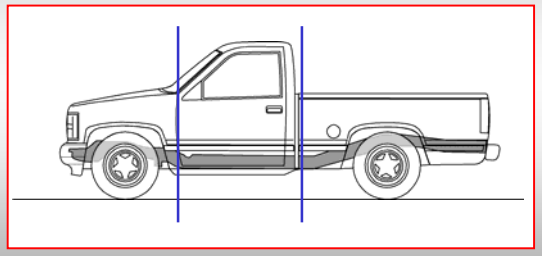
- **Three Section Principle**

Eight Basic Control Points Form Three Sections

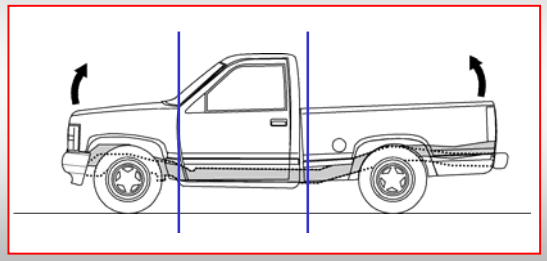


- **Why Three Sections?**

Vehicle Design



Vehicle Reaction During A Collision



V. Measuring And Analyzing

- Basic Principles Of Measuring For Structural Alignment
- **SEQUENCE FOR CHECKING STRUCTURAL ALIGNMENT**
- Measuring Vehicle's Center Section
- Measuring Vehicle's End Sections
- Measuring Main Crossmember Area
- Analyzing Multiple Misalignment
- Body Misalignment
- Diagramming / Analyzing Structural Misalignment

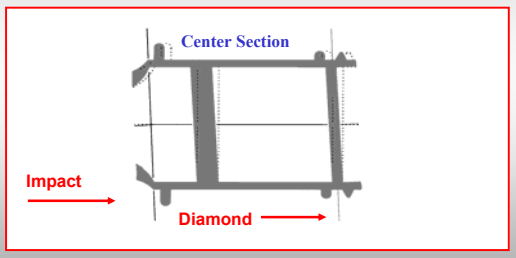
Identify the following misalignments in this sequence:

1. Diamond
2. Twist
3. Level
4. Centerline
5. Datum

Let's Examine These Individually

1. Diamond

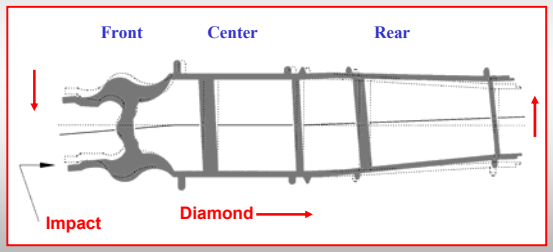
- Check First
- Check Center Section



1. Diamond.....continued

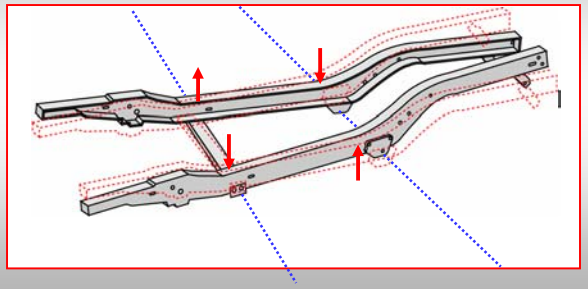
- Effects Centerline

(Front Section / Rear Section)



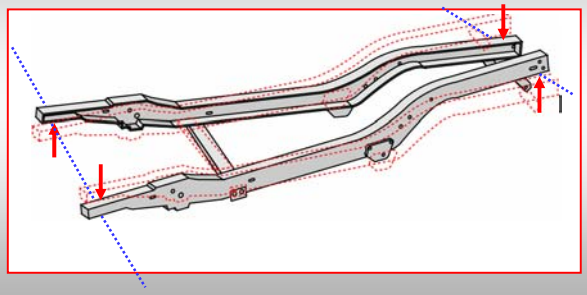
2. Twist

- Check Second
- Center Section Only



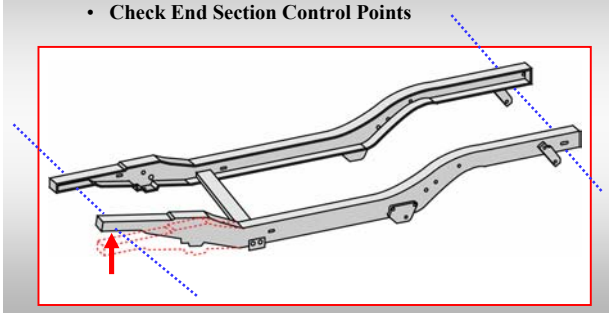
2. Twist.....continued

- Effect On End Sections



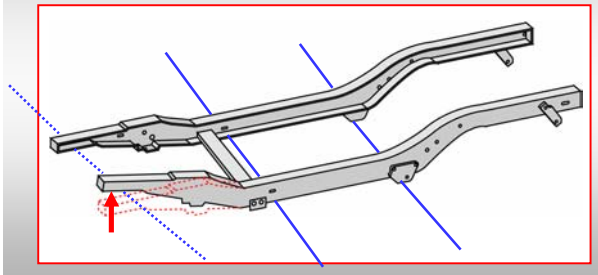
3. Level

- Check Third
- Check End Section Control Points



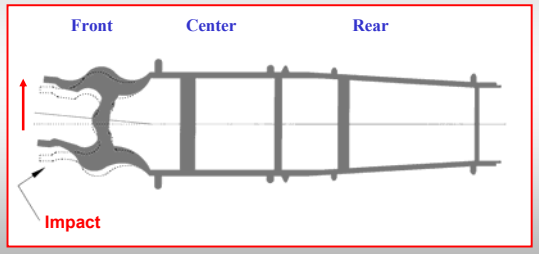
3. Level.....continued

- Adjacent Control Points Are Not Parallel
  - Referred To As Out-Of-Level
  - Length Measurements Are Also Affected



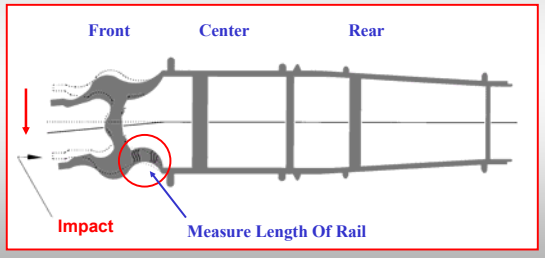
4. Centerline

- Check Fourth
- Check Width Measurements



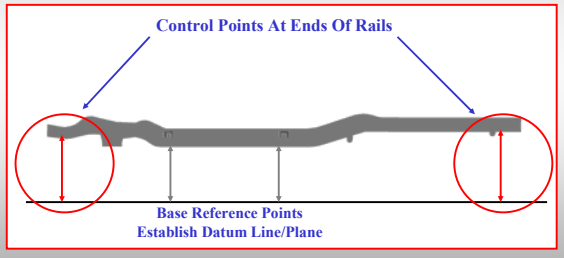
4. Centerline.....continued

- Short Rail Effect On Centerline
  (Check Length Measurements)



5. Datum

- Check Fifth
- Check Height Of Control Points At Ends Of Rails



V. Measuring And Analyzing

- Basic Principles Of Measuring For Structural Alignment
- Sequence For Checking Structural Misalignment
- **MEASURING VEHICLE'S CENTER SECTION**
- Measuring Vehicle's End Sections
- Measuring Main Crossmember Area
- Analyzing Multiple Misalignment
- Body Misalignment
- Diagramming / Analyzing Structural Misalignment

Check for diamond and twist in center section only.

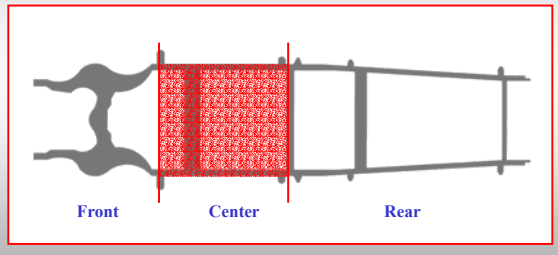
Check For Diamond In Center Section Only

- Identify Center Section Base Reference Points And Determine If Out-Of-Square
  - Pickups (Body-On-Frame)
    - Regular Cab
    - Extended Cab
  - Sport Utility Vehicles
    - Body-On Frame

Let's Examine These Individually

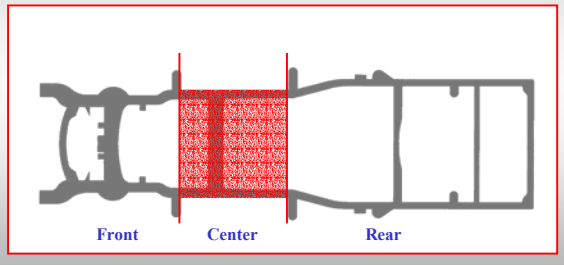
Pickup Truck

Small Area Directly Under Cab



Sport Utility Vehicle

Body On Frame



IMPORTANT:

- Do Not Measure Cab Mounting Bolts
- Out-Of-Square Condition Indicates Diamond
  - Check width measurements. Incorrect measurements indicate control point width misalignment, not diamond.

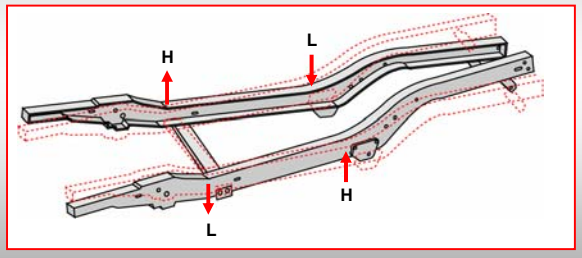
Check For Twist In Center Section Only

- Measure Height Of Four Center Section Control Points
- Consider Carry Through Effect Of Twist On End Sections

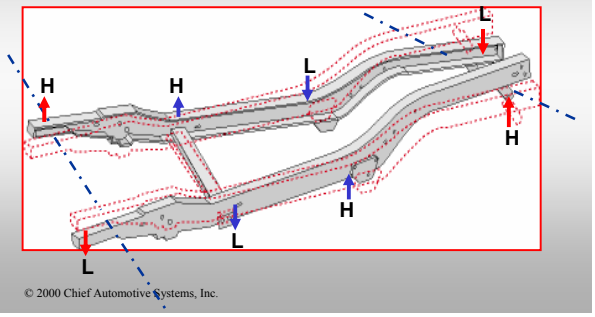
Let's Examine These Individually

Measure Height Of Four Center Section Control Points

- High Areas Are Diagonally Opposite Each Other
- Low Areas Are Diagonally Opposite Each Other



Effect Of Twist On End Sections



V. Measuring And Analyzing

- Basic Principles Of Measuring For Structural Alignment
- Sequence For Checking Structural Misalignment.
- Measuring Vehicle's Center Section
- **MEASURING VEHICLE'S END SECTIONS**
- Measuring Main Crossmember Area
- Analyzing Multiple Misalignment
- Body Misalignment
- Diagramming / Analyzing Structural Misalignment

Check vehicle's **end sections** for **level**, **centerline** and **datum**.

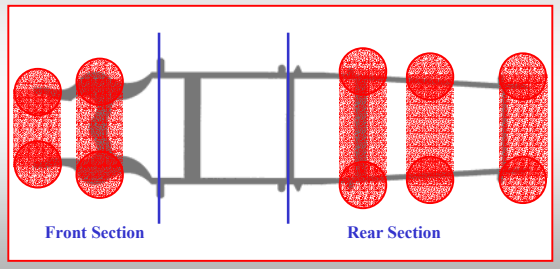
Read For Level In End Sections

- Identify Control Points
  - Suspension Areas
  - Ends Of Rails
  - Other
- Measure Height Of Control Points
- Check Parallel Relationship Of Control Point Areas
  - Work From Center Section Outward
  - Determine If Out-Of-Level

Let's Examine These Individually

- Identify Control Points

Suspension Areas And Ends Of Rails

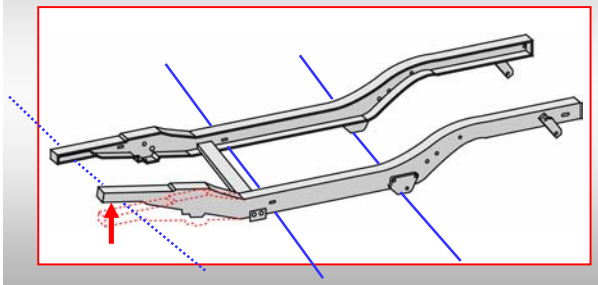


- Measure Height Of Control Points

- Check Parallel Relationship Of Control Point Areas

Start with nearest pair of base reference points and work outward to ends of rails.

Out-Of-Level



Check Centerline Misalignment In End Sections

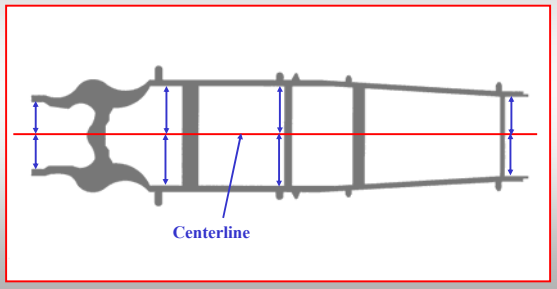
- Centerline
- Identify Sway
- Other Damages Affecting Centerline
  - Diamond
  - Short Rail
  - Out-Of-Level

Let's Examine These Individually

- **Centerline**

Centerline

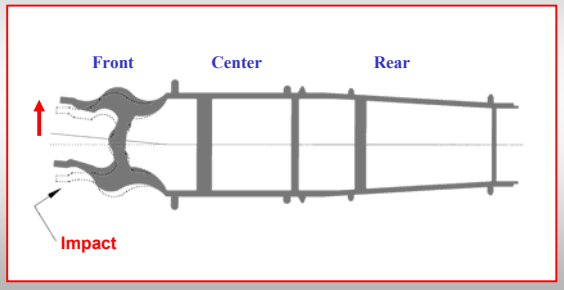
Equal Distance From Control Points



- **Identify Sway**

Sway

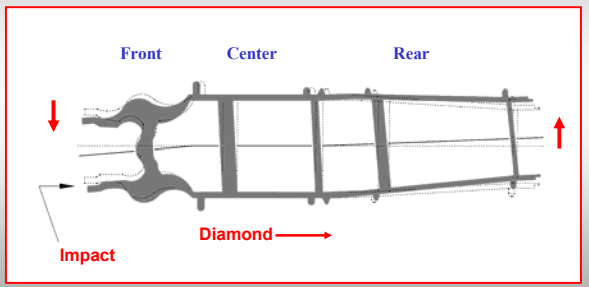
Centerline Misalignment (May Include Width Variances)



- **Other Damages Affecting Centerline**

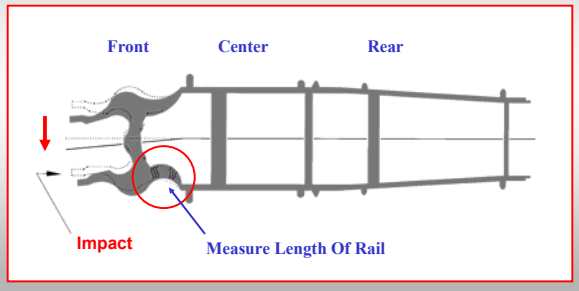
Diamond.....continued

Affects Both End Section



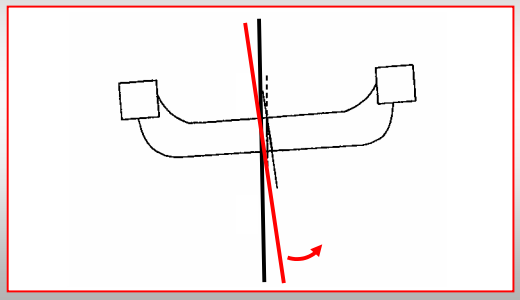
Short Rail

Requires Length Measurement And Analysis To Detect



Out-Of-Level

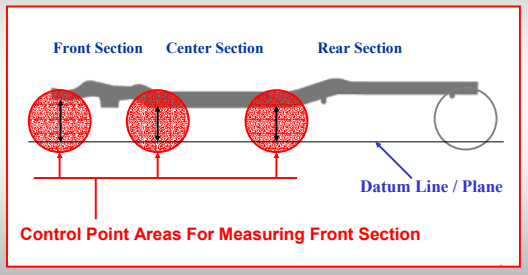
Pendulum effect moves centerline toward the high rail



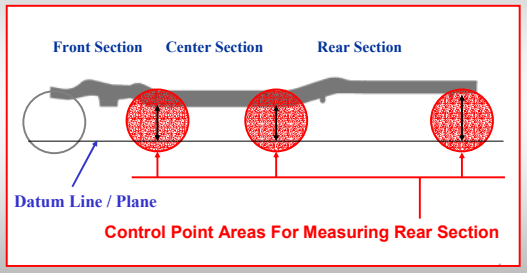
Check Datum Height Misalignment In End Sections

- Datum Line / Plane
- Identify Control Point Areas To Use
- Measure Datum Height

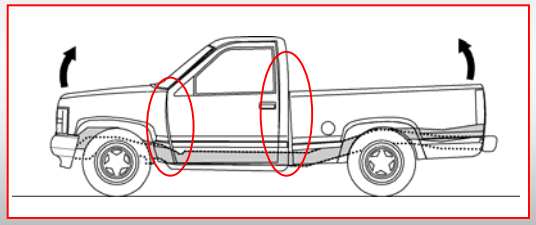
Measure Datum Height Of Front Section



Measure Datum Height Of Rear Section



Datum Height Of End Sections Affects Vertical Alignment of Side Panels



V. Measuring And Analyzing

- Basic Principles Of Measuring For Structural Alignment
- Sequence For Checking Structural Misalignment
- Measuring Vehicle's Center Section
- Measuring Vehicle's End Sections
- **MEASURING MAIN CROSSMEMBER AREA**
- Analyzing Multiple Misalignment
- Body Damage Misalignment
- Diagramming / Analyzing Structural Misalignment

The alignment of the main crossmember area is important for the following to perform correctly:

- **Engine/Drivetrain**
- **Suspension**
- **Steering**

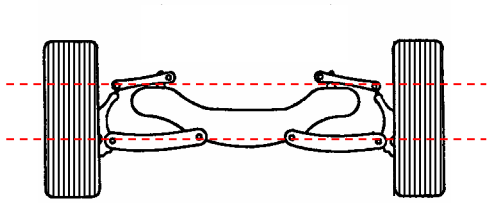
Main Crossmember

- **Position (Location)**
- **Condition (Within)**
- **Ball Joint Length**

Let's Examine These Individually

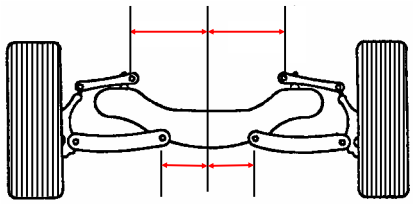
Position

Location (Level)



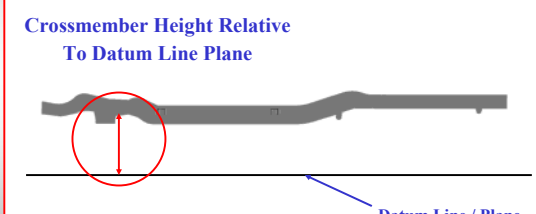
Position

Location (Centerline)



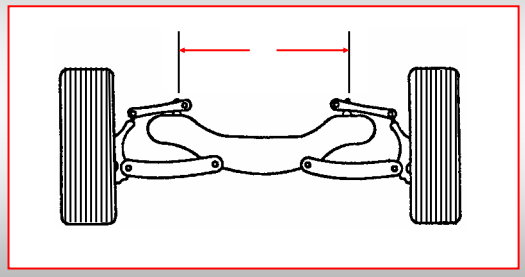
Position

Location (Datum)



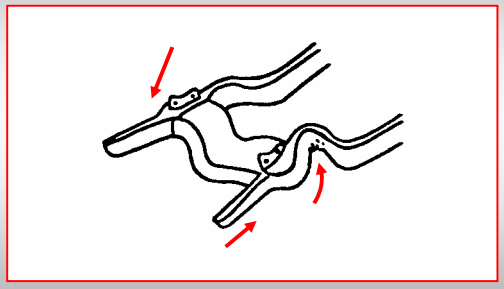
Condition

Width Of Main Crossmember

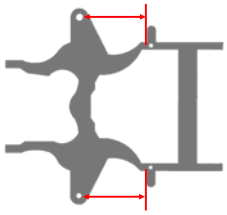


Condition

Twist Within Main Crossmember



Ball Joint Length



Measurements Must Be Equal Side-To-Side

V. Measuring And Analyzing

- Basic Principles Of Measuring For Structural Alignment
- Sequence For Checking Structural Misalignment
- Measuring Vehicle's Center Section
- Measuring Vehicle's End Sections
- Measuring Main Crossmember Area
- **ANALYZING MULTIPLE MISALIGNMENTS**
- Body Misalignment
- Diagramming / Analyzing Structural Misalignment

To analyze multiple misalignments first determine if they are:

- **Overall**
- **Localized**

Overall Misalignment

- **Overall Misalignment**
  - **Misalignment In Center Section That Influences End Sections**
    - **Diamond**
    - **Twist**
  - **Consider Influence On End Sections During Analysis Of Vehicle**

Localized Misalignment

- **Misalignment Confined To One Section**
  - **Short Rail**
  - **Sway**
  - **Datum**
  - **Collapsed Crossmember**

In summary, keep in mind each of the overall and localized misalignments when diagramming and analyzing multiple misalignments.

V. Measuring And Analyzing

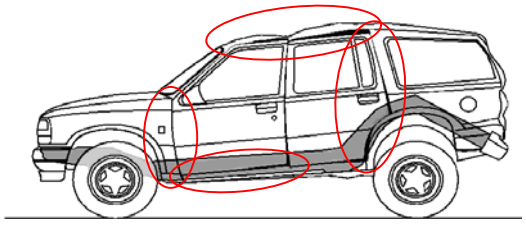
- Basic Principles Of Measuring For Structural Alignment
- Sequence For Checking Structural Misalignment
- Measuring Vehicle's Center Section
- Measuring Vehicle's End Sections
- Measuring Main Crossmember Area
- Analyzing Multiple Misalignments
- **BODY MISALIGNMENT**
- Diagramming / Analyzing Structural Misalignment

When analyzing body misalignment consider the relationship between the following areas:

- **Front Hinge Pillar To Rocker Panel**
- **Front Door To Fender**
- **Quarter Panel To Door**
- **Windshield Pillar To Door Frame**

Also consider lateral misalignment of body sections.

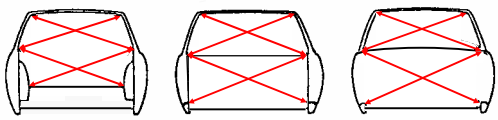
Body And Panel Alignment



- **Front Hinge Pillar To Rocker Panel**
- **Front Door To Fender**
- **Quarter Panel To Door**
- **Windshield Pillar To Door Frame**

Lateral Misalignment

Diagonal Measurements



Rear View SUV | **Rear View Pickup** | **Front View Pickup / SUV**

V. Measuring And Analyzing

- Basic Principles Of Measuring For Structural Alignment
- Sequence For Checking Structural Misalignment
- Measuring Vehicle's Center Section
- Measuring Vehicle's End Sections
- Measuring Main Crossmember Area
- Analyzing Multiple Misalignments
- Body Misalignment
- **DIAGRAMMING / ANALYZING STRUCTURAL MISALIGNMENT**

The purpose of diagramming is to:

- **Document structural damage**
- **To help visually understand what the measurements mean in three dimensions**

When analyzing, consider the following key points:

- **Collision theory principles**
- **Visual inspection**
- **Normal build tolerances**
- **Sequence for analyzing each section**

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VI. Steering And Suspension Alignment

Steering and suspension alignment is the process of correctly positioning steering and suspension components to each other and to the vehicle's structure.

VI. Steering And Suspension Alignment

- Steering Geometry
- Check Suspension Control Points
- Front End Suspension Component Alignment
- Steering Linkage Alignment
- Rear Suspension Alignment
- Weight Distribution

VI. Steering And Suspension Alignment

- **STEERING GEOMETRY**
- Check Suspension Control Points
- Front End Suspension Component Alignment
- Steering Linkage Alignment
- Rear Suspension Alignment
- Weight Distribution

• Steering Geometry

- S.A.I. (Steering Axis Inclination)
- Caster
- Camber
- Toe
- Toe Out On Turns

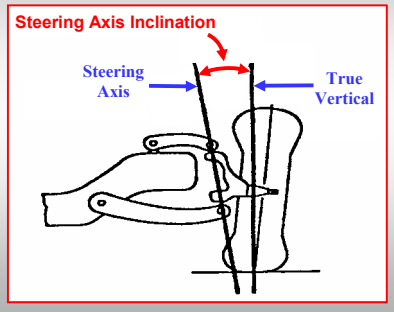
Let's Examine These Individually

S.A.I.

Inward Tilt Of Steering Axis When Viewed From Front

(Measured In Degrees From True Vertical)

SAI Is Non-Adjustable

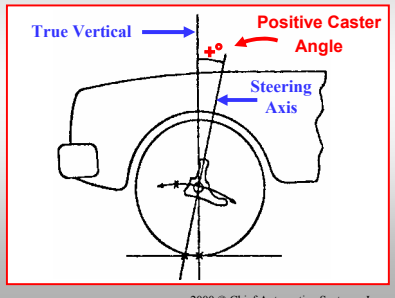


Caster

Forward Or Rearward Tilt Of Steering Axis When Viewed From Side

(Measured In Degrees From True Vertical - 'Positive' Or 'Negative')

On Most Vehicles Caster Is Adjustable

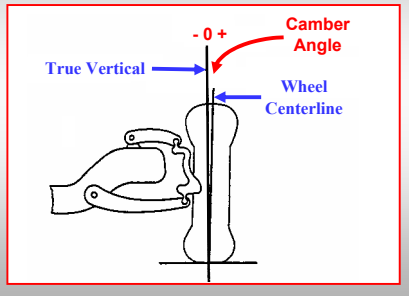


Camber

Inward Or Outward Tilt Of Wheel When Viewed From Front

(Measured In Degrees From True Vertical - 'Positive' or 'Negative')

Camber Is Adjustable On Most Vehicles

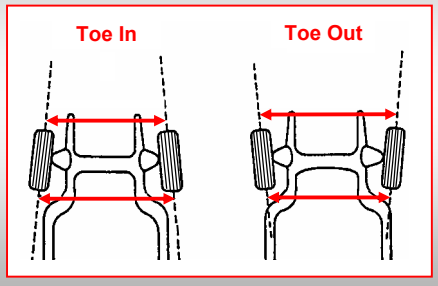


Toe

Straight Ahead Position Of Wheels Relative To Each Other

(Linear Measurement Expressed In Inches Or Millimeters)

Toe Is Adjustable



Toe Out On Turns (Turning Radius)

Angle Controlling Amount Each Wheel Turns While Cornering

Toe Out On Turns (Turning Radius) Is Non-Adjustable