
Carbody

Inspection and Maintenance

Course 208

Participant Guide

Participant Guide

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Rail Car Training Consortium

FOR SME REVIEW

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MODULE 1

General Inspection and Maintenance

Outline

- 1-1 Course Overview
- 1-2 Preparing for Inspection and Maintenance
- 1-3 Periodic Maintenance
- 1-4 Summary

Outcome and Objectives

This module presents a general overview for inspection and maintenance tasks on major components of the rail vehicle's carbody. Following the completion of this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

- Explain agency maintenance schedules for the carbody.
- Describe required PPE practices.
- Apply standard safety precautions when working on the carbody.

Key Terms

- On-track equipment (OTE)
- Periodic inspection and maintenance
- Risk mitigation

Abbreviations

APTA	American Public Transportation Association
FMEA	Failure Mode and Effects Analysis
FMECA	Failure Modes, Effects and Criticality Analysis
HRV	Heavy Rail Vehicle
LOTO	Lock out / Tag out
LRV	Light Rail Vehicle
OTE	On-track Equipment
PPE	Personal Protective Equipment
RTS	Rail Transportation System
SMP	Standard Maintenance Procedure
SOP	Standard Operating Procedure

1-1 COURSE OVERVIEW

Maintenance is defined as the method by which equipment is kept in its existing condition; preserved or protected; or kept from failure or decline. The ultimate goal of maintenance is to provide optimal reliability, meet safety standards, and provide onboard services for rail passengers and crew.

Working in a rail maintenance facility is fraught with hazards including electrical, fire, fall, heavy equipment, and other hazards. Everyone involved in the inspection of and work on the carbody should follow their agency's guidelines and requirements for working safely. The following chart is a summary of key safety precautions when working on the rail carbody.



Warning: Safety Precautions!

- All agency and statutory regulations, precautions, and procedures concerning working in the rail maintenance facility should be strictly followed. These include adherence to LOTO and PPE policies.
- All maintenance work should be carried out only by skilled personnel familiar with and informed of the possible dangers involved.
- Precautions must be taken to ensure that vehicle movements will not occur that could result in equipment damage, injury, or fatality.
- Be aware that hazardous voltages can still be present even after equipment is disconnected from the power supply.

Along with these safety precautions, APTA recommends that each rail transportation system (RTS) should follow these safety considerations:

- Conduct task-appropriate equipment and safety training.
- Identification and creation of danger, warning and caution elements within the task descriptions through a job hazard analysis (**risk mitigations**) such that employees are made aware of procedures that could be harmful to either themselves or others.
- Safe operation is the intentional outcome of the **on-track equipment** (OTE) periodic inspection and maintenance program.
- Ensure facilities and equipment are adequate to safely perform the periodic inspection and maintenance tasks.

COURSE 208: INSPECTION AND MAINTENANCE OF THE RAIL CARBODY
MODULE 1: GENERAL INSPECTION AND MAINTENANCE

- Availability and identification of the PPE necessary to perform each inspection and maintenance task.
- Promote the regular enforcement of rules and procedures to maintain the safety culture within the rail transportation system (RTS).
- Use of FMEA and FMECA, or other failsafe methodologies to validate changes to safety critical equipment that the RTS has specified. FMEA and FMEACA will be explained in more depth during class.


This course introduces the participant to carbody inspection and maintenance procedures. For the most part, these procedures incorporate best practices provided by subject matter experts who advised and contributed towards the Rail Car Training Consortium courses. It is important to note that, because of the varying configurations and design of rail vehicles, this course is not a one size fits all and, in fact, represents a wide sampling of truck designs from Consortium agencies. Some of the examples used in the course may differ from the participant’s RTS. The participant is encouraged to look for similarities and explore differences of maintenance steps described in this course.

Because of these varying configurations, this Participant Guide is designed with space for the participant to take notes on their own rail vehicle’s similarities and differences. Use this Participant Guide as a job aid to enhance your agency’s manuals and standard operating procedures (SOPs).

This course shall be used in conjunction with agency instructions and recommendations from the rail vehicle manufacturer.

1-2 PREPARING FOR INSPECTION AND MAINTENANCE

Relying on the physical senses of sight, smell, hearing, and touch, an experienced rail car technician will conduct a sensory inspection upon their review and maintenance of the carbody. Below are some sensory symptoms that may indicate a problem with the components of the propulsion system. With more experience, the carbody technician will become more familiar with the normal smells, sounds and touch of the rail vehicle’s carbody.

Sense	Check for:
Smell 	<ul style="list-style-type: none"> • An unusual electrical / burning smell may indicate burning of electrical system or insulation • Odor of dust burning may indicate dirty components. • Mold odor may indicate problems with carpeting, HVAC, or some air filter needing to be replaced. • Oil/ grease / petroleum smells may indicate leakage from those systems.

1-3 PERIODIC MAINTENANCE

This portion of the Participant Guide is sourced from APTA's recommended practice for the periodic inspection and maintenance of on-track equipment (APTA RT-VIM-RP-027-17).

There are many variations in rail vehicle design, ridership, environmental conditions and such, that no single method of developing and implementing carbody inspection and maintenance can be applied to the entire industry. Each RTS follows periodic inspection and maintenance protocols that are based on its specific equipment design, usage, maintenance facilities and operating environment.

Each RTS schedules periodic inspection and maintenance of the carbody following recommendations of the rail vehicle manufacturers, authorities having jurisdiction, public transportation industry and others. Generally, these schedules are based on **time**; for example, the number of hours that a rail car is in operation; or on **distance**, specifically the number of miles the rail car is in operation.



Learning Application 1B

Examine the checklists for inspection and maintenance that is in use at your RTS for the carbody of its rail vehicles.

-
1. Attach a copy of a blank checklist to your class notes.

 2. Check the areas of your checklist that shows you how to perform tests following specific procedures provided by your agency.

 3. Where are the procedures (or manuals) that are stored in your agency's maintenance shop? Are they available on a computer tablet or other device? Are they available online?

 4. While working on the carbody, how do you access required inspection and maintenance procedures? Do you fill out a paper form? Do you enter information on a device?

 5. What are some other specific instructions regarding the written procedures for completing the inspection and maintenance checklist?
-

MODULE 2

Carbody Interior

Outline

- 2-1 Overview
- 2-2 Operator Cab
- 2-3 Flooring, Sides, and Ceilings
- 2-4 Seating and Other Installations
- 2-5 Windows and Windscreens
- 2-6 Interior Lighting
- 2-7 Summary

Outcome and Objectives

This module provides participants with a framework of the steps involved in inspecting and maintaining the carbody interior.

Upon completing this module, the participant should be able to complete the following objectives with an accuracy of 75% or greater:

- Check that components of the operator cab are in good working order.
- Inspect condition of flooring, sides, and ceiling for needed repairs.
- Inspect condition of seating and other installations.
- Inspect condition of windows and windscreens.
- Check that interior lighting components are in good working order.

Abbreviations

ADA	Americans with Disabilities Act
HRV	Heavy Rail Vehicle
LRV	Light Rail Vehicle
RTS	Rail Transportation System
WSMD	Wheeled and Seated Mobility Devices

2-1 OVERVIEW

The carbody interior varies in layout and configuration depending on age, type of vehicle, manufacturer and other criteria. In this module “interior” refers to the area of the rail vehicle where the passengers ride and the cab area where the operator

Some of the major components of the carbody interior include:

- Operator cab
- Windows.
- Bike racks.
- Stanchions, grab rails, hanging straps.
- Stops for wheeled and seated mobility devices (WSMD) – mostly on older rail vehicles.
- Bulkhead doors (typically on heavy rail vehicles).
- Passenger seating.
- Signage, such as system maps, decals, ads.
- Rider alert panels.
- Fare collection or card equipment (typically on streetcars).

This inspection and maintenance course lists steps for inspecting, testing, and maintaining major components of the interior of the rail car. Carbody technicians will need to be familiar with repair and fabrication of the varied materials used as well as the electrical and mechanical skills necessary to maintain the various components.


This module categorizes the carbody interior components into five areas:

1. Operator Cab
2. Flooring, Sides, and Ceilings
3. Seating and other Installations
4. Windows and Windscreens
5. Interior Lighting

This module lists procedures for each of these areas. Participants are encouraged to fill out the module’s learning application forms with information on maintaining carbodies specific to their rail transportation system (RTS).

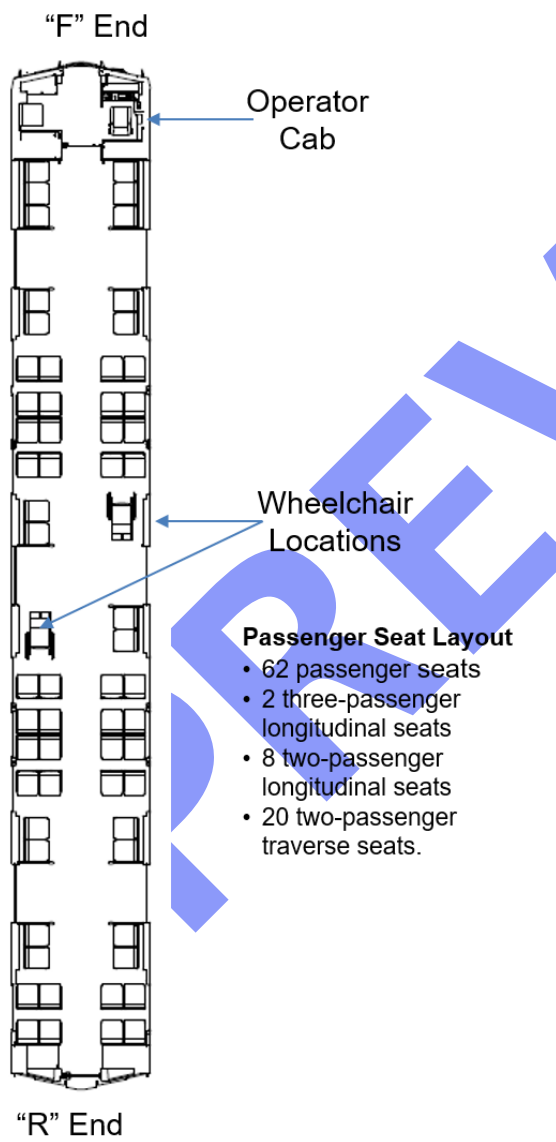
2-2 OPERATOR CAB

The operator cab is an enclosed area of the rail vehicle from which the train operator works. It is closed off from the passenger seating area. Some rail vehicles are designed with operator cabs on both ends of the carbody. Other configurations have one cab. Not all rail cars have an operator cab – some rail cars are part of a married pair where one car has the operator cab and the other does not.



Learning Application 2A

In the space below, sketch the layout of a consist typical of the rail cars on which you work. Label the location of the operator cab(s). Use the example from WMATA's 7000 Series car as a guide.



Passenger Seat Layout

- 62 passenger seats
- 2 three-passenger longitudinal seats
- 8 two-passenger longitudinal seats
- 20 two-passenger traverse seats.

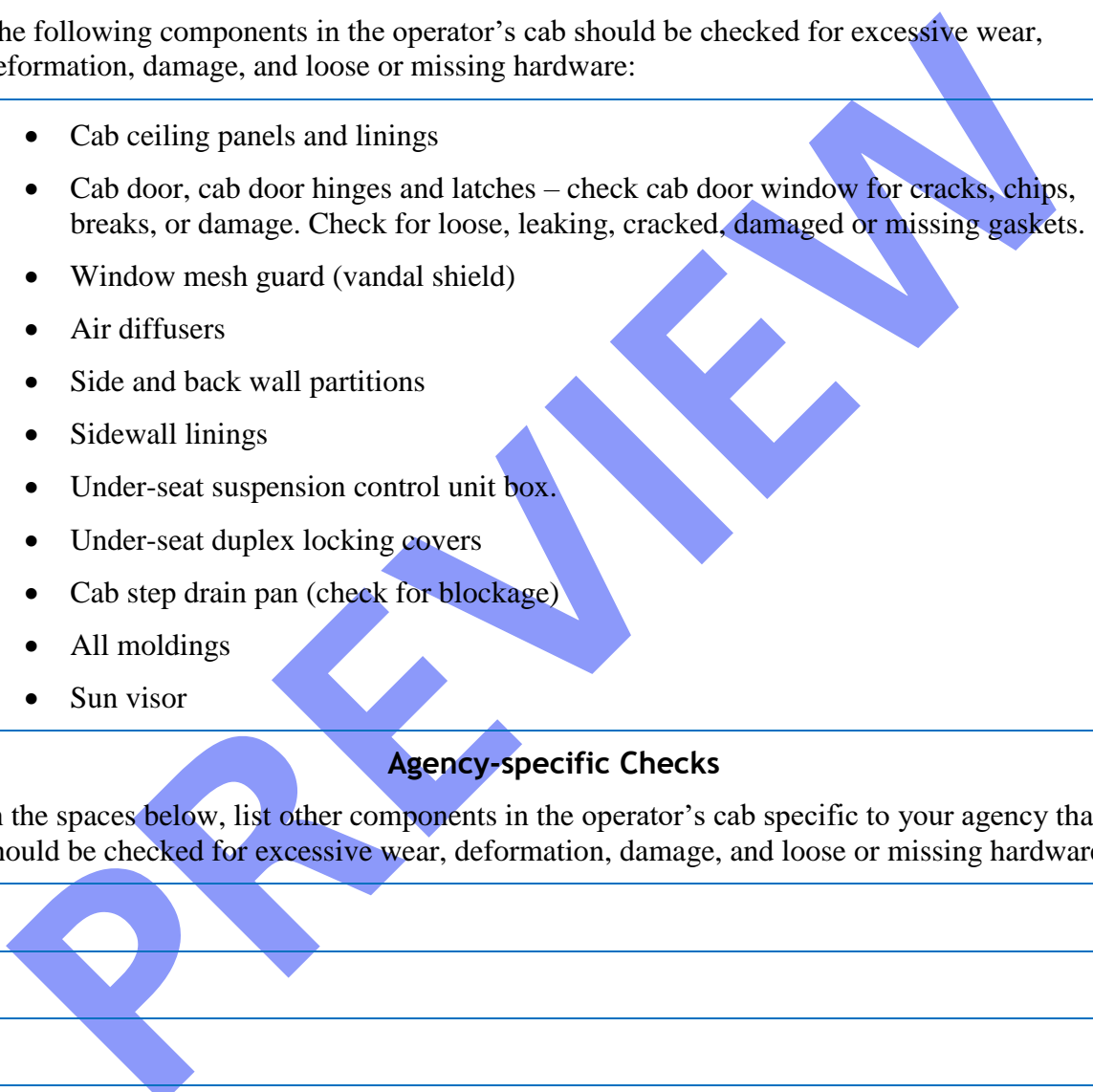
Source: Transit Car "7000" Series Running Maintenance and Servicing Manual –courtesy WMATA

COURSE 208: INSPECTION AND MAINTENANCE OF THE RAIL CARBODY
MODULE CARBODY 3: CARBODY EXTERIOR

For the carbody maintainer, much of the work in the operator cab involves inspecting components to see that they are working as designed. In particular, the maintainer examines the cab area, checks and tests the windshield wiper assembly as well as the operator seat and assembly.

Cab Area

<p>The following components in the operator’s cab should be checked for excessive wear, deformation, damage, and loose or missing hardware:</p>
<ul style="list-style-type: none">• Cab ceiling panels and linings• Cab door, cab door hinges and latches – check cab door window for cracks, chips, breaks, or damage. Check for loose, leaking, cracked, damaged or missing gaskets.• Window mesh guard (vandal shield)• Air diffusers• Side and back wall partitions• Sidewall linings• Under-seat suspension control unit box.• Under-seat duplex locking covers• Cab step drain pan (check for blockage)• All moldings• Sun visor
Agency-specific Checks
<p>In the spaces below, list other components in the operator’s cab specific to your agency that should be checked for excessive wear, deformation, damage, and loose or missing hardware.</p>



MODULE 3

Carbody Exterior

Outline

- 3-1 Overview
- 3-2 Carbody Roof
- 3-3 Carbody Ends and Under-Frame
- 3-4 Carbody Sides
- 3-5 Exterior Lighting
- 3-6 Summary

Outcome and Objectives

This module provides participants with a framework of the steps involved in inspecting and maintaining the carbody exterior.

Upon completing this Module, the participant should be able to complete the following objectives with an accuracy of 75% or greater:

- Inspect components of the carbody roof.
- Inspect components of the ends of the carbody and its under-frame.
- Inspect condition and components of the sides of the carbody.
- Examine exterior lighting components are in good working order.

Key Terms

- Crash Energy Management System (CEMS)

Abbreviations

APTA	American Public Transportation Association
HRV	Heavy Rail Vehicle
LRV	Light Rail Vehicle
RTS	Rail Transportation System

3-1 OVERVIEW

This module outlines the major steps involved in the inspection and maintenance of carbody exterior including the carbody roof, ends and under-frame, sides, and exterior lighting.

Much of the maintenance tasks on the carbody exterior involves inspection of its many components. These components vary by car type and manufacturer and they may include:

- Body panels, skirting panels, struts.
- Step panels, step boxes, thresholds, ramps.
- Bumpers and anti-climbers.
- Exterior lights such as headlights, taillights, indicators, turn signals (LRV only), passenger emergency lights, and others.
- Carbody paint, wraps, and decals.
- Roof shrouds.
- Destination signage.
- Wiper blades and accessory equipment.
- Mirrors (including camera mirrors) and accessory equipment.
- Transponders used for wayside communications.
- Audible alert devices such as gongs, bells, or horns.
- Bellows (discussed in the articulation section).
- Barriers between cars such as rods or chains.

An initial inspection of the carbody involves walking around the vehicle performing a visual inspection. Here is an overview of the exterior inspection and maintenance task:

1. Verify that vehicle is secure. This may require that no power is transmitted to the vehicle and that it is powered off.
2. Check for secure attachment of hardware repairing as necessary following OEM recommendations and agency guidelines.
3. Check for damage to components.
4. Check for proper operation of subcomponents such as struts and prop rods, as applicable.
5. Record defects and appropriate action to fix.
6. Repair as necessary.

3-2 CARBODY ROOF

When working on the carbody roof, take all necessary safety precaution and follow required safety procedures such as:

- Wearing body harness to protect from falls.
- Power off all equipment to the rail vehicle.

Roof Seam Sealing

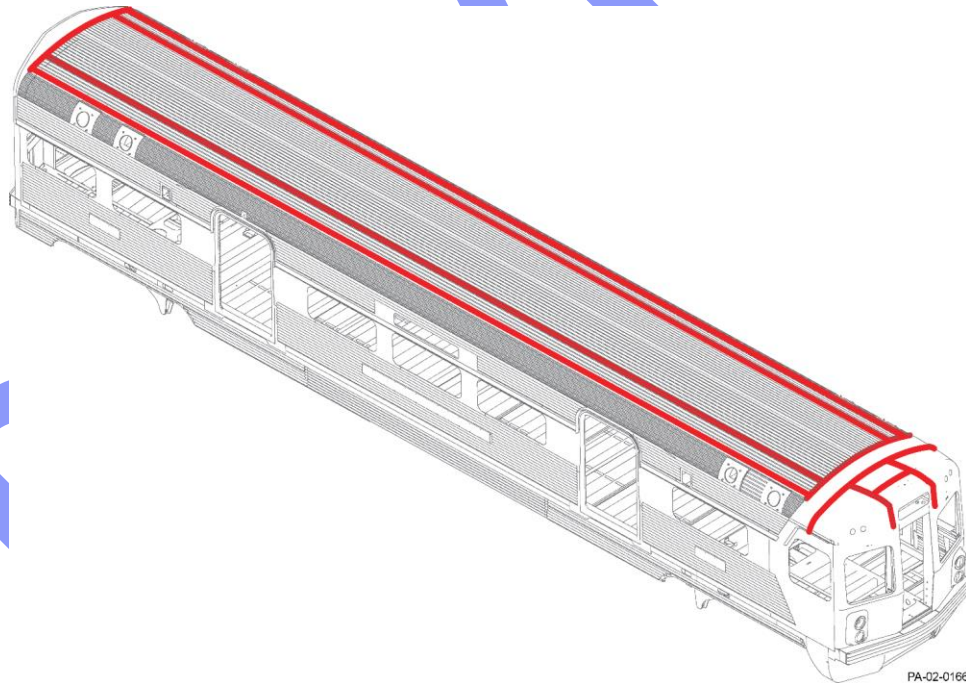


Learning Application 3A

The diagram below illustrates the areas of roof sealing on a rail car used in the PATCO service area. How similar or different are roof sealants on your agency's carbodies to the one illustrated here?

Consult with OEM manuals to check for type of sealing materials that are in use at the carbodies that have come in for inspection and maintenance. Is it a sprayed-on coating? How is it applied?

Bonus question: Other than the roof, where are seam sealing evident on the carbody?



Source: *Roof Seam Sealing Inspection* –courtesy PATCO



Learning Application 3B

The diagram below shows the mounting brackets that are welded to the roof of a light rail vehicle used in Santa Clara Valley. How many maintainers would be needed to remove and install a roof shroud? How much time would you estimate this task would take? Write your answers in the spaces below.

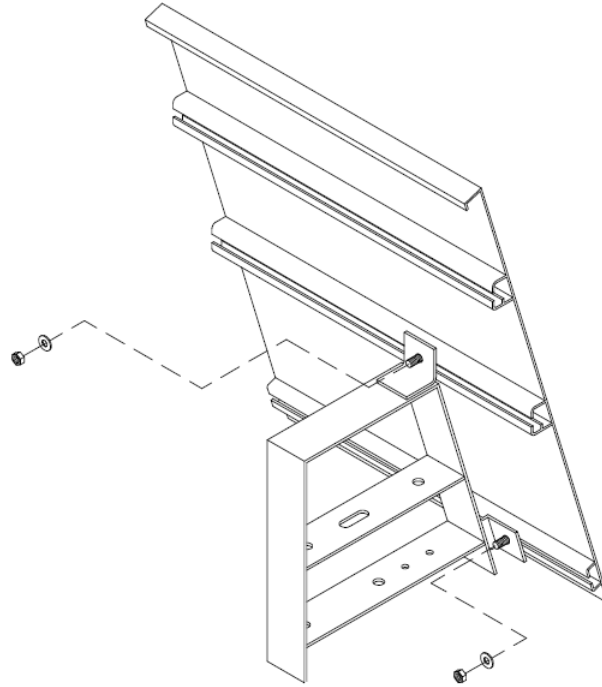


Figure 9.5-3: Roof Shrouds

Source: Diagnostic and Troubleshooting Manual: Carbody and Articulation –courtesy VTA

MODULE 4

Articulation

Outline

- 4-1 Overview
- 4-2 Major Components
- 4-3 Summary

Outcome and Objectives

This module provides participants with a framework of the steps involved in inspecting and maintaining the articulation system on the rail carbody.

Upon completing this module, the participant should be able to complete the following objectives with an accuracy of 75% or greater:

- Inspect articulation panels.
- Inspect articulation floor, rub plates, rubber bearing, and bearing supports.
- Inspect the bellows assembly.
- Inspect the slewing bearing.

Key Terms

- Articulation section
- Slewing bearing
- Bellows

Abbreviations

APTA	American Public Transportation Association
FTA	Federal Transit Administration
LRV	Light Rail Vehicle
HRV	Heavy Rail Vehicle

4-1 OVERVIEW

This module outlines the major steps involved in the inspection and maintenance of carbody articulation system including the following components: bellows, damper, joint, floor (turntable), and bearings.

Much of the inspection and maintenance tasks for an articulation system on a light rail vehicle are shown in the video instruction in Learning Application 4A.

Learning Application 4A



1. What inspection and maintenance tasks on an articulated rail car are described in this video (link below).
2. Participate in classroom activity, discussion, and knowledge checks led by your instructor.

Video link <https://vimeo.com/356979514>. Password available from your instructor.

4-2 INSPECTION AND MAINTENANCE TASKS

Verify the frequency of inspection with your rail transportation agency for the type of rail car articulation system you are working on.

Inspection and Maintenance of the Rail Vehicle's Articulation System	
Device and Components	Tasks
Articulation damper	<ol style="list-style-type: none">1. Inspect for damage, oil leakage, or loose retaining hardware.2. Torque retaining plate mounting bolts to OEM specifications.
Bellows	<ol style="list-style-type: none">1. Inspect bellows for fit, damage, cuts, loose or missing hardware.2. Check for signs of leakage.
Articulation joint	<ol style="list-style-type: none">1. Check for damages and loose hardware.2. Torque per OEM specifications.3. Follow OEM recommendations for lubrication.