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POLICY MEMORANDUM NO. 2024-GM05

To: Equipment Maintenance and Repair	Subject: Vehicle & Equipment Inspection and Serviceability Maintenance Standards
Effective Date: October 1, 2024	**Revision Date:**
Approved by: **RORY J. RESPICIO, General Manager**	

I. INTRODUCTION.

A. This publication implements the Port Authority of Guam (PAG) directive advising on types of inspections, inspection standards, and minimum serviceability standards.

B. Policy reference United States Air Force Technical Order 36-1-191 Technical and Managerial Reference for Motor Vehicle Maintenance.

II. PURPOSE.

A. Prescribes required inspections, services, and minimum serviceability standards for repairs for all PAG motor vehicles and equipment. All Inspections, services, and maintenance will be documented with electronically generated work orders.

B. Provides information and direction for the selection, inspection, service, and control of motor vehicles tires. Reflects policies and guidelines consistent with the Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA).

III. SCOPE.

A. This policy shall be the maintenance standard for all PAG motor vehicles and equipment, to ensure the safety of personnel and the protection of vehicles and equipment this shall be adhered to by all EQMR maintenance personnel unless conflicting with the manufacturer's recommendation. In all instances, the Manufacturer's direction shall override this policy.

IV. GENERAL INSPECTION STANDARDS.

A. **Appearance.** The equipment, internally and externally, shall be clean, dry, and free from mud and other debris. The vehicle finish will be in such condition as to afford adequate protection against rust or corrosion.

1. **Inspections.** Inspections shall be performed to ensure that such items as supporting, attaching, or connecting members are in good condition, and that stowed or assembled items are secure, adequately lubricated, and not excessively worn or leaking.

2. **Inspect for Good Condition.** Inspect for good condition means parts and components that are not bent, twisted, chafed, burned, broken, cracked, bare, frayed, collapsed, torn, cut, or deteriorated.

3. **Inspect for Excessive Wear.** Excessively worn is construed to mean "subject to early parts failure". Excessive wear of mating parts or linkage connections is usually evidenced by too much play (lash or lost motion). It also includes illegibility as applied to markings, data and caution plates, and other printed matter.

4. **Wooden Components.** Wooden components of equipment shall be in such condition so as not to compromise their structural strength. Cracks running with the grain that do not affect strength need not be replaced. (Wood may crack from natural causes without necessarily having its strength impaired.) Bruises and dents do not render wooden components unacceptable. Below is an acceptable example.

5. **Scratches and Marks.** Scratches, tool marks, compression and/or stress marks that do not impair structural integrity or components are ordinarily of no significance and do not render an item unacceptable.

6. **Castings.** All castings will be without cracks, securely bolted, and free from excessive lubricant leaks at all joints. Obvious imperfections, such as external blow holes, slag and sand inclusions, and improperly dimensioned sections due to imperfect molding will be cause for rejection of assemblies.

7. **Welds.** All welds of major elements must be sound. Minor welds, involving attachments only, may be imperfectly provided sufficient connecting metal remains to retain attachment through normal shipment, handling, and operation without further breakage, or loss (overlapping welds, etc.).

8. **Riveted/Welded Components.** Components of equipment permanently attached through rivets or welds must be firmly attached so that loss through vibration or normal operation will not occur.

9. **Corrosion.** Indications of corrosion around rivets, bolts, joints, or welds will be cleaned and inspected to determine the extent of damage. It will then be repaired and/or treated to prevent further deterioration.

10. **Seals, Oil, and Grease.** Seals used for retaining hydraulic and gear oils on revolving or reciprocating shaft applications may show slight seepage and still be considered acceptable. If seepage is sufficient to form flow tracks and drips from the housing or shaft, or forms wet accumulations on adjacent members or panels from thrown lubricant, the seal shall be rejected. The following shall apply:

    a. **Seals in Rotating Assemblies.** Seals used for retaining grease in rotating assemblies such as wheel hubs shall show no evidence of leakage. Presence of a slight oily film on the exterior and areas adjacent to the oil seal may be caused by the capillary action of light oils present in most greases, and is not cause for replacement of seal.

b. **Wiping Surfaces.** Wiping surfaces of synthetic-type seals shall be smooth and maintain pressure contact with the intended sealing surface throughout the radial or surfaces of the seal.
c. **Leather Seals.** Leather seals that have hardened shall be rejected. Sealing edges that are worn to a sharp or ragged edge are not acceptable.
d. **Bellows Type Seals.** Bellows type seals (steering knuckle, constant velocity (CV) joints, gear case shifter shafts) shall not be cut, slit, or cracked. Mounting clamps or devices shall be secure and properly installed.

11. **Bearings, Anti-Friction Ball and Roller.** Bearings removed for lubrication, service, or inspection shall exceed minimum serviceability standards.

12. **Operational Test.**
a. **Power.** The vehicle engine will be capable of effectively delivering the motive power for which it was designed.
b. **Unusual Noises.** All components of the equipment will operate without unusual noises. An unusual noise is a sound which by its nature indicates a malfunction of the component or a probability that the component will, if continued in use, cause further damage.
c. **Compression.** The compression pressure developed in a cylinder of an internal combustion engine shall not differ by more than the variance specified by the manufacturer. Vehicles exhibiting compression variances of more than 10 percent between cylinders shall be acceptable if vehicle is capable of attaining maximum allowable speed, runs smoothly at low speed, and shows no signs of excessive oil consumption.
d. **Vacuum Tests.** All internal combustion engines, except diesel engines, shall be capable of producing a steady intake manifold vacuum of 18 inches or more at idling speed, and at approximately 75 percent maximum allowable engine speed, when the engine is at normal operating temperature. (Required intake manifold vacuum will be reduced by 1 inch for every 1,000 feet (ft) if the test location is above sea level.)

V. TYPES OF INSPECTIONS.

A. Preventative maintenance inspections/tests and services for Port Authority of Guam (PAG) owned vehicles, vehicular support equipment, and powered Support Equipment maintained by the Equipment Maintenance and Repair Division (EQMR), are defined in this policy and are identified by type of inspection as follows:

1. **Operator Inspection.**
a. Preventative Maintenance and Inspection (PM&I).
b. Vehicle Condition Inspection.
c. Special Inspection.
d. Survey Inspection.
e. General inspection and service requirements applicable to most vehicle/equipment are specified in the following paragraphs by type of inspection/service and special inspections/tests are contained in manufacturer's commercial manual to include

specialized requirements peculiar to certain equipment and exceptions to general requirements and/or intervals.

B. **Inspection Intervals.**

1. **Except for operator inspections, inspections will be performed by EQMR.** All actions will be recorded on a work order. Follow the manufacturer's recommended lubrication, oil, and filter change (PM&I) intervals during the vehicle warranty period; after the warranty period continue to follow the manufacturer's mile/hour/kilometer intervals. When accomplished concurrently, each of the inspections, services, or tests, will require a separate work order.

2. **Mobile Maintenance Team Inspections.** Due to their design limitations, vehicles/equipment that cannot be practically transported to the maintenance shop for inspection or services will be serviced by a mobile maintenance team. When the required service exceeds the team's capability, the Maintenance Manager, Assistant Maintenance Manager, or Superintendent will determine the alternate course of action.

3. **PM&I.** Any safety-related inspections, adjustments, and services recommended by the manufacturer and outlined in the applicable commercial manual will be performed. As a minimum, the following systems and their components are inspected to ensure proper configuration, functionality, serviceability, and compliance (i.e., manuals, technical data, safety recalls, service campaigns, or service bulletins) during PM&I. PM&Is will be documented using system-generated work orders for all vehicle types.

    a. **Operator Compartment.** Check gauges, accessories, clutch free travel, parking and service brake operation, transmission control lever, and operation of engine and accessories. Also, check seat belts for operation, cleanliness, or frayed/ deteriorated condition.
    b. **Hydraulic Systems.** Check the brake system for fluid levels and leaks. Check power steering and/or hydraulic systems for fluid level and leaks. Check the general condition on all lines and fittings to include chaffing and abnormal wear.
    c. **Coolant System, Heater and Air Conditioning.** Check hoses and radiator for leaks, proper fluid level, and general condition. Take specific gravity readings. Wash and clean off radiator fins/coils as applicable. Test coolant and reserve alkalinity using a testing kit or comparable equipment.
    d. **Fuel System.**
        i. Check for proper operation or leaks.
        ii. Ensure the fuel tank sump is drained on vehicles so equipped.
        iii. Check and drain filter bowls as required (per manufacturer recommendations).
    e. Inspect, service/replace the air filter as required.
    f. Inspect the exhaust system including catalytic converters, tailpipes, and spark arrestors for damage and leaks. Repair or replace all unserviceable items.
    g. Inspect, service/replace the passenger compartment air filter as required on vehicles so equipped.

h. **Spark Arrestors, Purifiers, and Mufflers.** Inspect and service spark arrestors, purifiers, and mufflers as follows:
   i. Check spark arresting muffler following the manufacture's recommendation.

NOTE: *Management shall initiate more frequent maintenance as necessary where inspections reveal excessive carbon buildup.*

i. **Suspension System.** Check front-suspension and rear springs, shackles, and shock absorbers/struts for leaks, ball joints/kingpins for excessive wear, upper/lower control arms for excessive wear and damage, steering for loose connections, free play, and excessive wear.
j. **Air Brakes.** Check air and brake hoses, valves, and air tanks for leaks and tight connections. Adjust slack adjusters as required. Drain moisture from air tanks. Check the air system for leaks.
k. **Wheels and Tires.** Check for visible damage, abnormal wear, age, and pressure.
l. **Vehicle Lighting.** Check all lights, (i.e., headlights, turn signals, warning lights, mounted signals, spot/flood lights) for general condition and operation.
m. **Pintle Hooks and Towing Attachments.** Check pintle hooks and towing attachments. Make sure of proper mounting and proper locking, safety pin installation in accordance with manufacture's recommendations.
n. **Battery.** Check the battery for the proper solution level. Clean and service terminals and battery boxes as necessary.
o. **Corrosion.** Inspect all areas of the vehicle for corrosion and treat as required.
p. **Hydraulic System (Special Purpose Assemblies).** Check cylinders, lines, seals, and reservoirs for general conditions and possible contamination (particles and water). Change fluid every 3600 operating hours or three years, whichever comes first. Change filters following the manufacturer's recommendation.

NOTE: *Sonic filters can be removed, cleaned, and reinstalled instead of replacement.*

q. **Drive Line.** Carefully inspect the drive line to keep the vehicle operating smoothly. Check boots for leaks, cracks, weathering, and security of placement. Replace as required.
r. **Warning Devices and Decals.** Inspect all vehicle warning devices (lights and buzzers) for proper operation. Ensure all warning and caution decals are in good repair and easily read.
s. **Engines.** Perform an engine diagnostic test using available test equipment. Repair/replace only those parts/ assemblies necessary to ensure engine performance following manufacturer's specifications.
t. **Brakes.** Inspect the condition of brake components (pads/shoes, wheel cylinders/calipers, rotors/drums) and adjust/replace them as needed.

NOTE: *Manufacturer's fluid recommendations should be checked prior to adding or changing automatic transmission lubricant.*

C. **Vehicle Condition Inspection.**

1. The Vehicle Condition Inspection will be performed by technicians using the incoming vehicle inspection form, to verify a vehicle's condition when accepting a vehicle or equipment into maintenance.

D. **Special Inspections.**

1. For reasons of safety and to ensure operational reliability, numerous special inspections and operational test requirements are imposed by the manufacturer's specifications. Every effort should be made to perform the inspections/tests concurrently with the PM&I. When not accomplished as a part of the regularly scheduled PM&I, these inspections/tests will be separately tracked and accomplished at intervals specified by the prescribing directive. Applicable directives must be consulted for detailed procedures when accomplishing these inspections. Each special inspection/test will be recorded by an electronically generated work order.

***NOTE**: Special Inspections may be completed up to 180 days before due to complete concurrently with scheduled PMI and/or other Special Inspections.*

2. **Wheel Bearings.** Clean, inspect (replace as required), and repack wheel bearings every 3 years, 36,000 miles, 57,900 km, or 2400 hours, or more frequently if operating conditions require. Trailers and semi-trailer wheel bearings will be repacked every three years.

***NOTE**: Wheel bearings lubricated by oil shall be cleaned and inspected (replaced as required) whenever the brake shoes are replaced, anytime wheel bearing serviceability is in question, or annually if regularly submerged in water (i.e., boat trailers).*

3. **Hydraulic Systems (Special Purpose Assemblies).** Change hydraulic filters and hydraulic fluid every three years or 3600 hours.

4. **Fifth Wheel Plate and Trailer King Pin.** The truck tractor's fifth wheel plate and semi-trailer kingpin will be thoroughly cleaned of all grease and foreign material and components carefully inspected to determine the condition. Worn or damaged components visually determined to be in doubtful condition will be cause for disassembly and repair or replacement. Standard fifth-wheel locking jaws will be adjusted to fit a 2.005-inch round rod stud. Locking jaws in the locked position that are worn 1/8 inch beyond all available adjustments will be replaced. Semi-trailer king pin worn 1/8 inch maximum when measured in front to rear direction will be replaced. Maximum combination wear of locking jaws in the locked position and kingpin will not exceed 1/4 inch. Upon completion of inspection/repair, lubricate the fifth wheel plate and trailer kingpin.

VI. MINIMUM SERVICEABILITY STANDARDS.

A. After any maintenance on PAG vehicles/equipment technicians will wash entire vehicle to assist with corrosion prevention to include the motor, transmission, and chassis. Vehicle operators will not wash the engine or transmission.

B. **These standards are intended as guidelines.** Always reference the manufacturer's technical manuals for specifics.

1. **Configuration Control.** Vehicle repairs to operating systems will maintain the manufacturer's original configuration; for example, levers that pull to raise the dump bed will not be changed to a push action. The operation of all controls shall be clearly labeled, configured, and operated in the same manner as intended by the original manufacturer's design and technical guidance.

2. **Component Serviceability.** In the following subparagraphs, and listed in alphabetical order, the vehicle components and the minimum serviceability standards are provided.

3. **Agitator.** (Bituminous Mixers and Asphalt Distributors) Components shall be correctly aligned, securely mounted, and shall have no leaks. The gearbox shall contain no excessive foreign matter and be free of cracks. The gearbox shall be serviced with proper lubrication and to proper level. There shall be proper clearance between the face of the tamper and the edge of the screen. Drive chains will exhibit proper tensions.

4. **Air and Hydraulic Motors.** Motors shall operate freely without excessive vibrations or without binding (correctly aligned). Fittings and connections shall be free of leaks.

5. **Air Cleaner and Pre-Cleaner.** Gaskets, seals, clamps, hoses, tubes, elements, baffles, and body shall be secure and shall not be damaged so as to prevent it from operating properly. Dry-type elements shall be clean. Wet type shall be clean and contain the proper amount and type of oil.

6. **Air Compressor.** The compressor shall be capable of delivering a maximum of compressed air to the system without unusual noise or leaks. Unloader valve cut-in and cut-out pressure shall be at the prescribed pressure setting of the governor.

7. **Air Hydraulic Cylinder.** The cylinder shall be capable of producing braking action comparable with variable pedal pressures applied. There shall be no leaks at gaskets, lines, or seals.

8. **Air Governor.** Air governor and lines shall be securely mounted with no leaks. Cut-in and cut-out pressure shall be within limits established by applicable publication/manufacturer's specifications.

9. **Air Tanks, Lines, and Valves.** Air reservoir tanks shall be securely mounted and free from dents or other external damage. Air dryers and/or moisture rejecters shall function properly. Air hoses, lines, and their connections shall be tight and free of leaks. Safety valves shall not leak after manual operation and air pressure returned within normal operating limits.

10. **Antifreeze Protection.** Antifreeze type and strength shall be sufficient to protect the lowest expected ambient temperature. An approved antifreeze coolant shall be used year-round to provide cooling system protection. The optimum coolant/water solution shall be

50/50 or the vehicle manufacturer's specifications. Use of OEM-recommended extended-life coolant is recommended throughout the vehicle's warranty period. After the warranty expires, revert to use of antifreeze meeting the commercial item description.

***NOTE**: Under no circumstances will water be added to the coolant system to "top off" the coolant level. Only the proper antifreeze type and solution shall be used to replace lost coolant.*

11. **Apron and Tail Gate.** The apron and tailgate shall close properly without binding. Guide rollers shall maintain proper apron or gate alignment. Tailgate hinges and latches shall function properly and hold the gate in proper alignment. The apron and tailgate shall have no cracked or bent members. Cables or chains and sheaves shall not be excessively worn.

12. **Automatic Fire Extinguisher System.** Fire extinguisher system tanks and valves shall be secure with no leaks. Tanks shall be fully charged. Lines and nozzles shall be secure. Nozzles shall be clean and properly aimed at points most likely to catch fire.

13. **Fire Extinguishers Brackets.** Brackets shall be of the proper type and size. Latches shall not be cracked or bent which prevent the fire extinguisher from being held securely. Brackets shall be securely mounted to the vehicle or equipment.

14. **Axle, Front.**
    a. Rigid Type Axle.
        i. Axle beam shall not be cracked or bent. Steering knuckle, tie rod, drag link bearings, or spindle bushing shall show no sign of excess play or movement. The camber and caster shall be following the manufacturer's specifications. Wheel bearings shall be properly adjusted.
    b. Live Axle.
        i. Axle housing or tube shall not be bent or cracked and shall be free of leaks. Outer machined surfaces of steering knuckle joints on axles that house constant velocity universal joints shall be free of rust or other damage. The steering knuckle boot or guard shall not be bent, torn, or otherwise defective. Steering knuckle bearings shall be properly adjusted.

15. **Axle, Intermediate.**
    a. Axle housings or tubes shall not be bent, cracked, or twisted. Spring seats and torque rod mounts shall be tight and shall be free from cracked welds. The axle shaft flange shall show no signs of lubricant leaks. Axle vent caps shall be free of mud and other foreign debris. The cap shall turn freely.

16. **Axle, Rear.** Same as Intermediate Axle.

17. **Axle, Steerable Rear.** Same as Front Axle Live.

18. **Battery/Battery Box/Battery Clamps.** The battery shall be of proper size, type, and capacity and without external cracks in the case or cover. Connectors or sealing compounds shall show no signs of leaking electrolytes. Dry-charged batteries (with the correct amount

of electrolyte in separate containers) will normally be used for overseas shipments. When exceptions are authorized to ship wet batteries, the electrolyte shall be at the proper level (3/8 inch over plates) and have a specific gravity reading of not less than 1.265 corrected to 26.6 degrees Celsius (°C) (80 degrees Fahrenheit (°F)). Terminals and terminal posts shall be firmly anchored, and clean, and shall show no corrosion or deterioration. The voltage reading of each cell shall be at least two volts. Nickel-iron-alkaline-type batteries shall be fully charged, and the electrolyte level and specific gravity reading shall be correct for the particular battery concerned. The battery box shall be clean and show no signs of corrosion. Battery clamps shall be clean with no cracks or corrosion evident and firmly anchored.

19. **Belts, "V" and Serpentine.** All belts shall be of proper groove width and length. They shall have no visible cracks or signs of fraying, shall not bottom in pulleys (except ribbed serpentine belts), and shall be properly adjusted for tension. Friction surfaces of the belt shall be capable of driving accessories without noticeable slippage. The belt tensioner shall be serviceable following applicable technical orders. *(See Manufacturer's recommendation on Serviceability of Ribbed Serpentine Belts.)*

20. **Bits, Augers, Drills, and Attachments.** All items shall be in generally good working condition and secured. Cutting edges shall be clean and free from nicks or burrs that would affect operation.

21. **Body and Cab.** Doors, hoods, ventilators, trunks, and other operating items shall function satisfactorily. Fenders, hoods, running boards, steps, and other sheet metal items shall not be damaged or broken. Vehicle bodies, fenders, trunks, and hoods with small dents and scratches shall be acceptable if there is no evidence of tearing or creased metal. Holes in sheet metal (other than drain or access holes) shall not be greater than 1/2 inch in diameter. All body and cab bolts will be intact and tight. Body or cargo stakes and cover bows shall be free of cracks and connecting devices shall work properly.

22. **Bogies Suspension (Trunnions/Torque Rods/Bushings).** Bogie's suspension components shall not be bent, cracked, or twisted. Trunnion rollers shall rotate smoothly, free of any binding. Rubber bushing bearings seals, and shafts shall not be excessively worn or show signs of deterioration/leaks. Torque rods shall be correctly assembled and securely mounted; metal bushings shall not be excessively worn.

23. **Boom (Crane and Wrecking Equipment), Mast Assembly, and Insulated Booms.** The boom assembly shall not be bent or deformed in such a manner as to impair strength or efficiency. All welds of major elements shall be sound. Telescopic (extension) mechanisms will operate smoothly without binding or drag. Manual cranks shall be present, serviceable, and securely mounted. Pulleys and sheaves shall have no excessive wear or broken flanges that might damage the cable. All mounts and hinge bushings shall show no evidence of excessive wear or deterioration. Insulated boom sections shall be free of all dirt, oil, grease, or other foreign matter. The dielectric (voltage breakdown) test must be current following the manufacturer's specifications.

24. **Brake System (Parking Hand).** The control handle or foot pedal shall have at least 1/3 of its full travel in reserve when fully applied and holding the vehicle. Control cables, rods, and linkage shall operate freely. Anchor adjustments on an external band type parking or hand brakes shall be properly adjusted and safety wired. Parking/hand brake will be checked following the manufacturer's specifications.

25. **Brake System (Service).** Service brakes will be capable of stopping the vehicle effectively. When applied, service brakes will indicate no appreciable side pull, unusual noises, or excessive pedal travel and will not indicate a lack of pull-back spring action. The brake pedal shall have 50 percent of the total brake pedal travel in reserve when brakes are fully applied with the vehicle stationary. Anti-lock brake systems shall operate following the manufacturer's specifications. The following shall apply:
    a. Brake pedal on air over hydraulic and vacuum assist brake systems shall have 50 percent of total brake pedal travel in reserve when brakes are fully applied with the vehicle stationary.
    b. Power assist service brake pedal travel shall follow the manufacturer's specifications.
    c. Hydraulic brake lines and fittings shall be free of leaks. Master and wheel cylinders and/or calipers shall function properly without leaks. Reconditioned cylinder bores shall not exceed 0.003-inch oversize. The master cylinder fluid level shall be within 1/2 inch of the top of the cylinder reservoir. Cylinder mounting bolts shall be secure.
    d. The air brake system with pressure above the governor cut-in point shall not bleed down more than 3 Pound-force per Square Inch (PSI) per minute with the service brakes in fully applied or fully released position.
    e. Air brake diaphragm pushrod travel shall be within limits established in the applicable equipment handbook. The diaphragm shall not leak through or around its outer edge. Should the diaphragm leak, the complete set must be replaced.
    f. Hydrovac brake booster shall display no visible interior/exterior leaks from the booster when operationally checked following the applicable equipment handbook.
    g. Hoses, hose coupling and/or gland gaskets will not leak or show evidence of deterioration. (Hoses may exhibit minor superficial weather cracks.)
    h. Riveted brake linings shall have not less than 1/32 inch of the lining material remaining above rivet heads at the thinnest point. Bonded lining and disc brake pads shall have not less than 1/32 inch of original material thickness remaining at the thinnest point.
    i. Brake drums and rotors shall be free of cracks, hub lubricant, and brake fluid. Disc brake rotors shall meet specifications for lateral runout, parallelism, and thickness following the applicable commercial manual.
    j. The brake combination valve and warning system shall be operational.
    k. Brake pedal pads shall be firmly secured and not be worn to where metal shows beneath the pads.

26. **Brakes (Steering).** (For friction-type steering brakes, as used on crawler-type tractors and similar equipment that operate independently or are connected with the operation of steering clutches). Riveted linings shall have no less than 50 percent of the material above

rivet heads remaining at the thinnest point. Bonded linings shall have no less than 50 percent of the original material thickness remaining at the thinnest point. Brakes shall operate effectively.

27. **Brush Guard and Grille.** Brush guards shall be securely installed and properly aligned. The original contours of metal members will be maintained. Welds shall not be cracked or have rusted areas. Grilles shall be securely mounted and properly aligned. Grilles shall not have large areas broken out or main structure members cracked or broken. Medallions and chrome strips, if applicable, shall be securely fastened.

28. **Bumpers and Push Plate.** Bumpers and push plates shall have the original contour of metal and shall not be cracked or have rusted areas. All welds and mounting bolts shall be secured. Rubber pads shall be secured and not show signs of excessive deterioration.

29. **Cables.** Boom/hoist and winch cables shall be of properly rated capacity as prescribed by the manufacturer. The cable will be free of kinks, excessive wear, flat spots, frayed or broken strands, and properly lubricated. All mounts and U-bolt clips will be properly torqued.

30. **Carburetor, Fuel Injector/Governor, and Injector Pump.**
    a. **Carburetor.** Carburetors shall be securely mounted with all attachments installed. Carburetor circuits shall operate properly. Fuel mixture screw caps (Environmental Protection Agency (EPA) limit stops) shall not be removed and shall have full control of air/fuel mixture from rich to lean at idle. Gaskets and diaphragms shall be in good condition and not leak.
    b. **Fuel Injector.** Fuel injectors shall be securely mounted and shall show no signs of leaking. Fuel injection pumps and fuel injectors shall operate following applicable technical manuals.
    c. **Governors.** Governor shall control engine within 5 percent of maximum rated Revolutions Per Minute (RPMs), but shall not exceed maximum rated RPMs. Governor shall have no surge at maximum RPMs.

31. **Carriage Lift Forks and Mast Assembly.** Cargo rest shall be securely installed and properly aligned. Welds shall not be cracked. The horizontal position of both forks shall be the same plane and be free of cracks. Fork locks shall be in place and function properly. The mast assembly shall be free of cracks and will be properly aligned. Chain sprockets and rollers shall be free from binding and cracks. Load chains shall be properly adjusted and securely anchored. All bolts and locking pins shall not show signs of wear and shall be secured. The backrest will be secure.

32. **Centrepin or Gideon (Revolving Shovel Crane, Manlift, or Work Platform Type Assets).** All components will be securely mounted, and properly adjusted, and will indicate no excessive wear. The lock will operate effectively (all adjustments shall follow the applicable equipment manual). Centrepin flange mounting bolts or cap screws shall be secure.

33. **Chains.** Chains shall not be excessively worn, pitted, or have broken rollers. Half/master links shall be of proper size and the locking device shall be secure. Tension adjustment shall follow the applicable technical manual.

34. **Clutch.** The clutch disc shall not bind or drag when disengaged and shall engage without grabbing or chattering. The clutch adjusting device shall have at least 50 percent of the adjustment range left. Clutch pedal free travel/floorboard clearance shall follow the applicable technical manual. The clutch release bearing shall be properly lubricated and operate without unusual noise. The hydraulic clutch master and slave cylinder shall be free of all leaks. Clutch adjustments and operational characteristics will follow the manufacturer's specifications.

35. **Coil and Suppressors.** Coil, wiring, and shielding shall be in good condition, secure, clean, and connections tight. The coil shall be capable of producing the minimum voltage required by the manufacturer's specifications. Suppressors shall be in good condition and effectively eliminate interference.

36. **Commutator and Slip Rings.** Armature bearings and lubricant seals shall indicate no wear or leaks. Armature and circulating air passages shall be free of excess dust, oil, and grease. Slip rings or commutator and brushes shall be in good condition and properly fitted, and brush holders secure.

37. **Controller, Contactor, and Accelerator Resistor.** The controller shall be free of all dust and grit and shall operate freely. There shall be no broken springs and shunts. All connections shall be clean and tight. Contacts shall be clean and not excessively worn or rough. Contacts shall have at least 1/2 of their usable thickness intact. The contactor shall be free of all dust and grit. Contacts shall have no burned or scorched tips and will have at least 1/2 of their usable thickness intact. Cable and shunt connections shall be clean and tight. The accelerating resistor shall be free of all dust and grit, and connections shall be tight. The resistor ribbon and porcelain insulator surface shall have no defects.

38. **Cooling System.** The cooling system shall be free of leaks and capable of maintaining a proper temperature range during normal engine operation. Pressurized cooling systems shall be capable of withstanding and holding recommended test pressures. Cooling systems shall be serviced with an approved antifreeze/coolant solution at the 50/50 ratio or as specified by the vehicle manufacturers. The radiator shall be clean and properly mounted. Radiator caps shall be of the prescribed pressure recommended by the manufacturer. Hoses shall be of proper size and shall show no signs of deterioration. The water pump, shaft, and bearings shall not be excessively worn and shall operate without unusual noise.

39. **Conveyors (Applicable to Loaders, Graders, Ditchers, Etc.).** All components shall be securely mounted and in good operating condition. Conveyor belts shall ride correctly and rollers shall turn freely. All belt splices shall be in good condition. Belt tension adjustment shall follow the manufacturer's specifications. Frame and roller bolts shall be secured and free of cracks.

40. **Cutting Edges (Scrapers, Runners, Shoes, and End Bits Applicable to Dozers, Graders, Rooters, Drag Lines, Etc.).** There shall be no excessively worn, loose, cracked, or broken parts. There shall be no missing or broken parts. Wear shall not exceed 50 percent.

41. **Cylinders (Hydraulic).** Cylinder packing glands or seals shall show no evidence of oil leaks. The piston rod/ram shall be free of nicks, burrs, or scratches that may cause damage to the packing gland or oil seals.

42. **Cylinder Head and Engine Block.** The cylinder head and block shall be free of cracks or indications of oil, water, or compression leaks around studs, bolts, and/or gaskets. Core plugs shall have no leaks or signs of deterioration.

43. **Differential/Final Drive.** Differential carriers shall be free of cracks or leaks around the mounting gasket and pinion seal. Carriers shall have no mounting studs, nuts, or bolts missing. Ring and pinion gear adjustment shall follow the manufacturer's specifications. Carrier bearings shall be properly lubricated and adjusted and operate free of unusual noise/lubricant leakage.

44. **Dipper, Clamshell, Drag Line, Back Hoe, and Hook Block.** There shall be no excessive wear, missing teeth, cracks, loose or missing bolts or rivets. Sheaves shall have no excessive wear, broken flanges worn bushings, pins, or pin retainers. The shovel, dipper, and dragline bucket shall be properly adjusted to ensure satisfactory operation.

45. **Distributor and Ignition Systems.** Caps and rotors shall not be cracked, corroded, or damaged. Breaker points shall not have burned, pitted, or misaligned contact surfaces. Point opening shall be adjusted following the manufacturer's specifications. The pick-up coil, magnetized field core, and module in High Energy Ignition (HEI) distributors shall be free of dust and dirt. Advance timing device shall work properly with no worn or broken parts evident. Due to numerous and varied ignition systems, operating consult manufacturer's specifications.

46. **Drawbar/Tow Bar.** Draw or tow bars shall not be bent in such a manner as to impair the strength of efficiency. All welds shall be sound and not cracked. All safety chains shall be of proper length and size *(See Pintle Hook/Lock Pin, page 18).*

47. **Drive/Propeller Shafts and U-Joints.** The following shall apply:
    a. Drive shafts shall be straight and balanced. All welds shall be sound and without cracks. Drive shaft splines shall not be worn more than 15 percent of the original spline's width.
    b. Universal joint trunnion bearings shall indicate no excessive rotary lost motion. U-joint bearings shall be properly lubricated.
    c. Pillow block and/or center/support bearing shall not allow any radial motion and be properly lubricated.
    d. Propeller shaft end yokes will be in the plane when the propeller shaft is assembled, with splined yoke alignment markings matched.

48. **Drums, Elevators, and Discharge Chutes.** Drums, elevators, and discharge chutes shall be properly mounted with no indication of excessive wear and shall function following the applicable equipment manual.

49. **Eccentric Shaft or Sleeve.** Eccentric shafts used on jaw crushers and sleeve type eccentric used on rotary crushers shall have no excessive wear and shall be properly aligned and lubricated.

50. **Electric Motors.** The commutator surface shall have a smooth polish and shall be free of copper beads and grease. The Interior of the motor shall have no charred or broken insulation or other damage. Connections shall be clean, tight, and painted with the proper grade of armature varnish. Bearings shall show no evidence of excessive wear or end play. Brushes shall move freely in the holders and shall be free of dirt and other foreign matter. The brush pressure arms shall be free from bending in the bodies and shall have approximately the same pressure on each brush. Brushes shall have at least 1/2 of their usable length intact. Motors shall be capable of performing their specific operation without excessive noise, arcing, or overheating.

51. **Engine, Air/Liquid Cooled.** The engine shall be free of oil leaks, securely mounted and all accessories, shrouds, and attachments shall be properly installed. Engine cylinder compression shall be within the manufacturer's specifications or allowed standards, Compression. Governor shall maintain steady operation within 25 RPM of maximum rating at full throttle operation.

52. **Exhaust System.** Exhaust pipes, catalytic converters, mufflers, flame arresters, and rain caps shall not be excessively rusted to result in early failure and shall be free of obvious leaks. Exhaust system hangers and clamps shall not be broken and shall be securely mounted. Muffler condensation drain holes shall be in the proper position to prevent early failure. Heat shields and shrouds used in conjunction with catalytic converters shall be properly installed. Catalytic converters will meet federal emission requirements. All straight-up exhaust stacks shall have a rain cap installed.

53. **Fairleads (Cranes).** Bushings, sheaves, pins, and mountings shall have no excessive wear.

54. **Fifth Wheel.** The fifth wheel and rocker pins shall be properly lubricated and not show signs of excessive wear. Locking jaws in the locked position shall not have more than 1/8-inch wear. Locking components shall operate properly and be free of excessive wear *(See King Pin and Fifth Wheel Plate, page 6).*

55. **Floodlight and Spotlights.** Flood and/or spotlights shall operate properly and be securely mounted. Directing components shall be securely mounted and operate properly. Lenses shall be properly installed and shall not be chipped or cracked to the point which allows dirt or water to enter.

56. **Floors.** The floor deck/platform shall be firm and shall not be deteriorated to the point that it will not hold/sustain a load satisfactorily. Wood platform/planking shall not be dry rotted or cracked to the point it will impair its strength. Metal decks shall not be loose or have rust holes in them. All welds and attached hardware shall not be cracked or broken. There shall be no loose, missing, or broken bolts, nuts, or washers.

57. **Frame.** The frame shall not be bent, cracked, or twisted. Cross members shall not be loose at the point of attachment to side rails. Frames that have been repaired by welding will not be considered serviceable if welds are cracked or a good fusion of metals has not been obtained. Welded areas that extend 1/3 or more across a frame section will be reinforced with channel or angle iron over the welded area. There shall be no missing or broken bolts or rivets.

58. **Fuel Pump/Fuel Filter.** The pump shall be free of oil and fuel leaks. The pump filter or sediment bowl shall be free of dirt or water. The pump shall be capable of providing prescribed pressure and quantity following the manufacturer's specifications.

59. **Fuel Tank and Lines.** The fuel tank shall be securely mounted to prevent shifting or movement during operation of vehicle. Tank seams, filler neck, and connections shall be properly aligned, with no leaks or cracks. Lines shall be secure and anchored in a manner to prevent failure due to vibration.

60. **Gauges and Sending Units.** All instruments and/or gauges shall operate properly and be securely mounted. Pressure-sending units shall be free of leaks. Dials and lenses shall be clear and free of cracks. Indicator needles and numerals shall be legible *(See Meters, page 18).*

61. **Gantry, A-Frame, and Revolving Base.** The gantry, A-frame, and revolving base shall be properly aligned and shall have no breaks, cracks, or excessive wear of pinholes and brackets. All bolts shall be in place and tight.

62. **Generators/Alternators/Auxiliary Chargers, Etc.** Generators, alternators, and charging devices shall operate without undue heating and will indicate proper charging during operation. Commutators will not be burned or scored to the extent that early failures will occur. Brushes shall have at least one-half usable length intact and be free from binding. Brush holders and brush springs shall provide proper pressure for contact with commutator or slip rings. The generator/alternator shall show no evidence of rough bearings or bearing play. Mountings shall be secure and free from oil and foreign material.

63. **Grapnels and Hooks.** Grapnels and hooks shall be clean and free of cracks and broken welds.

64. **Hammers, Jaw Linings, Plates, and Rolls.** These items shall not be excessively worn where damage to the mounting base may occur. On gyratory-type crushers, mantle and concaves shall show no signs of looseness or excessive wear.

65. **Heaters/Defrosters.** Heaters shall be securely mounted and operated properly. Heater blower motors shall operate at proper speed and shall be free of unusual noise. The heater core and hose connections shall be free of leaks. Heater hoses shall not be cracked, brittle, or mushy. Gasoline-burning heaters shall ignite and operate within time limits specified by the manufacturer. Heater control systems shall operate and maintain all operating circuits following the manufacturer's specifications. Defroster hoses shall not be torn and shall be connected properly. Heater/defroster control cables and linkage shall be securely mounted and operated without binding.

66. **Heater Exchanger and Evaporator.** Heat exchanger bonnets and core assembly shall have no leakage nor damaged or defective parts. The evaporator shall have no leaks, rust, or corrosion.

67. **Heater Flues and Stacks (Distributors).** Burners shall not be operated if a trace of asphalt is leaking into the flues. Failure to comply could result in damage to, or destruction of, equipment or loss of mission effectiveness. Heater flues and stacks shall have no leaks or broken connectors or straps.

68. **Heater Tubes and Flues (Oil Servicing Units).** Heater tubes and flues shall be securely mounted and shall not leak.

69. **Hinges and Latches.** Alignment of hinges and latches shall allow opening, closing, and removal of panels without difficulty. Hinges and latches shall be properly lubricated and securely mounted. Hinges for personnel doors shall be properly aligned to not allow door to drop or hang up when door is opened.

70. **Hoisting Control Units.** Levers, pedals, and control cables shall show no evidence of excessive wear, lost motion, or rust. Sheaves bearings shall not have excessive wear and be properly adjusted. Brakes shall be capable of holding a capacity load, and bands shall have 50 percent original lining thickness remaining. Operating clutches shall not slip or drag under load and bands shall have 50 percent of their original lining thickness remaining.

71. **Hoisting and Topping Winch Controls.** Controls shall operate smoothly without unusual noise. Drum clutches shall have no drag, but at the same time, they shall have ample movement for operation and proper travel on the screw for shifting the drum to the clutch. Lever and linkage shall have no excessive lost motion.

72. **Horn.** Horn shall be securely mounted and shall produce a loud clear signal when actuated by the horn button. The horn button shall be securely mounted within easy reach of vehicle operator and be protected from water and dirt. Relays shall be securely mounted and operated properly.

73. **Hoses, Nozzles, and Pumps.** Hoses shall show no evidence of deterioration other than small weather cracks that will not impair serviceability and shall be free of leaks. Nozzles shall operate properly and shall show no evidence of leakage. Pumps shall be free of leaks and shall operate properly at the required pressure as indicated in applicable technical publications.

74. **Hydraulic System.** Hydraulic pumps and relief valves shall maintain operating pressure as prescribed by the manufacturer. Pumps shall operate smoothly without unusual noise. Reservoirs shall be in good condition and securely mounted. Reservoirs shall be serviced with proper lubricant and be free of water. Lines, hoses, and their connections shall be tight and free of leaks.

75. **Ignition Wire (Secondary).** Secondary wires shall be clean and free of weather cracks, chaffing, and burn spots. Secondary wires shall be of proper type and length. Spark plug and distributor cap terminal boots shall be clean and form a tight seal. Sealed/waterproofed type secondary wires shall be clean and the connecting end shall be secured properly.

76. **Inter-Cooler and After-Cooler.** Inter-cooler and after-cooler shall be securely mounted and connections shall not leak. Air passages shall be clean and not damaged. The relief valve assembly shall function properly.

77. **Interior Trim.** Panels headliner and floor coverings shall be clean, complete, properly mounted/anchored, and free of major tears. Molding and metal/plastic trim shall not be rusted, cracked excessively, or broken, nor have missing screws/ mounting clips.

78. **King Pin and Fifth Wheel Plate.** Semi-trailer kingpin and fifth wheel plate shall be properly lubricated and shall not have more than 1/8-inch wear in front and rear direction. The fifth wheel plate's welds shall be sound and not cracked.

79. **Landing Gear.** Landing gear shall operate smoothly without binding or dragging and be securely mounted. Cranks shall be present, serviceable, and securely mounted. Mounting flanges/frames shall have no cracks, loose bolts, or loose rivets. Landing pads/wheels shall not be bent, cracked, or broken.

80. **Lights.**
    a. **Clearance and Marker.** Lights shall be securely mounted and operated properly. Light output shall be sufficient to be visible in normal shaded daylight. Lens shall not be cracked or broken (to allow water to enter housing) or be discolored.
    b. **Headlights and Parking/Directional.** Headlights shall be securely mounted and properly adjusted. Sealed beam units shall be securely installed to reflect the correct beam pattern on the road surface. Lens shall not be cracked, broken, or discolored.
    c. **Tail, Brake/Directional, and Backup.** Tail lights, brake/directional, and backup lights shall be securely mounted and operated properly. Light output shall be sufficient to be visible in normal shaded daylight. Lens shall not be cracked or broken (to allow water to enter housing) or discolored.

81. **Manhole Vents.** Manhole filler cover, hinges, and front and rear air vent valves shall be clean and function properly. Gaskets shall be in good condition and proper placement.

82. **Manifolds (Intake and Exhaust).** Manifolds shall be free of cracks and securely mounted. Manifolds and gaskets shall be free of leaks. There shall be no missing mounting studs, nuts, or bolts. Heat riser and choke valves shall operate freely.

83. **Meters.** Meters shall operate properly and shall be calibrated in accordance with manufacturer's recommendation.

84. **Mirrors.** Mirror heads shall be clear (not discolored) and free cracks and chips. Mounting brackets shall be free of bent or deformed members in such a manner as to impair strength. Mounting bolts shall be properly secured. Adjustment controls will operate properly.

85. **Moldboard.** Moldboard, circle pins, pivots, balls, and sockets shall have no excessive wear and shall be properly lubricated. Mounting bolts, pin keepers, and adjustment shims shall be properly mounted.

86. **Mowers, Sickle, Guards, and Pitman.** The Pitman arm and shaft shall be properly aligned. There shall be no excessive wear in attaching or reciprocating parts.

87. **Oil Filter and Coolers.** Oil filters, coolers, or external oil lines shall have no internal or external leaks.

88. **Oil Pans and Covers.** Engine oil pan and valve covers shall not be damaged to the point that would impair the proper seal of the gaskets. Pan and covers shall be securely tightened and be free of leaks.

89. **Oil Pumps and Relief Valves.** The oil pump and relief valves, with the engine at operating temperature, shall be free of leaks and shall be able to produce and maintain the required pressure as prescribed by the manufacturer.

NOTE: Condition of engine shall be considered when observing oil pump pressure indications.

90. **Pintle Hook and Trailer Type Connection.** Pintle hooks shall be securely mounted with properly hardened bolts and lubricated properly. No excessive wear shall be found in the jaw pins and the locking device. Safety lock pins shall be of proper size in length and be attached with a chain following the manufacturer's recommendation. Other types connections shall be properly mounted and free of cracked welds or excessive wear.

91. **Power Controls and Winches.** Power control units and/or winches shall be securely mounted and properly aligned. Housing, drums, seals, and gaskets shall be free of leaks and cracks. Drum bushings/bearings shall not be excessively worn. Clutch and/or brake bands shall be properly adjusted and not be excessively worn. Cables shall be properly reeled on drums and be lubricated. Sheaves shall not be broken or worn to the point where cable damage might result.

92. **Rectifier.** The rectifier shall show no evidence of damage due to heat, broken terminals, bent blades/plates, or excessive dust accumulation. Blowers shall operate properly. Fan blades shall have no bent blades. The transformer shall have no heat damage.

93. **Refrigeration and Air Conditioners.** Compressors shall operate properly without unusual noise. The condenser, evaporator, and hoses/lines fittings shall be clean and free of leaks. The thermostat control units shall operate properly.

94. **Rotors and Paddles.** Rotors and paddles shall be securely mounted and properly aligned.

95. **Scarifier.** The scarifier shall be securely mounted. Teeth shall not be excessively worn. The lift mechanism shall be properly aligned and operate without binding.

96. **Seats.** Seats shall be securely mounted. Seats should not have loose springs or missing padding. Adjusting devices shall operate properly. Seat covers shall not be torn, frayed, nor be taped as a repair.

97. **Seat Belts/Restraint Devices.** All devices shall be securely mounted and retractors and centrifugal clutches shall operate freely. The webbing will not be cut, melted, or frayed. Buckles will open freely. Belt buckles shall latch and release properly without binding. Number and type seat belt installed shall be in accordance with manufacturer's recommendation.

98. **Segregators.** Segregators shall meet the manufacturer's recommendation.

99. **Shock Absorbers.** Shock absorbers shall not have leaks or excessively worn bushings and be securely mounted. Shock absorbers shall be recommended type and size according to the vehicle manufacturer and shall effectively control rebound.

100. **Sling Mechanism and Controls.** The mechanism shall operate freely and shall be free of excessive loose motion. Positive limit stops on both sides shall be in place and securely attached.

101. **Solid Tires.** Solid tires shall be of the size and type specified for the vehicle. Tires shall exceed the minimum serviceable standards established in *VII. TIRES, page 23.*

102. **Spark Plugs.** Spark plugs shall be of the proper type and heat range recommended by the manufacturer. Insulators shall be clean and free of cracks. Spark plugs shall be gapped and torqued following the manufacturer's specifications.

103. **Speedometer, Tachometer, or Hour Meter.** Speedometer, tachometer, or hour meter shall be mounted securely and operate without any apparent defects such as noise or fluctuations of indicating hands or pointers. The lens shall not be cracked or clouded to the extent that the visibility of the instrument dial or point is restricted. Dial and odometer numerals shall be legible. Hour meters shall not continue to operate more than 3 minutes after the engine has been stopped.

104. **Spray Bars, Piping, and Connections.** Spray bars shall have no leaks or structural damage. Joints and couplings shall operate properly with nozzles in place. Spray bar support rods shall be properly adjusted.

105. **Springs.** Springs shall not have cracked or broken leaves. Springs shall be correctly assembled with rebound clips and the center bolt properly torqued. Spring leaves shall not indicate excessive deflection or reverse curvature. (Reverse curvature acceptable on 4 x 4 models with front axle leaf springs.) Both springs shall have approximately the same deflection with vehicles parked on level surfaces. Spring shackle bolts and bushing shall not be excessively worn. Spring U-bolts shall be of proper size and length and be torqued following manufacturer's specifications.

106. **Starter/Solenoid.** Starter/solenoids shall engage and operate the starter properly. The solenoid shall be clean and securely mounted. Wire connections shall be clean and tight. Starter brushes shall have 1/2 length remaining and brush holders/springs free to maintain sufficient brush pressure.

107. **Static Ground.** Static ground cables shall be replaced if more than one-third of the cable strands are broken or if electrical continuity is suspected. Clips will be serviceable and securely attached. Reels shall be mounted securely and should rewind without binding.

108. **Steering Gear and Components.** The steering gear shall afford positive control of the vehicle and shall not indicate undue wear, incorrect adjustment, worn bearings, or loose connections. The steering gear box and mast jacket shall be securely mounted and in proper alignment. Steering gear shall be properly lubricated and be free of leaks. Steering linkage shall be properly lubricated and be adjusted in accordance with the manufacturer's specifications. Linkage connection shall be securely fastened and locking devices shall not be missing or broken. The worm shaft shall not have appreciable end play or radial movement at the mast jacket bushing/bearing. The steering wheel shall not be broken or cracked to the point it will impair its strength or reliability. The steering wheel shall be properly centered.

109. **Switches.** Switches shall operate properly in all positions and shall not indicate overheating when used for extended periods. A suitable control knob or lever shall be properly installed.

110. **Tanks.** Tanks shall be clean and free of leaks. Tank baffles and fittings shall be securely mounted and free of cracked welds.

111. **Tires.** Tires shall be of the size and type specified by the vehicle manufacturer. Tires of different construction designs (belted bias, radial, and bias) shall not be intermixed on the same vehicle. Tires on the same axle shall be matched in construction and tire size designation. They shall be free of cuts, fabric breaks, or other damage that would cause early failure. Retreaded tires will not be used on ambulances, law enforcement sedans, the front wheels of buses, or for any other reasons cited in *VII. TIRES, page 23.*

112. **Thermostat and Shutters.** Thermostats shall operate properly and shall be of the correct temperature range prescribed by manufacturer. The shutter control mechanism shall operate freely without binding and shall not have excessively worn components. Shutter control devices shall be clean and free of leaks. Shutter vents shall not be bent, broken, or missing.

113. **Tilt and Lift Control Mechanism.** Lever and/or control mechanism shall operate freely without binding or dragging and shall not have excessively worn components.

114. **Transmissions, Transfers Cases, and Power Takeoffs.**
    a. **Transmissions.** Conventional transmissions shall shift into the selected gear smoothly and without unusual noise. Synchro-clutches and shaft bearings shall not be excessively worn and shall operate properly without unusual noise. Automatic transmissions shall shift into proper gear at a specified speed without hesitation or clutch slippage. The transmission case, pan, and attached covers shall be securely mounted and be free of leaks. Transmissions shall be serviced with the proper lubricants at prescribed levels. Operational linkage shall be properly adjusted and operate without binding.
    b. **Transfer Case.** The transfer case shall shift into the selected gear range smoothly and without unusual noise. Sprague units and shift bearings shall not be excessively worn and shall be properly adjusted. Transfer case and attached covers shall be securely mounted and free of leaks. Transfer cases shall be serviced with the proper lubricant at prescribed levels. Shift linkage shall be properly adjusted and not be excessively worn.
    c. **Power Takeoffs.** Power takeoff units shall be properly secured and free of leaks. Controls shall be properly adjusted and not be excessively worn.

115. **Valves and Piston Rings.** Valves and lifters shall not have excessive lash or clearance. Valve stems and guides shall not be worn to the point that excessive oil consumption or plug fouling is present. Valve faces and valve seats shall be in good condition to prevent undue loss of compression. Piston rings shall not be excessively worn as to cause excessive oil consumption or plug fouling.

116. **Voltage Regulator.** The voltage regulator shall operate properly at a controlled rate of voltage output. Voltage regulators shall be securely mounted and their connections shall be clean.

117. **Warning Devices (Backup).** Warning devices shall be securely mounted and shall emit a loud, clear warning (signal) when actuated by placing the transmission in reverse. Wiring connections shall be clean and tight. Relays shall be securely mounted and operated properly. Wire installation shall not be chaffed or worn through.

118. **Water/Foam Tank.** Water and foam tanks shall be in serviceable condition and securely mounted. Tank filler cover or manhole, gasket, and fastening device shall be serviceable. Tank valves and piping shall be securely mounted and shall have no leaks.

119. **Wheels, Sprockets, and Tracks.**
    a. **Wheels.** Wheels shall be of proper size and type following vehicle manufacturer. Wheels shall not be cracked or damaged to impair the sealing of the tire to the rim. Lock rings or wheel grooves shall not be bent, rusted, or pitted to the extent proper fit is impaired. Wheel lug bolt holes shall not show evidence exceeding 1/8 inch out-of-roundness condition. Lug bolts/nuts shall all be present and have proper torque.
    b. **Drive Sprockets.** The drive sprocket shall not be worn more than 1/16 inch on the driving face. The throat or track guiding surfaces of sprocket flanges shall not be worn more than 1/8 inch deep at any point. Idler flanges shall not be worn more than 3/16 inches deep at any point on track guiding surfaces. Bogie top rollers shall rotate freely and will be free of flat spots on the cylindrical surfaces. Idler shackles shall swing freely on the idler post.
    c. **Tracks.** Rubber or steel tracks shall have at least 1/2 of their original usable tread thickness intact and shall be free of cuts, grooves, cracks, or other damage likely to cause early failure. The usable thickness of these treads is approximately 1/4 inch. The track blocks shall not vary more than 1/8 inch in thickness. If installed, "Road Pads" will have a minimum of 50 percent of pad life remaining.

120. **Windshield and Windows.** Windshields and windows shall not be clouded or have foggy areas extending more than 2 inches from the edge of the glass. The glasses shall not have cracks with a radius of 25 percent of the length or width of glass or following local laws/manufacturer's manuals guidelines whichever are more stringent. Cracks extending to the opposite edge or through both laminations shall be rejected. Star, bull's-eye, or combination cracks successfully repaired following approved maintenance practices shall be considered serviceable. Plexiglas shall not be used for windshields. Plexiglas installed on doors shall not have major scratches and/or abrasions. Plexiglas, which exhibits minor discoloring or abrasions that affect operator's vision, which cannot be removed by polishing, shall be replaced.

121. **Wiper Motor, Blades, and Washers.** All components shall be securely mounted and shall operate properly. Wiper blade edges will be pliable and will maintain full contact with glass. Wiper arms will have adequate tension to ensure effective wiper action. Arm or blades will not strike frames or division bars when operated. Hoses shall show no evidence of leaks or signs of deterioration. The washer spray pattern and quantity shall be sufficient to cover a wiped area of the window.

122. **Wiring and Connections.** All wiring shall be of proper gauge and be securely attached/mounted to prevent damage. All connections shall be clean and secured. Wiring insulation will be free of significant weather checks and shall not be frayed/chaffed to expose the internal conductor. Wiring harnesses shall be secured in such a manner that they will not interfere with other components or be subject to potential damages.

123. **Qualified vs. Certified Welder.** A qualified welder is a task-qualified welder. A certified welder is a person who has completed a welder's training course and possesses one or more of the following:

a. Certification from American Welding Society.
b. Certification from a third party that welds samples have been destructively inspected and found acceptable.

VII. TIRES.

A. **Safety Summary.** The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operations and maintenance. Personnel must at all times observe all safety regulations. Some equipment and chemicals have inherent hazards that cannot be mechanically, safeguarded. Personnel must perform these functions with caution.

B. **Safety Precautions.**

1. **Resuscitation.** Personnel working with or near highly toxic chemicals should be familiar with modern methods of resuscitation. Such information may be obtained from base medical services.

2. **Warnings.** The following warnings appear in the text of this policy and are repeated here for emphasis.

3. **Buffing Operations.** Buffing solvent is flammable and toxic to the skin, eyes, and respiratory tract. Eye and skin protection is required. Avoid prolonged or repeated contact. Good general ventilation is normally adequate. Watch out for ignition sources.

4. **Compressed Air.** Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 Pound-force per Square Inch (PSI). Eye protection is required.

5. **Vulcanizing Cement.** Vulcanizing cement can be flammable and toxic to the skin, eyes, and respiratory tract. Eye and skin protection is required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate. Watch out for ignition sources.

NOTE: Not all Vulcanizing cement is flammable.

6. **Sharp or Pointed Tools.** To prevent injury to personnel, exercise caution when using sharp or pointed tools.

7. **Tire Mounting.** To prevent injury to personnel or damage to equipment, observe the following mounting precautions.

8. **Injury Prevention.**
   a. Rims can be hard to remove, especially on larger vehicles when they are not removed for years. The rims can rust and stick to hubs and lug nuts. Use extreme caution when removing these rims. The use of proper tire removal tools and equipment can prevent injury. Use of non-seize on the back of rims where they mate with the drum/hub may prevent future seizing of the rim. Do not use non-

seize on lug nuts, or wheel studs. Failure to comply could result in injury to, or death of, personnel or long-term health hazards.

b. To prevent injury to personnel or damage to equipment, always lubricate beads and never exceed 40 pounds of air pressure until the bead is seated.

c. Air Pressure (Tire). Do not dislodge tire beads, lock rings, or split flange rings until certain that no air pressure remains in the tire. Failure to comply could result in injury to, or death of, personnel or long-term health hazards

C. **General.**

1. Motor vehicles depend on pneumatic, semi-pneumatic, or solid rubber tires for mobility. Tire technology is expanding rapidly and has reached a point where much more than a cursory glance and candid opinions are necessary to devise a satisfactory tire management program. The constantly changing tire manufacturing processes and their products dictate an up-to-date reference source for tire management.

2. This chapter provides information and direction for the selection, inspection, service, and control of motor vehicles tires. This chapter reflects policies and guidelines consistent with the Environmental Protection Agency (EPA) and Occupational Safety and Health Administration.

3. **Scope.** This chapter applies to all Port Authority Maintenance activities involved in tire maintenance.

4. **Selection of Tires.** Leadership is tasked with the job of obtaining correct replacement tires for their vehicle fleet. Replacement tires must be selected to match the use application of each vehicle. Replacement tire selection must be based on the user's mission (application) and the original equipment manufacturer's (OEM) operations manual. This section is intended to provide necessary basic information on tire construction and industry ratings so that logical tire selections can be made. Under no circumstances will replacement tire(s) be of a lesser ply rating/load range than recommended by the manufacturer. Under no circumstances will working air pressure exceed the capacity of the rim. Rims requiring replacement will meet or exceed OEM specifications for the vehicle. When replacing tires with a higher load range (due to local availability), do not exceed rim capacities. OEM vehicle load capacities and gross vehicle weight will not change.

5. **Tire Construction Material.** The term "tire" means a manufactured product made of rubber, chemicals, fabric, steel, or other materials, which when mounted on a suitable wheel, provides traction and/or sustains the load. The most important tire materials are those used for cord body. These materials determine the strength and maintain the inflated configuration of the tire.

   a. **Rayon Fiber.** Rayon fiber is used because of its low cost, resilience, and the fact that it provides a soft ride. However, it is not as strong as most of the other materials and loses strength when subjected to heat. Rayon will absorb moisture, but it does not have flat spot tendencies.

   b. **Polyester Fiber.** Polyester fiber is a synthetic fiber, stronger than rayon, but equally resilient. It is more heat resistant and less expensive than rayon

c. **Nylon Fiber.** Nylon fiber is a synthetic fiber that is probably the widest used of all cord fibers. It has high heat resistance, excellent impact resistance, minimum flex, and will not absorb water. It gives a harsher ride and will tend toward flat spotting.
d. **Fiberglass.** Fiberglass is the newer tire cord body materials and is used only as a belt or buffer material. It provides excellent cord strength, resists flexing, and provides a cooler running tire, and one that provides long wear.
e. **Steel.** Steel wire is being used as a radial cord, as a belt cord, and as an armor material. Steel shavings are embedded in the underbody as a buffer material. The steel wire cord is used in radial tires, both truck and passenger. Steel wire makes a very strong belt. It provides excellent traction and gives maximum wear for a given thickness of tread.

D. **Load Range.** Load range defines the type of service as well as the load carrying capacity based on the category of tire. Under no circumstances will replacement tire(s) be of lesser ply rating/load range than recommended by the manufacturer in the OEM Operators/User's Manual. In the event OEM deviates from this guidance (through service bulletins, recalls, etc.), Refer to *Figure 4-1, page 44* for a load range ply rating conversion.

E. **Tire Construction.**
1. **Conventional Bias Ply.** *(Figure 4-2, page 45).* The bias tire is the conventional tire that has been in use since the 1920s. The cords in the plies, or layers, which make up the body of the bias tire crisscross at an angle called the bias angle, usually about 30 - 40 degrees to the center line. Cords may be arranged in two or more (even number) plies, depending in general on the strength desired in the finished tire. This design provides rigidity in both side walls and tread, but bias tires squirm more and tend to run hotter than belted bias or radial.

2. **Bias Belted.** *(Figure 4-2, page 45).* In a belted tire the cords in the body are also arranged in a crisscross pattern; but, in addition, it has two or more layers of fabric or belt under the tread. The cords in the belt also run at an angle, of about 25 degrees to the center line. This construction provides a side wall stiffness similar to the bias tire, with increased strength and stiffness in the tread. Body cords are made of rayon, nylon, or polyester; belt cords are made of fiberglass, rayon, or steel. The belted bias tire squirms less than the bias tire, runs cooler, and gives more mileage.

3. **Radial.** *(Figure 4-2, page 45).* The radial tire carries a letter-number which has an "R" in it, such as P205/75R14. The cords in the body run at right angles to the center line and may be arranged in one to three plies. Over this radial section is added a belt made of up to four plies, whose cords run at an angle of about 15 degrees to the center line. The result is a tire with flexible side walls that, even when fully inflated looks as though it needs air, has great stiffness and strength in the tread area. In some radials, the belts are made of steel; in others, fiberglass or rayon. The radial tire, like the belted bias, has minimum squirm, runs cool, and provides long wear.

4. **Special Use Tires.** There are many other types of special-use tires on the market. Basic construction will fall into one of the above categories, but size, cord materials,

compounding ingredients, and tread designs (i.e., diamond and mud and snow tread) will vary with the purpose for which they are to be used. Various types of blow-out and puncture-resistant tires are on the market. Some have a steel safety belt underneath the tread. Some have an inner tire separated from the main body of the tire by an air space. Some others are difficult to balance satisfactorily. Foam-filled, puncture-proof (battle damage) tires have been used successfully on slow-moving construction and 463L vehicles. Their use has proven essential in some combat situations.

F. **Handling Characteristics.** Each of the basic tire construction designs have different handling characteristics *(See Figure 4-3, page 46).* Handling is also affected by tire size, width, tread design, inflation pressure, and rim width. Bias belted and radial tires may produce over-steer while increasing traction. When compared to conventional tires, they will also accentuate any steering and suspension problems that may exist *(See Figure 4-4, page 47).* They should only be used in complete wheel sets and never mixed with different types unless originally equipped by the vehicle/equipment manufacturer.

G. **Tire Size Rating.**
   1. **Bias.** Tire sizes are expressed in terms of inflated tire cross-section width and rim diameter, i.e., 6.00 x 13, 6.00 or 6 equals the tire cross-section width and 13 equals rim diameter.

   2. **Metric.** Most small tire sizes are now expressed with a metric designation such as P205/75R14. The P designates a passenger car tire, 205 is the cross-section width in millimeters, 75 is the aspect ratio, R is the radial designator, and 15 ex-presses the rim size in inches.

H. **Tire Markings.**
   1. **General.** Much is being done toward regulating the quality and the application of pneumatic tires, most of which will apply to passenger-type vehicles. Federal Tire Safety Regulations specify that the following markings must be included on tires manufactured for highway use *(See Figure 4-6, page 50).*
      a. Size
      b. Maximum permissible inflation pressure
      c. Maximum load rating
      d. Manufacturer's identification by name or by brand name and a specified numeric code marking
      e. Ply cord material
      f. Number of plies in the sidewall and number of plies in the tread, if different
      g. Note that the tire conforms to Federal Motor Vehicle Safety Standards
      h. Radial (if applicable)
      i. Tire tread must be molded to include a tread wear indicator 2/32-inch tread depth
      j. Temperature Grade. **NOTE:** Temperature grades are an indication of a tire's resistance to heat. Sustained high temperatures (for example, driving long distances in hot weather), can cause a tire to deteriorate, leading to blowouts and tread separation. From highest to lowest, a tire's resistance to heat is graded as "A", "B", or "C".

k. US Dept of Transportation (DOT) Tire Identification Number (TIN) and Date of Manufacture Code. **NOTE:** As tires age, they are more prone to failure. Some vehicle and tire manufacturers recommend replacing tires that are six to 10 years old, regardless of tread wear. The last four digits of the Tire Identification Number and Date of Manufacture Code indicate the week and year the tire was made. If the TIN reads 2613 it was produced in the twenty-sixth week of 2013. Look on both sides of the tire. The TIN may not be on both sides *(Refer to Figure 4-26, page 49).*

l. Tire Branding. Branding of tires is prohibited.

I. **Tire Rotation.** To realize full tire life potential, tires should be inspected and rotated following the recommendations in the operator's manual, if available, or at 5,000-to-10,000-mile intervals. The first such rotation is the most important one in setting the stage for long, even tread wear. In some instances, if irregular wear begins to develop, rotation will be advisable before the recommended mileage interval. Before rotating, determine the cause of wear and correct any misalignment, balance, or other mechanical problems. Earlier and more frequent rotation may also be desirable due to differences in tread wear between front and rear tires. After rotation, adjustment of individual tire air pressure to acceptable car or tire manufacturer's recommendation is required following the tire's new location on the car *(See Figure 4-7 and Figure 4-8, pages 50 and 51).*

J. **Tire Balance.**

1. Shaky, shimmying wheels are caused by all or part of the rotating assembly being out of balance. An assembly one ounce out of balance at the tread will develop a sledgehammer pounding at 50 Miles Per Hour (MPH). There are two main symptoms of out-of-balance:
    a. Tamp or road shock usually occurs at higher speeds and is felt through the steering wheel as the vibration increases with speed *(See Figure 4-9, page 51).*
    b. Shimmy is a rapid side movement of front wheels which usually is apparent in the sidewise vibration of the front end *(See Figure 4-10, page 52).*

2. To correct the tamp or shimmy symptoms, a static or dynamic balance is required. Refer to *Figure 4-9, page 51* for static out-of-balance procedures. For dynamic out-of-balance procedures, *See Figure 4-10, page 52.* Follow the manufacturer's guidance on tire balancing. Tires used on non-passenger-type vehicles (refueling trucks, tractor-trailers, semi-trucks, sweepers, etc.) are not normally balanced unless called out by the manufacturer.

3. **Wheel Nut Torque.** Tire shop personnel will obtain wheel nut torque values from the manufacturer's service manuals and formulate a chart or quick reference list to be used by personnel mounting tires. This reference will be readily available to the tire shop.

K. **Safety Economy and Service.** Tires are being offered in increasing numbers of sizes and constructions to provide added safety, improved economy, and special service capabilities. Environmental Protection Agency (EPA) findings indicate that up to a 10 percent fuel savings can be obtained by using radial tires of the largest practical size, and by keeping them inflated to upper inflation limits. Users must, however, avoid intermixing belted bias, radial and bias

ply tires on one vehicle. Each type of construction reacts differently under the same load; a mixture may cause sideslip, wandering, fishtailing, etc.

L. **Selection of Pneumatic Tires.** Tire type will be determined by application (i.e., passenger car, truck/bus, industrial, etc.) as identified in the description. Select the type of tread, ply rating, and type of construction (bias or radial) required.
   1. **Steel Belted Radial Tires.** For general-purpose use, steel belted radial tires will yield maximum life cycle safety/ economy.

   2. **Non-Radial Tires.** Non-radial tires should be replaced by steel radials on an attrition basis unless the vehicle and tire manufacturer recommend other constructions for special purpose/use.

M. **Tire Replacement.**
   1. **Purchase of New Radials.** Purchase new radial tires in complete sets for use on one vehicle where possible.

   2. **Purchase of New Non-Radials.** Avoid purchasing new tires of non-radial design for general-purpose use. Use existing non-radials by cross-switching between vehicles similarly equipped.

   3. **Sets.** Use radials and belted 60, 70, and 78 Series in complete sets.

   4. **Tire Sizes.** Do not mix tire sizes on the same vehicle unless so directed by the manufacturer's recommendation or operational necessity.

   5. **Break-In.** New tires should have a break-in period. Limit speed to 55 MPH for the first 50 miles. Avoid rapid acceleration or hard braking.

N. **Tire Management.** Inflate radial tires to the maximum pressure recommended by the manufacturer for the specific vehicle, tire, and mission. Adhere strictly to the following guidelines:
   1. **Maximum Pressure/Rim Capacity.** Never exceed the maximum pressure shown on the tire sidewall or capacity of rim, unless directed by the manufacturer's service guidance. In the event OEM through service bulletins, recalls, etc.

   2. **Under-Inflated Tires.** Never operate vehicles with tires under-inflated. Abnormal heat buildup and tread edge wear can result from under-inflation. Tread print can serve as an indication of proper tread contact for a given tire and load *(See Figure 4-4, page 47).*

   3. **Tire Variations.** When tires of a different make or tires of different tread wear are used, either the diameter or circumference should be measured after mounting and inflation. Never over-inflate or under-inflate a tire to compensate for tire measurement variations. *See Table 4-1, page 44* for matching dual tire variation tolerances.

4. **Dual Tires.** When dual tires have a permissible difference in measurements, the larger-size tire should be mounted outside. Ensure dual-mounted tires do not make physical contact with each other when mounted. A minimum of 1/4 inch separation is required. This will prevent unnecessary heat buildup and possible tire failure.

5. **Valve Positioning and Capping.** The following guidance shall be adhered to:
   a. Valves should be properly centered in valve holes and slots to prevent scraping against brake drums.
   b. Valves should be placed so they extend through the wheel.
   c. Valves on inside duals should point away from the vehicle and valves on outside duals should point toward the vehicle.

O. **Inspection and Servicing.** Tire inspections and servicing are essential in obtaining maximum tire use. The guidelines furnished below are those that will ensure economic and safe tire utilization. These procedures should be locally altered when it is beneficial to the Port Authority. However, the altering of these procedures should never result in a potential injury to personnel or impede equipment mission accomplishment or safety.

P. **Nitrogen Filled Tires.** Some new, commercially manufactured base maintenance vehicles are equipped with nitrogen filled tires. The advantages of nitrogen are a longer service life for the tire and lower fire/explosion potential during hot weather/high heat conditions. These tires can be serviced with standard nitrogen servicing equipment such as that used to service accumulators on Material Handling Equipment (MHE). Only trained personnel will accomplish this. Vehicle operators may check tire pressure if they have a pressure gauge suitable for nitrogen valve stems but they will not add nitrogen to the tires. Maintenance technicians will stencil "Nitrogen filled tires do not service" to each fender well and each inner rim near the valve stem.

Q. **In-Use Inspection.**
   1. **Operator Inspection.** The primary responsibility of detecting and reporting defects in the vehicle tires is placed upon the operator and/or Dispatch. These inspections are:
      a. Presence of valve caps, evidence of breaks, deep cuts, embedded glass or nails, bulges, or other potentially hazardous conditions.
      b. Tread wear as indicated by visible wear indicators across the tire tread or measured by a depth gauge in a major tread groove. The minimum tread depth is 2/32 inch. The front tires of trucks, 10,000 gross vehicular weight (GVW) and greater; operated primarily off base at speeds greater than 35 MPH shall have at least 4/32-inch tread depth.

NOTE: *Major tread is defined as any portion of a tire that is grooved and designed to make contact with the road surface. Any part of the tire that is subject to wear by rubbing against the pavement or ground.*

      c. Daily inspection for adequate inflation will be determined by a visual inspection unless otherwise stated in the equipment manual. Tires on equipment with duals will be pounded with a hammer or tool to determine if air pressure is present. Check

tire inflation pressures when tires are cold. In addition to the visual inspection, radial tire pressure will be checked with a gauge if handling problems are experienced.

d. When recommended by the manufacturer's Guidance, tire pressure should be temporarily increased (without exceeding maximum side wall pressure) while operating with heavy loads or for sustained highway operation. Stenciled tire pressure shall not be changed when tire pressure is temporarily increased, but will be changed if the vehicle is primarily operated under heavy load conditions.

R. **Maintenance Inspection.** *(See Figure 4-16, page 54).* When a vehicle is in for a scheduled inspection, or a mounted tire is brought in for repair, visually inspect and replace if any of the following are present:
   1. A break or cut exposing the body cords.
   2. A bump or bulge.
   3. Tire tread or side walls cracked or deeply weather checked, exposing cords or endangering vehicle safety. Tires made of nylon polyester cord need not be replaced if weather-checked.
   4. Tread is worn to 2/32 inch.
   5. Abnormal wear. Rotate abnormally worn tires and correct the cause of abnormal wear.
   6. Tire age. On over-the-road passenger-carrying vehicles, consider replacing tires when the date of manufacture is more than 6 years old *(See Figure 4-26, page 49).* Consider the vehicle's primary use, local road, and meteorological conditions (excessive heat) when deciding to replace the tire by age factor.

S. **Tire Shop Inspection.** Inspection shall be done following the following:
   1. All tires in for repair will be inspected along with the tube or tubeless tire valve stem and wheel before mounting.
   2. Prior to mounting all tires new, used or retreaded, shall be inspected for bead damage, cracks, cord damage, ply or tread separation, sectional repairs and quality of workmanship.
   3. New and retreaded tires found defective will be returned to the source of supply for adjustment/replacement.
   4. Inspect the inside and outside of retreaded tires for defects or substandard quality before mounting. A retreaded tire will not be mounted on a wheel if any of the aforementioned defects are prevalent.
   5. Inspection of carcass before retreading.

T. No tire, except as indicated below, will be submitted for retreading when a break, cut, or other defect would require repair or sectioning before retreading.
   a. Circumferential cracks found in the inner (band) ply, of the bead, or in the shoulder area will render a tire unsuitable for retreading.
   b. Any tire which is so worn that the cords will be exposed during the buffing operation will not be retreaded.

U. **Servicing Radial Tires.**
   1. Proper tire maintenance and servicing is mandatory for radial tires as improper mounting and under-inflation can severely reduce tire life. Radial tires have an inherent bulge, making it impossible to visually judge air pressure. The only sure way to determine if a tire

is properly inflated is to check it with a gauge. Regular air pressure checks are essential to ensure maximum service life from any tire.

2. **Mounting.** Inspect the wheel after wire brushing inside the wheel flange. All bead seats must be free of dirt and rust.
3. Remove all wheel weights.
4. If evidence of distortion or impact damage exists, measure the wheel for runout.
5. If the wheel flange is bent, replace the wheel.
6. New valve stems, cores, and caps shall be installed before new tires are fitted to the wheel.
7. **Lubrication.** Lubricate tire beads with a liberal amount of approved rubber lubricant. Beads must be lubricated in mounting and demounting to prevent bead damage. Ensure the portion of bead opposite the tire tool is inside the wheel flange before mounting, then mount in the usual manner. ***DO NOT ALLOW*** the tire to hang up on the tire tool. Relubricate the bead, if necessary. Without the valve core, inflate the tire to 40 PSI. Deflate. Install valve core and inflate to recommended tire pressure. Carefully check the bead-to-rim seat. Tire bead-to-rim clearance should be the same around the circumference. Repeat this process if the bead has not been seated. A radial tire with all improperly seated bead will cause vibration.
8. **Balancing.** Balance tires refer to the balancing procedure in the service manual for the vehicle being serviced.
9. **Inflation.** Always follow model-year-recommended tire pressure ratings.

NOTE: *Under-inflation can lead to tire bead chafing, thereby causing a slow leak. A slow leak condition is aggravated by use of wide rims and cold weather. Vehicles (all types, general and special purpose) tires and spares, if applicable, will be air gauge checked at least once a month, using an accurate calibrated air gauge. Check pressures when tires are cool. Check pressure more often in cold weather which may cause dangerously low pressure drops. For sustained highway driving, increase inflation 4 PSI above the recommended pressure, but do not exceed the maximum inflation stamped on the tire side wall.*

V. **Repair Procedures for Tires.**
   1. **Punctures.** Tread punctures, nail holes, or cuts up to 1/4 inch must be repaired from the inside of the tire. The repair material used must seal the inner liner and fill the injury to be considered a permanent repair. Industry-approved repair methods include a combination of plug and patch; chemical or hot vulcanizing patches and head-type plugs all applied from inside the tire. If a tire continues to lose air or has lost all or most of its air pressure, it must, be removed from the wheel for a complete internal inspection to be sure it is not damaged, the following shall apply:
      a. Never repair tires worn below 2/32-inch tread depth.
      b. Never try to repair tires with tread punctures larger than 1/4 inch in-house. Repair of side walls, bead sectioning, and large cuts will normally be available through the local recapping agency. All efforts will be made to effect repairs and recap damaged tires. The reduction of recyclable wastes and conservation of funds will be the determining factors. Off-road tires are more adaptable to these types of repairs than auto/truck tires. **NOTE:** Puncture repairs should be restricted to the tread area.

2. **Evaluation and Preparation.**
    a. **Inspection.** Before repairing, remove nails or other puncturing objects from the tire. With the tire inflated, apply soap solution to the damaged area to determine if air loss is from one or more punctures. Deflate the tire, unseat the beads, and apply the approved bead lubricant. Then remove the tire from the wheel carefully to avoid further damage to the tire, particularly to the bead, and place it on the spreader.
    b. **Probing.** Probe puncture with a blunt, smooth surface awl or other hand probing tool to determine size and direction of injury, making sure no foreign material is left in the injury.
    c. **Internal Examination.** Bulge tire on spreader marking the puncture with tire crayon. Inspect for evidence of other damage, e.g., in the bead area. Care should be used not to enlarge the injury.
    d. **Cleaning.** Clean the punctured area thoroughly with chemical buffer/cleaner, covering a slightly larger area than required for the patch. Make certain that no loose or frayed wire ends protrude through the liner.
    e. **Buffing.** Buffing operations create airborne particles. Eye protection consisting of safety goggles is required. Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 PSI. Eye protection is required. Failure to comply could result in injury to, or death of, personnel or long-term health hazards. Buff cleaned area thoroughly, to a smooth, velvet surface, taking care not to gouge liner or expose casing fabric. Remove dust from buffing with an approved method.
3. **Repair Procedures.** After completing basic preparation, finish the repair by selecting one of the following three repair methods:
    a. Chemical Vulcanizing Repairs.
    b. **Fill Injury.** The injury must be filled with contour-conforming material following the manufacturer's instructions. Cut off material flush with inner liner.
    c. **Cementing.** Vulcanizing cement is flammable and toxic to the skin, eyes, and respiratory tract. Skin and eye protection is required. Avoid repeated or prolonged contact, Good general ventilation is normally adequate. Avoid all sources of ignition. Always use self-vulcanizing cement recommended by the patch manufacturer. Apply a thin, coating of chemical vulcanizing cement to the prepared and buffed surface. Allow to dry thoroughly. Keep dirt and other impurities from contaminating the cement remaining in the can
    d. **Patch Application.** Remove backing from non-reinforced patch and center over injury. Stitch the patch down thoroughly with a stitching tool, working from the center out.
    e. **Hot Vulcanizing Repairs.**
        i. **Fill Injury.** The injury must be filled with contour-conforming material following the manufacturer's instructions. Cut off material flush with inner liner.
        ii. **Cementing.** Always use the cement recommended by the patch manufacturer. Apply a thin coat of recommended cement to the prepared and buffed surface. Allow to dry thoroughly.
        iii. **Patch Application.** Apply a hot vulcanizing patch and cure according to the manufacturer's recommendations.

f. **Head-Type Plug Repairs.**
   i. **Cementing.** Always use the cement recommended by the plug manufacturer. Apply a thin coat of chemical vulcanizing cement to the prepared and buffed surface. Allow to dry thoroughly.
   ii. **Plug Insertion.** Remove the backing from the stem and plug the head. Pull through according to the manufacturer's recommendations
   iii. **Stitching.** To prevent injury to personnel, exercise caution when using sharp or pointed tools. Stitch plug head down firmly with the stitching tool, working from the center out.
   iv. **Finished Repair.** There are several satisfactory methods of repair. Regardless of type of repair used, finished repair should seal the inner liner and fill the injury. After inflating, check the finished repair with water or soap solution to assure a complete seal.

NOTE: *Observe tire mounting precautions. Failure to comply could result in injury to, or death of, personnel or long-term health hazards.*

- Clean rim.
- Lubricate both tire beads.
- Lubricate bead ledges and flanges of the rim.
- Center tire on the rim.
- Use an extension hose with gauge and clip-on chuck.
- Stand clear.
- Never exceed 40 PSI.
- If beads do not seat, remove the valve core, re-lubricate, re-position, and re-inflate.
- Check repair for leakage with water or soap solution and adjust air pressure to recommended levels.

W. **Mounting and Demounting Tubeless Tires.** *(See Figure 4-15, page 53).*
1. Demounting.
   a. Remove the tire and wheel assembly from the car.
   b. Place the tire and rim on the machine or floor with a narrow bead ledge of the rim up *(See Figure 4-20, Views A and B, page 57).*
   c. Deflate the tire by removing the valve core from the valve stem.
   d. Use a liberal amount of approved rubber lubricant on the tire beads.
   e. Actual demounting must be done carefully. Never attempt to force the bead into the drop center well at one spot. Inch it off a little at a time, working around the tire to prevent damage to the beaded area.
   f. For preparation of the rim, check the rim to be sure it is in good condition and free of rust. Remove any rust or other accumulation of foreign material with a wire brush.
   g. It is important to carefully inspect the valve. Worn valves should not be reused, Install valve. Use a valve designated by the vehicle manufacturer since valves vary in length and diameter.

h. Lubricate tire beads and rim flanges and bead ledge area with a liberal amount of approved rubber lubricant. Properly lubricated beads will seat themselves quickly and easily with minimum air pressure.

X. **Tube-Type Tires.** Inspect tires for nails, glass, or other injurious particles in the tread *(See Figure 4-16, page 54).* Inspect for tread wear, cuts in fabric, fabric breaks, or damaged beads, and do not install tires unless satisfactory for service. Remove any dirt and foreign material from the inside of the tire.

Y. **Inner Tubes.** Check tubes for punctures, pinches, cuts, and cracks *(See Figure 4-18, page 55).* Inspect valves for proper bend and condition of inside and outside treads. New tubes may not have valves with proper bends. Replace any leaking cores. Install valve caps and tighten valve stem nuts, especially on new tubes. If installing or replacing tubes in radial tires, ensure radial designated tubes are used.

Z. **Tire Flaps.** Flaps should be of the proper size and type for the tire. Check flaps for cracks, folds, tears, and cleanliness. Ensure radial designated tube protection flaps are used with radial tires.

AA. **Rims.** Check rims for cracks, dents dirt, and rust especially in the gutter *(See Figure 4-18, page 55).* Be sure that the rim lock ring is of the proper size and type for the rim used and is not sprung or bent. Inspect wheels for worn or out-of-round stud holes and cracked disks. Side rings and locking rings are not interchangeable if they are of different manufacturers. Wheel rims for tubeless tires must be free of rust, gummy rubber deposits, nicks, and gouges in the rim bead seat surface to provide an airtight seal with the tire bead.
1. Rim and Wheel Maintenance During Tire Inspections. Check all metal surfaces thoroughly while making tire inspections, including areas between duals and on the inboard side of the wheel. Watch for:
2. Excessive rust or corrosion buildup cracks in metal.
3. Bent flanges, resulting from road obstructions.
4. Deep rim tool marks on rings or in gutter areas.
5. Loose, missing, or damaged nuts or clamps.
6. Bent or stripped studs,
7. Matched rim parts.

BB. **Disposal of Damaged Rims or Wheels.**
1. Excessively corroded or cracked rims of rings can be dangerous. Deflate tires before the removal of rims or wheels from the vehicle.

2. Mark damaged or hazardous areas with chalk so that part will be removed from service.

3. Replace damaged parts. Ensure that replacements are made with the proper sizes and types of rims and rings.

4. Inflate tires only to the recommended air pressure.

5. Rim and Wheel Maintenance During Tire Changes.

6. Check all metal surfaces. A more thorough check may be made however, after the tire been demounted.

7. Cracks in the rim base, in the back flange, and in gutter areas are caused by deep rim tool marks, overloading, over-inflating tires, and using larger than recommended tire sizes.

8. Cracks through the side ring, spreading laterally through the entire section are caused by improper mounting and demounting techniques, impact with road obstructions, and excessive clamping torques.

9. Cracks in the wheel disc, between stud holes or hand holes, are caused by loose wheel nuts, improper installation procedures, and use of incorrect sizes/types of attaching parts.

10. Erosion and chipping of bead seat of lock ring, resulting from excessive corrosion may occur with this part, as well as others, if protective measures are not taken.

11. Cleaning.

CC. **Wire brush operations are hazardous to the eyes.** Eye protection is required. Abrasive blasting operations involve airborne particles which may be hazardous to the body and eyes.
1. Thoroughly remove rust, dirt, and other foreign materials from all surfaces. Hand brushes, electric wire brushes, or sandblasting may be used.

2. Gutters of rim bases should be cleared of rust and other materials obstructing safe, positive seating of rings.

3. Bead seat areas of the rim should be free of rust and rubber deposits. This is especially important for drop center rims because the bead seat is the air-sealing element.

4. Rings should be cleaned with a wire brush. Pay particular attention to seating surfaces and bead particular seat areas.

DD. **Painting.** Metal Primer is toxic to the skin, eyes, and respiratory tract. Avoid skin and eye contact. Good general ventilation is adequate.
1. Paint rims by brush or spray with a fast-drying metal primer. Surfaces should be clean and dry before painting. Ensure that base metal areas on outside of the tire side of the rim are covered. This is especially important on drop center tubeless rims because warm and sometimes moist air is in constant contact with the metal surface on the tire side of the rim.

EE. **Lubrication.** Lubricate the tire side of the rim base just before mounting the tire. Avoid the use of any lubricant which contains water or solvent that is injurious to rubber. A combination lubricant and rust preventive compound is preferable. This protective measure is of particular importance with drop center tubeless rims as the air in the tire is contained by the tire side rim surface.

FF. **Preparation.**

1. Use lubricant solution on tire beads to make mounting and demounting easier, particularly when mounting and demounting tires on drop center or semi-drop center rims. Do not use oil or grease because petroleum products cause rapid deterioration of rubber. Do not use any lubricant that does not dry, for it may cause the bead to slip. Apply lubricant solution with a brush or swab, taking care not to allow excess solution to enter tire.

2. Large-size tubes should be folded before insertion in the tire.
   a. Deflate the tube completely.
   b. Install valve cap.
   c. With the tube in a circular position, fold a quarter of the tube to the left of the valve inward.
   d. Likewise fold two quarters opposite valve inward.
   e. Insert the pointed end with a valve into the tire; then insert another pointed end into the tire and unfold the tube into the tire *(See Figure 4-18, page 55).*
   f. When placing tubes in tires on wheels, be sure that:
   g. Valves point in the correct direction.
   h. Valves that are offset in tubes are placed to match the offset valve hole in the rim.
   i. Angle valves are pointed toward the removable flanges of the rim.
   j. Be careful not to damage beads with tire tools or hammers. Bead wires are easily damaged if gouged with steel tools. If proper directions are followed, severe use of tools is not necessary. When difficulties are met, check methods.
   k. Synthetic tubes and flaps require special care, and precautions must be observed in mounting to ensure maximum service. Before placing a small size tube in tire, the tube should be inflated to about three-quarters full or to point where it starts to round out. Large tubes should not be rounded out until after being placed in tires. Inspect the tire and repair all damage. Lubricate the entire surface of the tube with tire lubricant.
   l. Flaps must be dusted or lubricated on both sides (in addition to the tube). Natural rubber flaps used with synthetic tubes need only be dusted or lubricated on the side that comes in contact with the tube.
   m. After properly preparing the tube, tire, and rim, place the tube in the tire and mount in usual manner. Next, inflate sufficiently to force tire beads to seat properly against the rim flange of drop-center and semi-drop-center rims. Allow flaps to center properly between beads of flat-base rims and bead locks; then deflate, in all cases, to relieve unnatural strain, and free creases, or wrinkles. Finally, install the valve core and again inflate to recommended operating pressures.

GG. **Detachable Rims.**

1. To demount detachable rims on duals, remove the lug; then force off the outer rims, the space band, and the inner rim. Reverse procedures in mounting. When mounting, be sure lugs fit in their proper place against the rim. Before lowering wheel to ground, rotate wheel and check to make sure assembly does not wobble.

HH. **Drop-Center Rims.**

1. This type of rim has a well in the center which permits mounting and demounting. *Figure 4-19 and Figure 4-20, pages 56 and 57* show how the well in the rim makes these operations possible with the lower part of the bead in its seat. The upper part would have to be stretched or broken to free it, but with the lower part of the bead pushed into rim well, it is not necessary to stretch the upper part to slip it over the flange.

2. **Tire Removal.** Tires may be removed from a drop-center rim (except a safety-type rim) without removing the wheel, especially on small-size tires. Considerable skill is required to mount and demount tires on this rim when the wheel is on the vehicle. For this reason, the procedures in *Figure 4-19, page 56* are used when the wheel is removed.

3. **Demounting Tires.** Demount tires as follows:
   a. Determine which rim flange is nearer to the drop-center well and position the short side upward.
   b. Deflate the tire by removing the valve cap and valve core.
   c. After tire has been completely deflated, install cap to prevent damage to threads of valve stem. Loosen beads from rim flanges *(See Figure 4-19, page 56).*
   d. Do not dislodge tire beads, lock rings, or split flange rings until certain that no air pressure remains in the tire. Failure to comply could result in injury to, or death of, personnel or long-term health hazards.
   e. Insert two tire irons about 6 inches apart between the upper bead and rim, near the valve. Kneel the tire 180 degrees from the valve to force the upper bead into the well.
   f. Pry the outer bead over the flange near the valve.
   g. Work irons progressively around the tire bead, lifting the tire bead over the flange *(See Figure 4-19, page 56).*
   h. Remove the tube from the tire. Do not pull on the valve.
   i. Push the inner bead into the tube well on one side. Some passenger cars and light trucks use drop-center rims, known as safety rims *(See Figure 4-19, page 56).* These have a hump in the base of the bead ledge to hold beads in place. Sets of manual type iron are used to force beads off bead seats. The wheel must be demounted before, the removal of the tires. After beads are forced off the seats, proceed as discussed to remove the tire in the same manner as above.

II. **Mounting Tires.** Mount tires as follows:

1. Inspect tire, tube, and rim. Remove the valve cap. Inflate the tube slightly and insert it into the tire, placing the valve at the balance mark. Lay wheel flat with valve hole up. Screw a valve fishing tool on the valve stem. Start to mount the tire with valve pointing toward

valve hole, pulling handle of fishing tool through the valve hole in the rim. Place the inside bead in the rim well near the valve hole *(See Figure 4-20, page 57).*

2. Holding the inside bead in well, forcing the remainder of the inside bead over the flange with a tire tool or rubber-raced hammer. Spread the tire and pull the stem through the hole in the rim *(See Figure 4-20, page 57).*

3. Place the outside bead in the well, opposite valve, and pry on the rim with a tire tool with a rubber-faced hammer, being careful not to damage beads on the rim. Keep as much bead as possible in the rim well *(See Figure 4-20, page 57).*

4. Check position of valve, shifting tire in order to center valve in hole with aid of fishing tool. Pull very gently with a fishing tool in order not to tear the tube at the base of the valve.

5. Center tire around the rim and inflate to about 10 PSI. Apply air chuck to that part of a fishing tool that serves as a valve stem extension. In this operation, the valve stem may be held by the fishing tool. If the bead fails to seat properly against rim flanges at this pressure, either the tube is pinched or part of the bead is still in well, in which case, deflate and make appropriate corrections. Occasionally, beads will fail to sit in rim flange due to friction between beads and rim, especially if the rim has not been sufficiently or properly lubricated with solution. This can be corrected by holding the tire and rim (inflated 10 to 15 PSI) upright and bouncing it on the ground. If the bead is properly seated, remove the fishing tool, inflate to full pressure, then remove the valve core and deflate the tire to smooth out wrinkles in the tube. Install the valve core and again inflate to the recommended pressure. Check the valve for leaks and install the valve cap. Beads of tires mounted on safety rims used on some passenger cars and light trucks snap over the bump into place after approximately 20 PSI is applied. A snapping noise can be heard as beads snap into place. Inflate sufficiently to force beads against rim flanges, then deflate completely and again inflate to prescribed air pressure. Do not continue to inflate a tire beyond 40 PSI if beads are not in position. There is a danger that beads may strike the flange with enough force to break and jump the flange.

VIII. WHEEL AND ASSEMBLAGE OF TIRE, TUBE, AND MULTI-PIECE RIM COMPONENTS.

A. **Employee Training.** The employer shall provide an in-house training program to train and instruct all employees on hazards involved in servicing multi-piece rims and the safety procedures to be followed. The employer shall ensure that no employee services a multi-piece rim wheel unless the employee has been trained and instructed on correct procedures of mounting, demounting, and all related services, activities, and correct safety precautions for the rim type being serviced, and the safe operating procedures described later in this chapter. Information to be used in the training program shall include, at a minimum, data contained on the charts and contents of this technical order. Where an employer knows or has reason to believe that any of his employees is unable to read and understand the charts of rim manual, the employer shall assure that the employee is instructed concerning the contents of the charts and rim manual in a manner which the employee is able to understand. The employer shall

evaluate each employee's ability to perform these tasks and to service multi-piece rim wheels safely and shall provide additional training as necessary to assure that each employee maintains proficiency. The employer shall assure that each employee demonstrates and maintains an ability to service multi-piece rims safely, including performance of the following tasks:

1. Demounting of tires (including deflation).
2. Inspection of wheel components.
3. Mounting of tires (including inflation within a restraining device).
4. Use of the restraining device.
5. Handling of wheels.
6. Inflation of tires when a wheel is mounted on the vehicles.
7. Installation and removal of wheel
8. Tire Servicing Equipment. The employer shall furnish and shall assure that employees use a restraining device in servicing multi-piece rim wheels.
9. When replacing oversized tires, a restraining device is not available, chains may be used to restrain the lock ring. If a forklift is available, the forks should be used in conjunction with chains to secure the lock ring. Ensure that every precaution available has been taken to prevent injury to personnel. The following conditions apply:
    a. Each restraining device shall have the capacity to withstand the maximum force that would be transferred to it during an explosive wheel separation occurring at 150 percent of maximum tire specification pressure for the wheels being serviced.
    b. The restraining device shall be capable of preventing rim components from being thrown outside or beyond the frame of the device for any wheel position within the device.
    c. Restraining devices shall be inspected before each day's use and after any explosive separation of wheel components and any restraining devices exhibiting any of the following defects shall be immediately removed from service:
        i. Cracks at welds.
        ii. Cracked or broken components.
        iii. Bent or sprung components caused by mishandling, abuse or wheel separation.
        iv. Pitting of components due to excessive corrosion.
    d. Clip-On Chuck. A clip-on chuck with a sufficient length of hose to permit the employee to stand clear of the potential trajectory of the wheel components, in an in-line valve with a gauge or a pressure regulator preset to a desired valve shall be furnished by the employer and used to inflate tires. The following shall apply:
        i. Current charts shall be available in the service area.
        ii. A current rim manual containing instructions for the type of rims being serviced shall be available in the service area.
        iii. The employer shall ensure that only tools recommended in the rim manual for the type of wheel being serviced are used to service multi-piece rim wheels.

B. **Wheel Component Acceptability.** Wheel components shall not be interchanged except as provided in the charts, or in the applicable rim manual. Wheel components shall be inspected prior to assembly. The following shall apply:

1. Rim bases, side rings or lock rings which are bent out of shape, pitted from corrosion, broken or cracked shall not be used and shall be rendered unusable or discarded.

2. Mating surfaces of the rim gutter, rings and tires shall be free of any dirt, surface rust, scale or rubber buildup prior to mounting and inflation.

C. **Safe Operating Procedures.** The employer shall establish a safe operating procedure for servicing multipiece rim wheels and shall assure that employees are instructed in and follow that procedure. The procedure shall include at least the following elements:

1. Tires shall be completely deflated by removing the valve core, before a wheel is removed from the axle in either of the following situations:
    a. When the tire has been driven under inflated at 80 percent or less of its recommended pressure.
    b. When there is obvious or suspected damage to the tire or wheel components.

2. Rubber lubricant shall be applied to bead and rim mating surfaces during assembly of the wheel and inflation of the tire.

3. Tires shall be inflated only when contained by a restraining device, except that when the wheel assembly is on a vehicle.

4. Multi piece and single piece rim wheels used on large vehicles such as trucks, tractors, trailers, buses and off-road machines. It does not apply to servicing of rim wheels used on automobiles, or on pickup trucks and vans utilizing automobile tires or truck tires designated "LT". When wheel and tire assemblies are being inflated while mounted on the vehicle the employee performing the task shall use a remote inflating device to insure, they are clear of the trajectory, the remote device will consist of the following components; a clip-on chuck, an in-line valve with a pressure gauge and a sufficient length of hose of not less than 10 feet.
    a. The use of a forklift 10T or greater to act as a restraint device when installing and inflating oversized dismounted wheels.
    b. The use of a portable restraining device will be utilized while inflating oversized multi-piece and single piece rim wheels used on heavy equipment.

5. Tires that are under-inflated but have more than 80 percent of the recommended pressure may be inflated while the wheel is on the vehicle if remote control inflation equipment is used and no employees are in the trajectory, and except as provided below.

6. When a tire is being partially inflated without restraining device for the purpose of seating the lock ring or to round out the tube, such inflation shall not exceed 3 PSI (0.21 kg/centimeter (cm)2).

7. Whenever a tire is in a restraining device, the employee shall not rest or lean any part of his body or equipment on or against the restraining device.

8. After tire inflation, the tire, rim and rings shall be inspected while within the restraining device or make sure that they are properly seated and locked. If further adjustment to the tire, rim or rings is necessary, the tire shall be deflated by removal of the valve core before adjustment is made.

9. No attempt shall be made to correct the seating of side and lock rings by hammering, striking, or forcing the components while the tire is pressurized.

10. Cracked, broken bent or otherwise damaged rim components shall not be reworked, welded, braced, or otherwise heated.

11. Whenever multi-piece rim wheels are being handled, employees shall stay out of the trajectory unless the employer can demonstrate that performance of the servicing makes the employee's presence in the trajectory necessary.

D. **Ordering Information.** OSHA has printed two charts entitled "Demounting and Mounting Procedures for Truck/ Bus Tires" and "Multi-piece Rim Matching Chart" as a part of a continuing campaign to reduce accidents among employees who service large vehicle rim wheels. Reprints of the charts are available through the OSHA Area and Regional Offices. The address and telephone number of the nearest OSHA Area Office can be obtained by looking in the local telephone directory under US Government, US Department of Labor, Occupational Safety and Health Administration. Single copies are available without charge. Maintenance activities desiring single or multiple copies of these charts may order them from the OSHA Publications Office, US Department of Labor, Room N-3101, Washington, DC 20210, Telephone: (202) 219-4667. Available from Rubber Manufacturers Association are numerous demounting and mounting procedure charts for all special and general-purpose vehicles. Also available are booklets on safety and servicing and multi-piece rim wheels, and a training for a minor fee. Write for the catalog from: Rubber Manufacturers Association, 1901 Pennsylvania Ave., NW, Washington, DC 20060.

E. **Solid and Semi-Pneumatic Tires.**
1. Solid and semi-pneumatic tires will be used only on slow moving, industrial type materials handling equipment. Solid or semi-pneumatic tires provide much less cushioning than pneumatic tires, but are used where required loading is far beyond the capacity of comparable sized pneumatic tires.

F. **Type of Tires.**
1. Standard Solid Rubber Tires. Standard solid rubber tires have a relatively thin and hard section. This type of tire has greater load capacity than a comparative sized cushion-type. Rolling resistance and cushioning of this conventional type is less than the cushion rubber tire.

2. Cushion Rubber Tires. The cushion rubber tire has a relatively thick and soft section. This type tire offers greater cushioning and rolling resistance than a comparative sized conventional solid rubber tire.

G. **Type of Mountings.**
1. **Press On.** Press on type tire is bonded to a steel band and the complete unit is pressed on to the outside rim of the wheel. When the tire requires replacement, the band is pressed off and a new one pressed on.

2. **Bolt On.** Bolt on type tire is bonded to a flanged rim provided with holes for bolting to a drive flange.

3. **Integral Type.** Integral type tire is bonded directly to the metal wheel. When the tire requires replacement, a new tire may be cured on, provided the wheel is not deformed, cracked, or chipped beyond repair.

4. **Solid Lug Base Type.** Solid lug base type tire is used for light and medium loads. When loaded near rated capacity, it provides cushioning nearly equal to pneumatic tires. The tire is constructed of resilient rubber on base lugs which prevent creeping on the wheels. The wheels are of two-piece construction for mounting and demounting.

5. **Semi-Pneumatic Lug Base Type.** Semi-pneumatic lug base type tire is similar to the solid lug base except for a hollow center without tube or valve. Its carrying capacity is lower, but it has better cushioning characteristics than, the solid lug base type.

H. **Tread Patterns.**
1. **Smooth Tread.** Smooth tread is used for general shop and warehouse vehicles that require maximum surface contact to support maximum unit loading.

2. **Grooved Tread.** Grooved tread is used for large vehicles with extra heavy loads. The tread has good heat dissipation qualities.

3. **Diamond Tread.** Diamond tread provides good traction on ramps and wet surfaces. It combines good skid reducing characteristics and maximum heat dissipation qualities with minimum wear under heavy load and low speed conditions.

4. **Rib Tread.** Rib tread provides for maximum steady pull in either direction and is especially adapted to snow, slippery roads, sand and other extreme surface conditions.

I. **Preventive Maintenance.** Vehicle management responsibilities are as follows:
1. Wheel Bearing Adjustment and Lubrication. Proper wheel bearing adjustment and lubrication will reduce drag, thus reducing tire wear. Lubricate wheel bearings in accordance with manufacturer's recommendation.
    a. Do not over lubricate either wheel bearings or chassis since grease and oil will work out and deteriorate rubber.

J. **Steering Linkage Adjustment or Axle Alignment.** Improper steering linkage adjustment or axle alignment results in fast, irregular tread wear, flange wear, and chewed rubber. At the first sign of irregular wear, check for mechanical faults and correct according to the pertinent manual.

K. **Inspection.**
   1. Maintenance responsibilities performed during scheduled inspections/servicing are as follows:
      a. Inspect tires for uneven wear and separation.
      b. Check for oil or grease leaks that could or have contaminated the rubber tires.
      c. Check tires for wear and replace when necessary.
      d. Inspect tires for tread cracks, base separation, and slippage of rim on wheel.
      e. Check solid and semi-pneumatic lug base type tires for looseness or slipping on wheel.
      f. Solid rubber tires should be replaced on vehicles using the same tread on drive wheels.

LOAD RANGE	PLY RATING	LOAD RANGE	PLY RATING	LOAD RANGE	PLY RATING
A	2	E	10	J	18
B	4	F	12	L	20
C	6	G	14	M	22
D	8	H	16	N	24

Figure 4-1. Load Ranges

Table 4-1. Tolerance In Matching Dual Tires

Outside Diameter of Tire	Permissible Difference	
	Diameter	Circumference
Under 30 inches	1/4 inch	3/4 inch
From 30 to 40 inches	3/8 inch	1-1/8 inches
From 40 to 50 inches	1/2 inch	1-1/2 inches
Over 50 inches Type	3/4 inch	1-3/4 inches

Table 4-2. Measuring Procedure for New Tires

Type	Procedure
For Passenger Car (Except "P" Type)	Before measuring, tires shall be mounted and inflated to 24 PSI for Load Range B, to 28 PSI for Load Range C and to 32 PSI for Load Range D, and allowed to stand 24 hours minimum at normal room temperature, and inflation pressure readjusted to 24 PSI (Load Range B), 28 PSI (Load Range C) and 32 PSI (Load Range D).
For "P" Passenger Car Tires	Before measuring, tires shall be mounted and inflated to 26 PSI for Standard Load and 32 PSI for Extra Load, allowed to stand 24 hours minimum at normal room temperature and inflation pressure readjusted to 26 PSI for Standard Load and 32 PSI for Extra Load.
For Other Passenger Car	Before measuring, tire shall be mounted and inflated to the pressure for the maximum load (for duals if listed), allowed to stand for 24 hours minimum at normal room temperature, and inflation pressure readjusted to the pressure for the maximum load.
For "T" Type Passenger Car Tires	Before measuring, tires shall be mounted and inflated to 60 PSI, allowed to stand for 24 hours minimum at normal room temperature and inflation pressure readjusted to 60 PSI.
For "At" All Terrain Vehicle Tires	Before measuring, tires shall be mounted on an approved rim and inflated to the tire version pressure: • 1-star = 20 kilopascal (kPa) (3 PSI) • 2-star = 30 kPa (4 PSI) • 3-star = 40 kPa (6 PSI) Allow tire to stand for 24 hours at normal room temperature and inflation pressure readjusted to original pressure.

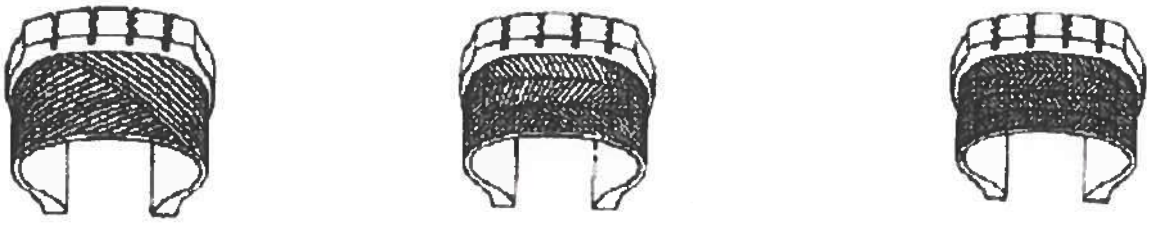


Figure 4-2. Tire Construction

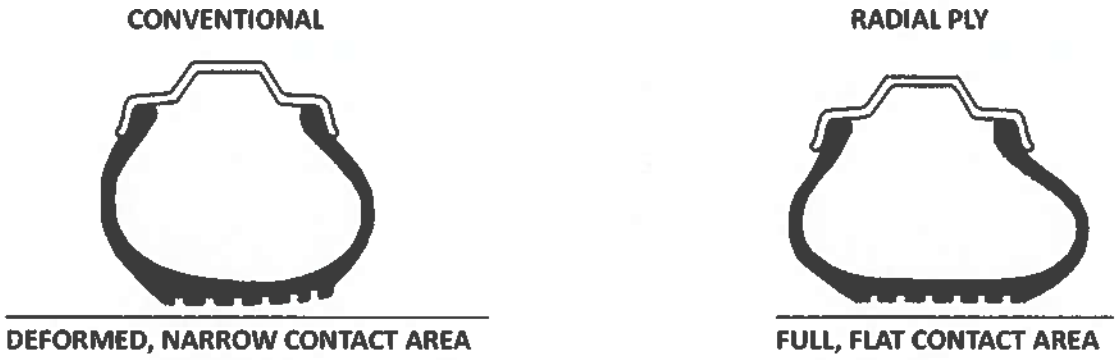
Figure 4-3. Handling Characteristics

Table 4-3. Tire Size Conversion Chart

78 Series	Acceptable Substitute	70 Series	Acceptable Substitute	60 Series	Acceptable Substitute
AR78-13	P165/80R13, P175/75R13	AR70-13	P185/70R13, 185/70R13	AR60-13	P195/60R13, P215/50R13
BR78-13	P175/80R13, P185/75R13	BR70-13	P195/70R13	BR60-13	P205/60R13
CR78-13	P185/80R13	CR70-13	P195/70R13, P205/70R13	CR60-13	P215/60R13, P235/50R13
BR78-14	P175/75R14	BR70-14	P185/70R14, 185/70R14	DR60-14	P215/60R14
CR78-14	P185/75R14	CR70-14	P195/70R14, 195/70R14	ER60-14	P235/60R14, P245/50R14
DR78-14	P195/75R14	DR70-14	P205/70R14	GR60-14	P245/60R14, P265/50R14
ER78-14	P195/75R14	ER70-14	P205/70R14	GR60-15	P245/60R15, P265/50R15
FR78-14	P205/75R14	FR70-14	P215/70R14	HR60-15	P255/60R15, P275/50R15
GR78-14	P215/75R14	GR70-14	P225/70R14	LR60-15	P275/60R15, P295/50R15
HR78-14	P225/75R14	HR70-14	P235/75R14		
BR78-15	P165/80R15, P175/75R15	BR70-15	P165/80R15, P175/70R15		
ER78-15	P195/75R15	ER70-15	P195/75R15		
FR78-15	P205/75R15	FR70-15	P215/70R15		
GR78-15	P215/75R15	GR70-15	P225/70R15		
HR78-15	P225/75R15	HR70-15	P235/70R15		
JR78-15	P225/75R15	JR70-15	P225/75R15, P235/70R15		
LR78-15	P235/75R15	LR70-15	P245/70R15, P255/70R15		

NOTE

Since interchange ability is not always possible for equivalent tires due to differences in load ranges, tire dimensions, fender clearances, and rim sizes, manufacturer's recommendations should be checked. Due to different handling characteristics, radial ply tires should not be mixed with bias ply tires on the same vehicle. In the case of "60" and "70" Series tires, mixing with conventional tires is permitted but only if used in pairs on the same axle.



Diagrams show differences in conventional bias ply tires and radial ply tires when cornering. Stiff sidewall of conventional tire lifts part of thread off the pavement. When radial is properly inflated, it resists such deformation due to all of tread area and sidewall, which flexes more easily.

Figure 4-4. Cornering Characteristics

Table 4-4. Tire Size Conversion Chart (European Metric Tire Size)

Metric Size	If Vehicle Tire Placard Specifies a European Metric Tire Size Acceptable Substitute Size
155R13	P155/80R13, P165/75R13, P175/70R13, 175/70R13
165R13	P165/80R13, P175/75R13, P185/70R13, P195/60R13, P215/50R13, 185/70R13
175R13	P175/80R13, P185/75R13, P195/70R13, P205/60R13
185R13	P185/80R13, P205/70R13, P215/60R13, P235/50R13
175/70R13	P165/80R13, P175/75R13, P175/70R13, P195/60R13, P215/50R13
185/70R13	P175/80R13, P185/75R13, P185/70R13
165R14	P165/80R14, P175/75R14, P185/70R14, 185/70R14
175R14	P185/75R14, P195/70R14, P215/60R14, 195/70R14
185R14	P195/75R14, P205/70R14, P245/50R14
185/70R14	P185/75R14, P185/70R14
195/70R14	P195/75R14, P195/70R14, P215/60R14
155R15	P155/80R15, P165/75R15
165R15	P165/80R15, P175/75R15
175R15	P185/75R15

Table 4-5. Tire Size Conversion Charts

P-Metric Size	If Vehicle Tire Placard Specifies a European Metric Tire Size Acceptable Substitute Size
P155/80R13	P165/75R13, P175/70R13, P175/70R13
P165/80R13	P175/75R13, P185/70R13, P195/60R13, P215/50R13, AR78-13, AR70-13, 185/70R13
P185/80R13	P185/75R13, P195/70R13, P215/60R13, P235/50R13, CR78-13, CR70-13
P165/75R13	P165/80R13, P175/70R13, P195/60R13, P215/50R13, AR78-13, AR70-13, 175/70R13
P175/75R13	P175/80R13, P185/70R13, P205/60R13, BR78-13, BR70-13, 185/70R13
P185/75R13	P185/80R13, P195/70R13, P215/60R13, P235/50R13, CR70-13, CR78-13
P175/70R13	P165/80R13, P175/75R13, P195/60R13, P215/50R13, AR78-13, AR70-13
P185/70R13	P175/80R13, P185/75R13, P205/60R13, BR78-13, BR70-13, 185/70R13
P195/70R13	P185/80R13, P215/60R13, CR78-13, CR70-13
P205/70R13	None
P165/80R14	P175/75R14, BR78-14, 185/70R14
P175/75R14	P185/70R14, CR78-14
P185/75R14	P195/70R14, P215/60R14, DR78-14, DR70-14, 195/70R14
P195/75R14	P215/70R14, P225/60R14, P245/50R14, ER78-14, ER70-14
P205/75R14	P215/70R14, P235/60R14, P265/50R14, GR78-14, GR70-14
P205/75R14	FR78-14 (Load Range D), FR70-14 (Load Range D)
P255/75R14	P225/70R14, P245/60R14, HR78-14, HR70-14
P185/70R14	P185/75R14, CR78-14, CR70-14
P195/70R14	P195/75R14, P215/60R14, DR78-14, DR70-14
P205/70R14	P205/75R14, P225/60R14, P245/50R14, FR78-14, FR70-14
P215/70R14	P215/75R14, P265/50R14, P235/60R14, GR78-14, GR70-14
P225/70R14	P225/75R14, P245/60R14, HR78-14, HR70-14
P235/70R14	JR78-14, JR70-14
P245/70R14	None
P155/80R15	P165/75R15
P165/80R15	P175/75R15, CR 78-15
P195/80R15	P205/75R15, P215/70R15, GR78-15, GR70-15
P165/75R15	P165/80R15, BR78-15
P175/75R15	CR78-15
P195/75R15	FR78-15, FR70-15, P195/80R15
P205/75R15	P215/70R15, P235/60R15, P265/50R15, GR78-15, GR70-15
P215/75R15	P225/70R15, P245/60R15, P275/50R15, HR78-15, HR70-15
P225/75R15	JR78-15, P235/70R15, P255/60R15
P235/75R15	P245/70R15, P275/60R15, P295/50R15
P215/70R15	P215/75R15, P235/60R15, P265/50R15, GR78-15, GR70-15
P225/70R15	P225/75R15, P245/60R15, P275/50R15, HR78-15, HR70-15
P235/70R15	P235/75R15, LR78-15
P245/70R15	P275/60R15, P295/50R15
P255/70R15	P305/50R15

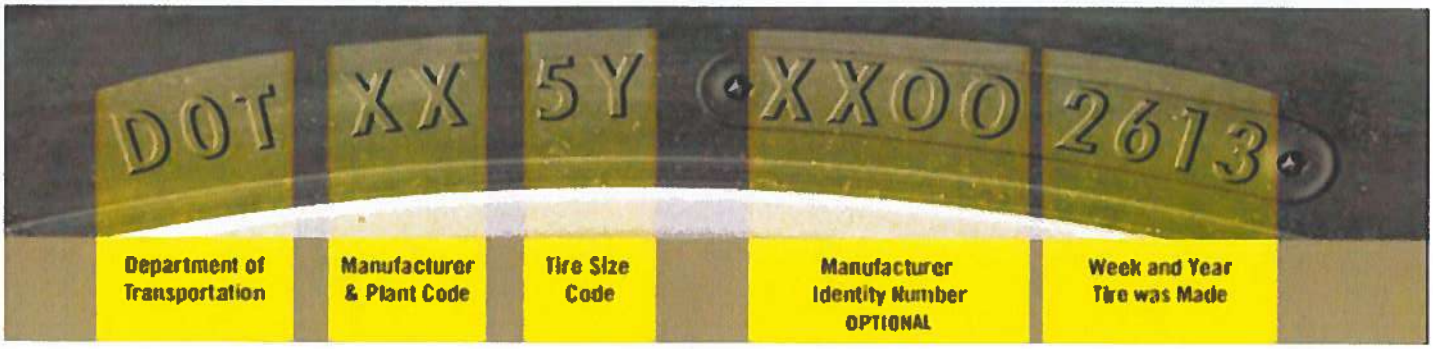
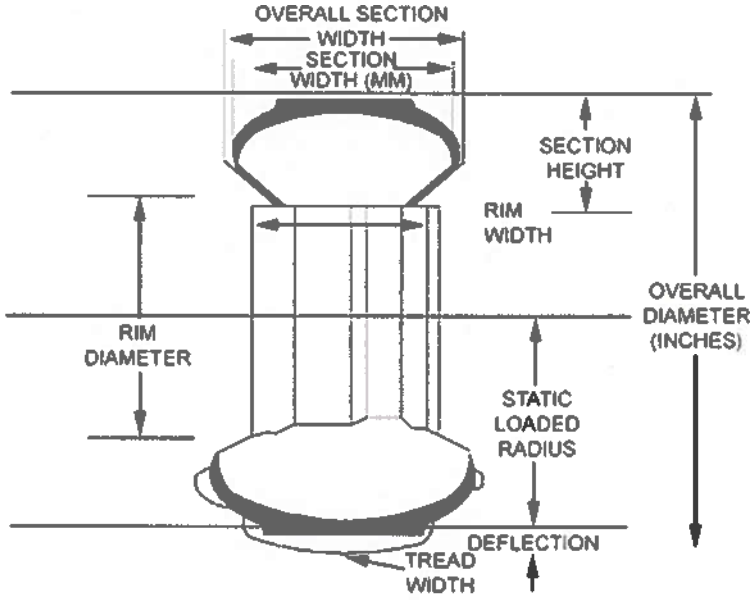
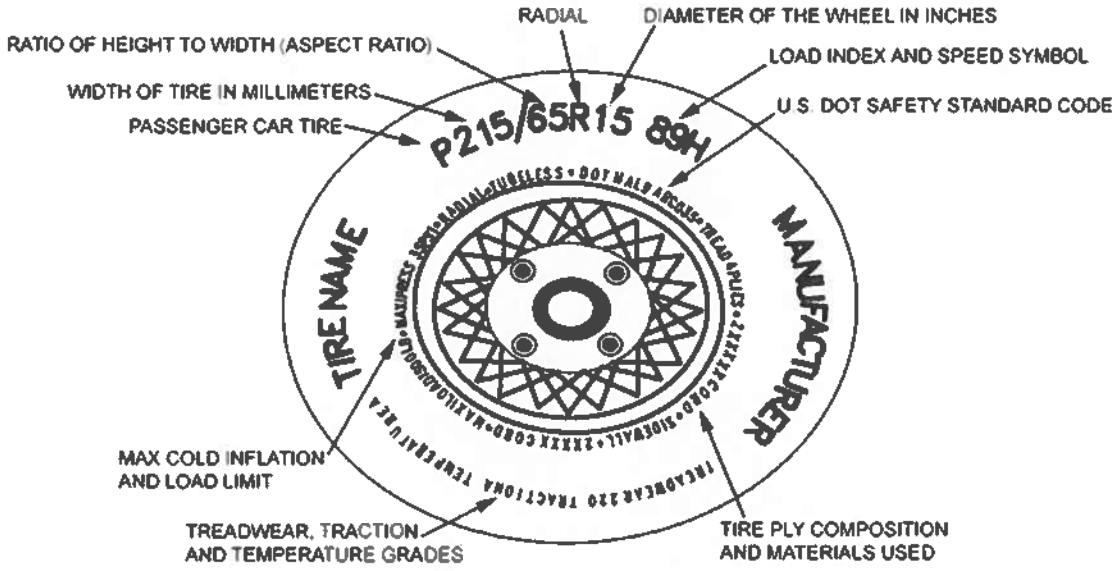


Figure 4-26. Tire Identification Number and Date of Manufacture Code



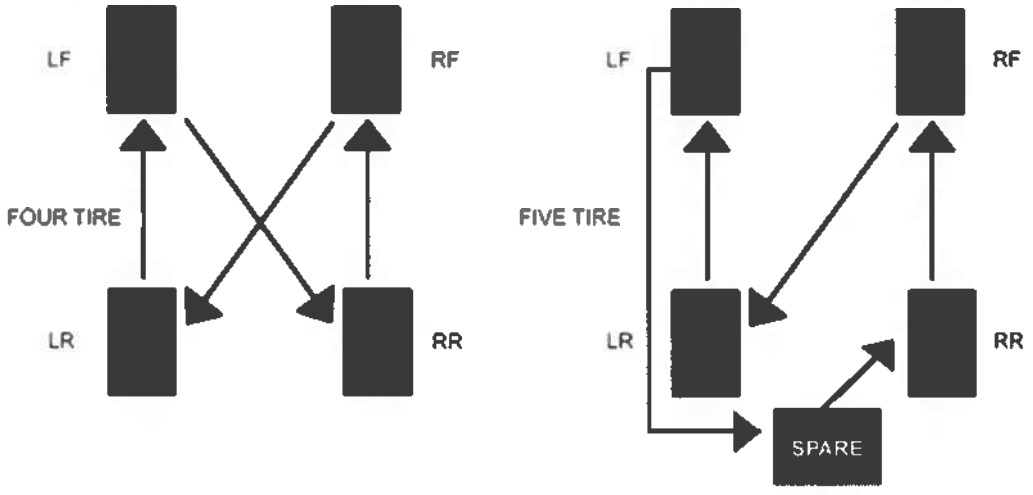
Static Loaded Radius: Distance from the center of the axle to the ground under the specified load and inflation pressure.
Rim Diameter: Diameter of the rim from bead seat to bead seat.
Overall Diameter: Diameter of the tire from tread surface to tread surface while inflated but unloaded.
Overall Section Width: Distance between the outer sidewalls of an inflated tire.
Rim Width: Distance between the inside of the rim flanges.
Section Height: Distance from the bead seat to the outer tread surface of the inflated tire.
Section Width: Distance between the outer side of the walls of an inflated tire, less any ornamentation or curb ribs.
Tread Width: The width of the tread surface, designed for contact with the road.

Figure 4-5. New Tire Dimensions



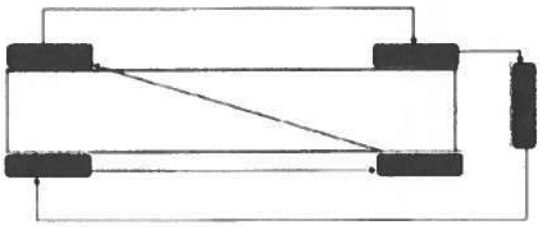
The tire size shown below is 215/65R16. The 215 represent its section width (tire width in MM). "65" is the tires "aspect ratio" (the ratio of the sidewall height to the tread width). The "R" represents tire construction, in this case radial, and the last item is "15" which represents the rim/wheel size.

Figure 4-6. Tire Markings

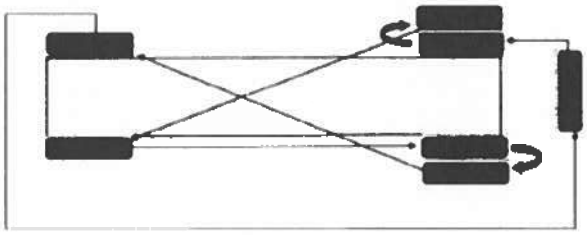


NOTE:
When snow tires are installed, the regular tread tires on the rear should be moved to the front and the front tires stored. When snow tires are removed, install stored tires on the rear.

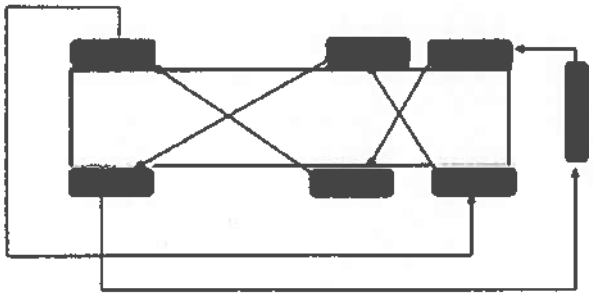
Figure 4-7. Tire Rotation



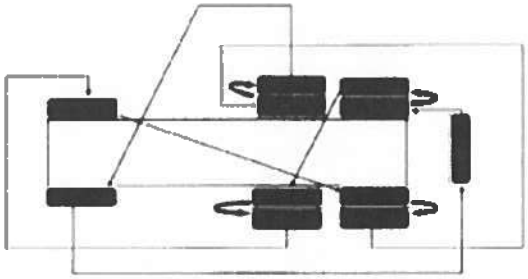
A-4X4 (ST), 4X2 (ST)
Trucks and Cars



B-4X4 (DT), 4X2 (DT)
Trucks



C-6X6 (ST)



D-6X4 (DT)

NOTE:
Include spare in rotation process in accordance with established measurements.

Figure 4-8. Rotation Patterns for Tires

A wheel out-of-balance when stationary causes vibration of the car due to the tendency of the heavier part of the wheel assembly to remain at the lowest point on the wheel. Vibration at this point causes "tramp" of bounce, resulting in rough ride and vibration of moving parts.

Figure 4-9. Static Out-of-Balance

A wheel out-of-balance when rotating or when the two halves of a wheel act in opposing directions along different planes tends to turn inward and outwards every one-half revolution. Tire and car damaging shimmy is created.

Figure 4-10. Dynamic Out-of-Balance

Tread Contact with Road

Under Inflation

Causes extreme tire flexing and build up, extreme heat, running the risk of failure. It causes rapid wear on the other edge of the tread.

Tread Contact with Road

Over Inflation

Causes tire to ride hard and subject to impact damage and weakening of the carcass. It also causes excessive wear in the center of the tread.

Tread Contact with Road

Proper Inflation

The correct profile for full contact with the tread.

Figure 4-11. Stages of Tire Inflation

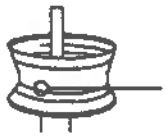
IMPORTANT PROPER PROCEDURES FOR DEMOUNTING AND MOUNTING TUBELESS PASSENGER CAR TIRES.

VIEW 1. RIM WITH NO HUMP AND WITH VALVE HOLE ON WEDGE LEDGE SIDE. MOUNT AND DEMOUNT WITH VALVE HOLE DOWN.

VIEW 2. RIM WITH HUMP ON EACH SIDE AND VALVE HOLE ON NARROW LEDGE SIDE. MOUNT AND DEMOUNT WITH VALVE HOLE UP.

VIEW 3. RIM WITH HUMP AND VALVE HOLE ON NARROW LEDGE SIDE. SIMILAR RIMS WITHOUT HUMP ALSO IN USE. MOUNT AND DEMOUNT WITH VALVE HOLE UP.

VIEW 4. PROPER POSITION OF RIM WITH NARROW LEDGE UP, VALVE ON NARROW LEDGE SIDE.



VIEW 5. PROPER POSITION OF RIM WITH NARROW LEDGE UP, VALVE ON WIDE WEDGE SIDE.

NOTE:
In both mounting and demounting, always start with the narrow bead.

Figure 4-15. Effects of Rim Design on Proper Mounting Position

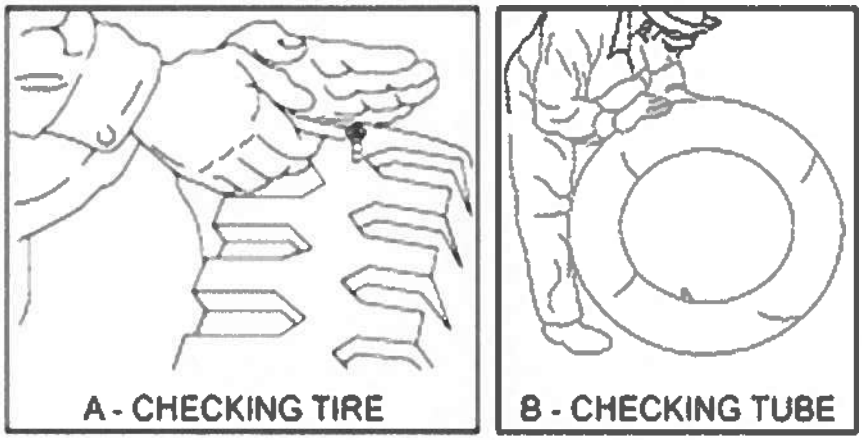


Figure 4-16. Points of Inspection for Tires and Tubes

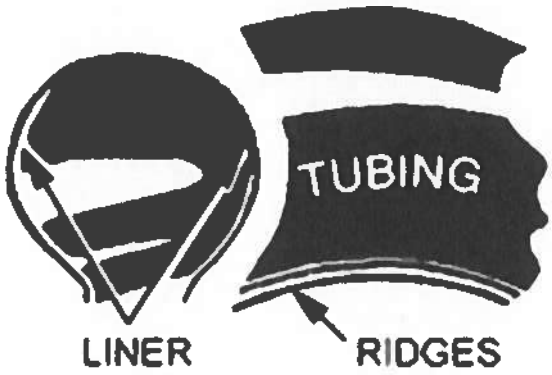


Figure 4-17. Tubeless Tire Construction

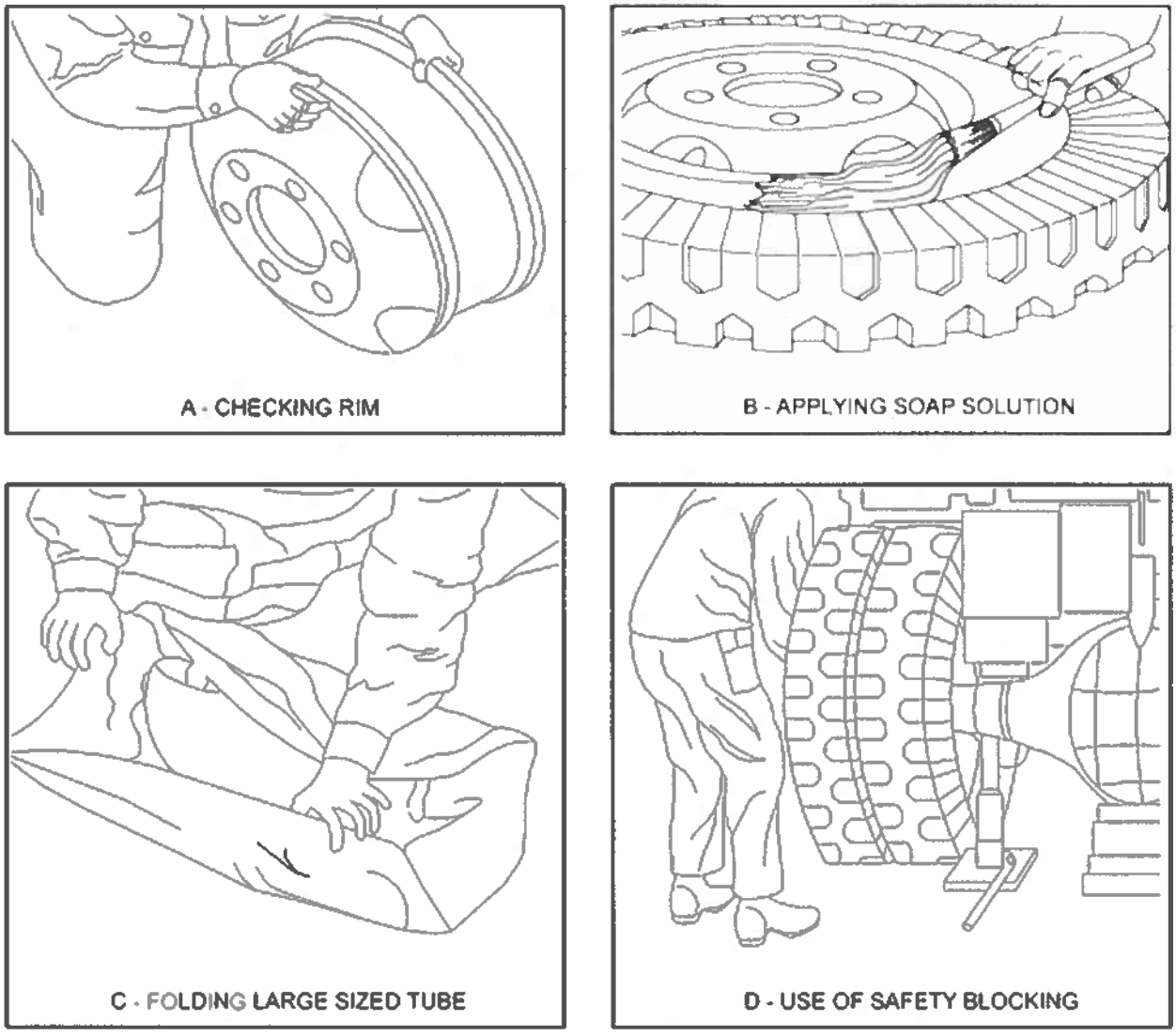


Figure 4-18. Tire Mounting and Demounting Operation

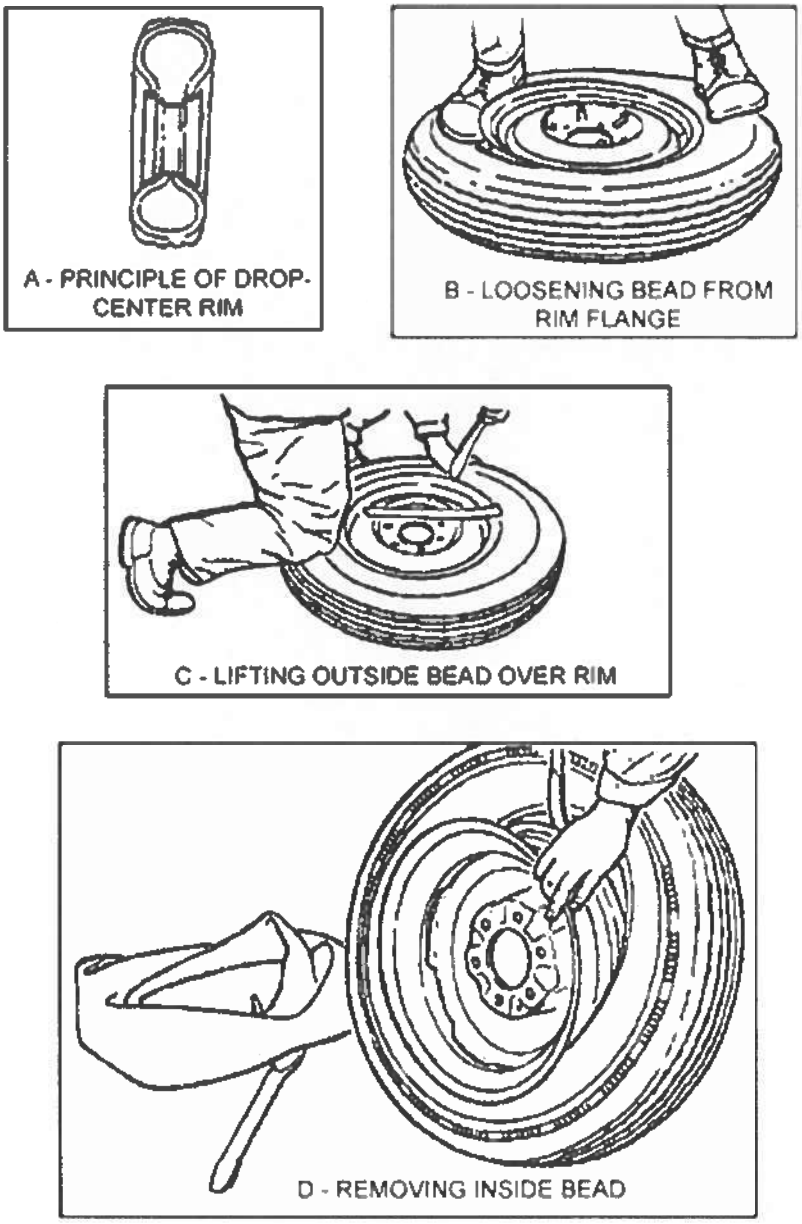


Figure 4-19. Manually Demounting Tire-Drop Center Rim

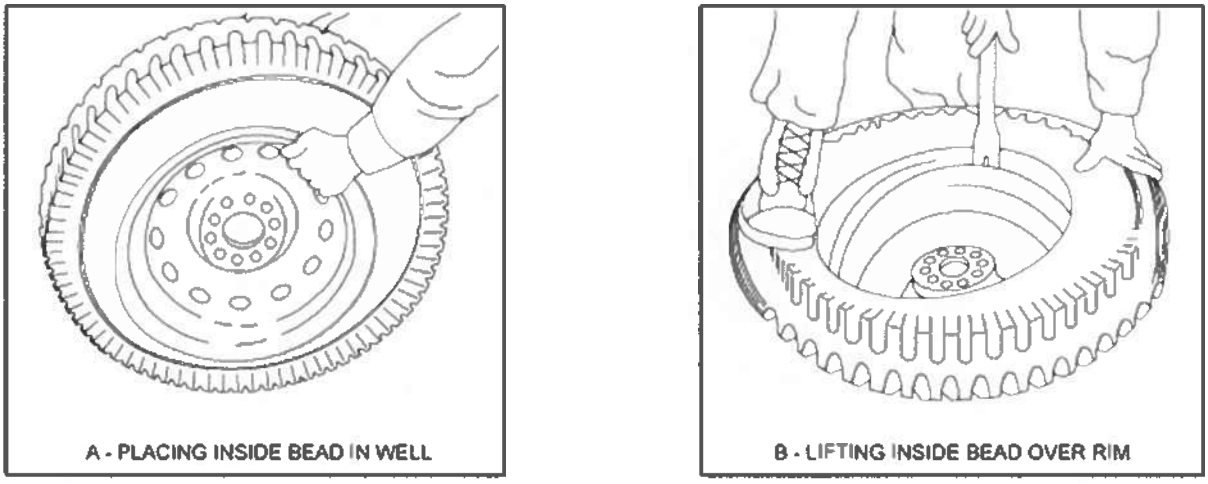
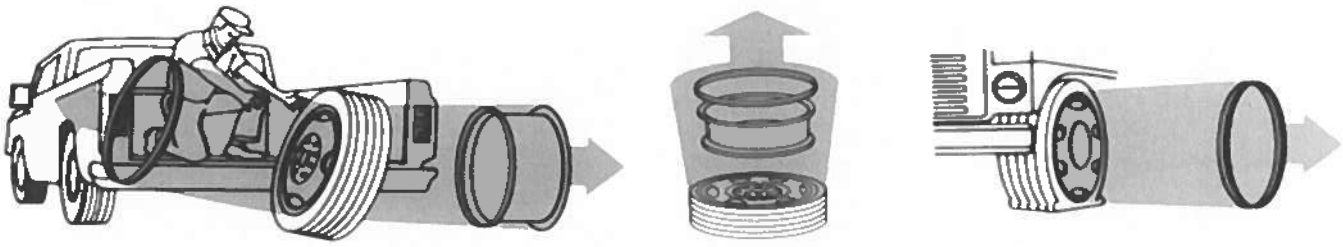


Figure 4-20. Manually Mounting Tire-Drop Center Rim



TRAJECTORY

WARNING

Stay out of trajectory area as indicated by highlighted markings.
Failure to comply could result in injury to, or death of, personnel or long term health hazards.

NOTE:
Under some circumstances the trajectory may be different than expected.

Figure 4-21. Trajectory Warning