Item and Method of Inspection	Reject If
1. Steering Lash Tests	
a) With front wheels in the straight ahead position turn the steering wheel until turning motion can be observed at the front wheels. Mark the rim of the steering wheel and using a pointer, turn the steering wheel in the opposite direction until motion can be observed at the front wheels. Measure the distance between the mark and pointer. On vehicles equipped with power steering, the engine must be running and the fluid level, belt tension and condition must be adequate before testing (as per Section 4, Item 7)	a) a total movement greater than shown in the following table is encountered at the steering wheel rim before the front wheels indicate movement. **Power** **50 mm (2 in.)** **Manual** **75 mm (3 in.)** **Rack & Pinion** **12 mm (1/2 in.)**
2. Travel	
Turn the steering wheel through a full right and left turn. Manually inspect:	
a) operation	a) binding or jamming is observed during cycle
b) clearance	b) less than 25 mm (1 in.) between tire and frame, fender or other parts
c) steering stops	c) missing, bent, not adjusted properly on applicable vehicles
3. Steering Linkage	
With vehicle on level floor and with engine shut down, rock the steering wheel left and then right and observe movement in steering components. If movement is observed, grasp the tie rod and attempt to move it in the direction of the ball stud. Do not use a pry bar for leverage.	
a) tie rod	a) bent, welded, reinforced
b) tie rod ends	b) wear is evident, bent, welded, injected, attaching nut loose, threads stripped or repaired in nut or on shank, does not meet OEM specifications
c) drag link	c) wear is evident, bent, welded, injected, attaching nut loose, threads stripped or repaired in nut or on shank, does not meet OEM specifications
d) pitman arm	d) loose, welded, injected, attaching nut loose, threads stripped or repaired in nut or on shank, does not meet OEM specifications – not properly aligned on output shaft
e) steering box	e) loose, insecurely mounted, bolts missing or loose – active leak

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Item and Method of Inspection	Reject If
f) idler arm	f) worn, loose, welded
g) cotter pins	g) missing, inferior substitute
h) steering column and wheel	h) loose, mounted insecurely, collapsed – "pot joint" or "rag joint" is badly misaligned or deteriorated, oil contaminated – clamp, bolt, nut or locking roll pin is loose or missing – steering wheel is broken, modified, less than OEM diameter – not same type and strength as OEM – does not meet OEM specifications (modified collector vehicles only) – less than 41 cm (16 in.) in diameter
i) steering shaft universal joint (if equipped)	i) loose beyond OEM specifications, welded, binds
j) steering shaft yoke (if equipped)	j) loose, welded, clamping bolt loose
k) slip joint (if equipped)	k) free play between splines exceeds 1.5 mm (1/16 in.) – horizontal play exceeds 6 mm (1/4 in.)
l) adjusting sleeve	l) loose, bent, tightening bolt in such a position that steering can be jammed or contacted
	OUT OF SERVICE **i) Steering column and wheel** **– Any bolts are loose or missing or any positioning parts allow movement from normal position.** **– Any universal joints are welded.** **– Steering wheel not secure.** **ii) Steering box** **– Any mounting bolts are loose or missing.** **– Any frame or mounting bracket is loose.** **iii) Pitman arm** **– Loose on steering gear output shaft spline or welded.** **iv) Ball and sockets** **– Any linkage shows looseness in alignment with the shank or neck of the ball in excess of 6 mm (1/4 in.).** **– Nuts loose on tie rod ends, adjusting sleeve, pitman arm, drag link or steering arm.**

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Item and Method of Inspection	Reject If
4. Rack and Pinion Steering	
With vehicle on a level floor and with engine shut down, rock the steering wheel left and then right and observe movement in steering components. If movement is observed, grasp the tie rod and attempt to move it in the direction of the ball stud.	
a) tie rods	a) bent, welded
b) tie rod ends/inner socket assembly	b) wear is evident, does not meet OEM specifications, worn, bent, welded, injected, nuts or shank threads stripped, nuts loose or missing, locking device for nut missing, inferior locking device used
c) bellow, clamp and boot	c) leaking, split open, missing – bulging, swollen or discoloured due to oil leak from internal end seal
d) clamps	d) missing, bent, welded, insecurely mounted
e) mounting bolts	e) threads stripped, missing, loose
f) mounting brackets	f) cracked, loose
g) alignment (move body up & down)	g) steering wheel moves
h) mounting bushings	h) any movement noted
i) housing	i) leaking, cracked, broken
	<u>OUT OF SERVICE</u> **i) Steering rack** **– Any mounting bolts are loose or missing.** **– Any frame or mounting bracket is loose.** **ii) Ball and sockets** **– Any linkage shows looseness in alignment with the shank or neck of the ball in excess of 6 mm (1/4 in.).** **– Nuts loose on the tie rod ends.** **iii) Any positioning parts allow movement from normal position.**

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Item and Method of Inspection	Reject If
5. Ball Joints	
For ball joints check as per original equipment manufacturer's methods. Check with dial indicator vertical and horizontal movement as required. Cracked seals are not reason for rejection. Manually inspect:	
a) condition	a) injected, loose in knuckle or control arm, – wear exceeds manufacturer's specifications – improper or loose retainer
b) boot or seal	b) boot or seal torn, lubrication is contaminated
c) ball joints with wear indicators (inspect with ball joints loaded)	c) surface flush with or inside cover surface – wear exceeds manufacturer's specifications
d) MacPherson strut joint Jack the vehicle so as to unload the strut joint. Inspect:	d) loose broken, misaligned
i) horizontal movement	i) exceeds manufacturer's specifications
ii) vertical movement	ii) exceeds manufacturer's specifications
6. Kingpin Play	
Raise vehicle so as to unload kingpins (if equipped with brakes, they should be applied to eliminate wheel bearing looseness) and using a bar for leverage.	
a) horizontal movement Attempt to rock in and out and observe movement at extreme top and bottom of tire.	a) in excess of 3 mm (1/8 in.) and/or OEM standards
b) vertical movement Place a bar under the tire and by prying vertically check for vertical movement between spindle support and axle.	b) in excess of 2.5 mm (1/8 in.) and/or OEM standards
c) condition	c) binding, seized, thrust bearing seized or binding

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Item and Method of Inspection	Reject If
7. Power Steering (if equipped)	
Manually inspect:	
a) fluid level	a) low, metal contamination present in oil
b) belts	b) insufficient tension, frayed, cracked
c) hoses	c) cracked, leaking, rubbed through (seepage permitted)
d) pump	d) loose, active leaking (seepage permitted)
e) cylinders or box	e) loose, active leaking
f) mounting brackets	f) cracked, loose, broken, bolts missing or loose
g) assist **NOTE: If equipped with hydraulic assisted brake booster apply brakes and turn steering wheel with engine running and check assist.**	g) ineffective assist
h) hose location	h) within 25 mm (1 in.) of exhaust system
	OUT OF SERVICE • **No assist is evident.**
8. Wheel Alignment	
a) Front wheels	
i) caster	i) not within manufacturer's tolerance
ii) camber	ii) not within manufacturer's tolerance
iii) toe	iii) not within manufacturer's tolerance
iv) SAI	iv) exceeds manufacturer's tolerance or the difference between right and left exceeds 0.5°
v) included angle	v) difference between right and left exceeds 0.5° or manufacturer's specifications
vi) total toe	vi) not within manufacturer's tolerance
vii) set back	vii) exceeds 0.5° or manufacturer's specifications
viii) turning angle	viii) exceeds 5° right to left or manufacturer's specifications

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Item and Method of Inspection	Reject If
b) rear wheels	
i) camber	i) not within manufacturer's tolerance
ii) toe	ii) not within manufacturer's tolerance
iii) total toe	iii) not within manufacturer's tolerance
iv) set back	iv) exceeds 0.5° or manufacturer's tolerance
v) thrust angle	v) exceeds 0.5° or manufacturer's tolerance
9. Telescope/Tilt Steering (applicable vehicles only)	
Mounting solid rather than repairing is permitted. Manually grasp steering column and attempt to move it horizontally and vertically on mounts. Inspect:	
a) controls	a) play is in excess of 6 mm (1/4 in.) OR does not comply with OEM standards for free play and security
	OUT OF SERVICE **i) Does not lock.**

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Steering Alignment Angles

1. Caster

The forward (-) or backward (+) tilt of spindle support (ball joints or king pin) at top.

Positive caster is the rearward tilt of the steering axis from a true vertical as viewed from the side of the wheel.

a) What it does

i) Positive caster gives front wheels tendency to maintain straight ahead position and return to straight ahead in turn.

ii) Positive caster can be used to enhance stability.

iii) Uneven caster will cause car to pull to side of least caster.

iv) Negative caster can be used to reduce steering effort.

v) Negative caster can be used to enhance ride.

b) Negative effects if incorrect:

i) Can cause vehicle to pull to one side.

ii) Can cause vehicle instability and to wander and weave.

iii) Instability at high speeds and braking.

iv) High effort steering.

v) Uneven braking.

2. Camber

The inward (-) or outward (+) tilt of the wheel at top.

Positive camber is the outward tilt of the wheel at the top from a true vertical line as viewed from the front of the wheel.

a) What it does:

i) Projects vehicle load towards the center of the tire.

ii) Provides easier steering by having the weight of vehicle borne by larger inner bearing.

iii) Reduces tire wear by allowing for the crown of the road.

iv) Reduces vehicle side skidding in a turn.

v) Gives maximum tire tread contact with the road.

b) Negative effects if incorrect:

i) Uneven camber from side to side will cause vehicle to pull to side with most camber.

ii) Cause tire wear and scuffing.

iii) Vehicle instability.

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3. **Toe-inward or outward pointing of wheels**

   Toe is defined as when a pair of wheels is set so that their leading edges are pointed slightly towards each other, the wheel pair is said to have toe-in. If the leading edges point away from each other, the pair is said to have toe-out. The amount of toe can be expressed in degrees as the angle to which the wheels are out of parallel, or more commonly, as the difference between the track widths as measured at the leading and trailing edges of the tires or wheels.

   a) What it does:
      i) Reduces tire scuffing and wear.
      ii) Ensures tires are pointing in straight line with vehicle when in motion.
      iii) Enhances vehicle stability.
   b) Negative effects if incorrect:
      i) Excessive tire scuffing and wear.
      ii) Vehicle wander.
      iii) Torque steering on front wheel drive vehicles.

4. **S.A.I. Steering Axis Inclination (Kingpin Inclination)**

   The inward tilt of a line through the centre of top of a strut mount or ball joint and the centre of lower ball joint in relation to a true vertical line through the center of the tire.

   a) What it does:
      i) Helps project the load of the car towards center of tire.
      ii) Enhances vehicle stability.
      iii) Assists in returning the steering to straight ahead position after a turn.
      iv) Can be used to increase steering effort.
   b) Negative effects if incorrect:
      i) Adversely effects stability especially in braking.
      ii) Steering wander
      iii) Increased transmission of road shock through steering.
      iv) Torque steering on front wheel drive vehicles if different from one side to the other.

5. **Included Angle**

   The included angle is the sum of the steering axis inclination angle (SAI) and the camber angle. A negative camber angle must be subtracted from the SAI to calculate the included angle.

   a) What it does:
      i) Enhances vehicle stability.
   b) Negative effects if incorrect:
      i) A difference from one side to the other will affect directional stability.
      ii) A difference from side to side will affect the steering returning to neutral position.

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6. Total Toe

Total toe is the sum of the toe, whether in or out, of the right and left tires of the vehicle.

a) What it does:
   i) Reduces tire wear.
   ii) Enhances stability.

b) Negative effects if incorrect:
   i) Increased tire wear.
   ii) Vehicle wander.
   iii) Torque steering on front wheel drive vehicles.

7. Setback

Setback is the condition in which one wheel is moved rearward in relation to the other.

a) What it does:
   i) Ensures that the front wheels track straight with the vehicle chassis and the rear wheels.
   ii) Steering wheel centered with vehicle direction.

b) Negative effects if incorrect:
   i) Tire scuffing and wear.
   ii) Adverse vehicle handling if extreme.

8. Turning angle

The turning angle is also known as the Ackerman Angle. This is defined as a turning angle of a vehicle in a corner when the front and rear wheels turn around a common pivot point with respect to the turning radius of each wheel.

This is the difference in steering angles of the right and left front wheels in turn. In a turn, the inside wheel must roll around a smaller circle than the outside wheel. Therefore, the inside wheel must be turned more if it is to follow the smaller inside circle.

a) What it does:
   i) Ensures the vehicle can negotiate a turn with minimal side slip.
   ii) Enhances vehicle stability when vehicle is in a turn.
   iii) Reduces tire wear associated with a turn.

b) Negative effect if incorrect:
   i) Tire scuffing in turns.
   ii) Poor turning characteristics.
   iii) Excessive side slip.

9. Thrust angle

The angle between centerline and rear wheel track.

a) What is does:
   i) Allows the rear of the vehicle to follow the front.
   ii) Rear wheels run perpendicular to the front.

b) Negative effects if incorrect:
   i) Poor handing
   ii) Tire wear

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