

* BRAKE SYSTEM UNIFORM INSPECTION GUIDELINES *

Article Text

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Saturday, March 18, 2000 10:03PM

ARTICLE BEGINNING

GENERAL INFORMATION

Brake Systems - Motorist Assurance Program
Standards For Automotive Repair

All Makes & Models

INTRODUCTION TO MOTORIST ASSURANCE PROGRAM (MAP)

OVERVIEW OF MOTORIST ASSURANCE PROGRAM

The Motorist Assurance Program (MAP) is the consumer outreach effort of the Automotive Maintenance and Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program is drawn from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

The Motorist Assurance Program was established as an industry-wide effort to address concerns raised by regulators, the media and consumers questioning our ethics and methods of doing business. The automotive repair industry had been bombarded by months of negative stories in the media and scrutiny from state and federal regulators who focused on how the need for repairs is determined. MAP was formed as an industry response to this issue.

Our mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take responsibility for their vehicles - through proper, manufacturer-recommended, maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt a Pledge to their Customers and the Motorist Assurance Program developed Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service which demonstrates to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made according to industry guidelines. After learning that neither the car manufacturers nor any other source had complete guidelines, leading industry organizations, along with other industry participants banded together to address this challenging task. During the past two and a half years, they successfully developed industry inspection guidelines for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, and Electrical systems. Guidelines for Drive Train and Transmission are currently being promulgated. Revisions to the inspection guidelines for Exhaust, Brakes/ABS and Steering and Suspension Systems, which were issued two years ago, are now being published for implementation beginning spring 1997. Participating shops utilize these Uniform Inspection Guidelines as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work

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cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials concerned with auto repair and/or consumer protection are conducted. Feedback from these representatives are brought back to members, and the program adjusted as needed.

To assure auto repair customers recourse if they were not satisfied with a repair transaction, the Motorist Assurance Program offers arbitration through MAP/BBB-CARE in cooperation with the Council of Better Business Bureaus and individual participating Bureaus. MAP "piloted" in Indianapolis and Pittsburgh during spring, 1996 - and publicized "roll-outs" in New Jersey, Detroit (MI), Chicago (IL) and Richmond (VA) were conducted. To put some "teeth" in the program, and accreditation requirement for shops was initiated. The requirements are stringent and a self-policing method has been incorporated which includes the "mystery shopping" of outlets. In addition, a committee of service providers had been working diligently developing standards for newspaper, television and Internet advertising.

We welcome you to join us as we continue our outreach ... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site: www.hunter.com/map.htm or contact us at:

808 17th Street, NW Suite 200
Washington, D.C. 20006
Ph. (202) 466-7050 Fax (202) 223-9569

The Motorist Assurance Program was formed in 1992 by forty (40) companies who were concerned about the image of automotive service establishments. Today, MAP is an industry-wide association dedicated to strengthening consumer satisfaction with the automotive repair industry. MAP's participants represent the majority of the nation's multi-bay retail automotive outlets, their parts and equipment suppliers, independent repair shops, industry associations, car companies, manufacturers representatives, and the trade press. MAP is developing standards of service, uniform inspection procedures and other programs to assure consumers of the industry's professionalism and the commitment to excellence shared by MAP's sponsoring companies.

MAP's achievements to date include production and distribution (over 280,000) of the consumer brochure "How to Find Your Way Under the Hood and Around Your Car", development of a Pledge of Satisfaction to Consumers and Standards of Service and establishment of relationships with regulatory agencies.

As auto repair becomes an issue for federal and state regulators, MAP is working to educate government leaders on the dynamics of automotive service and the self-monitoring efforts MAP has undertaken on the industry's behalf. MAP's sponsoring companies are becoming well-known to government representatives as exemplary

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businesses working to improve the industry. Media sources also look to MAP to provide information and advice to consumers and on working with automotive technicians and repair establishments.

In the next few months, MAP plans to assist member repair facilities in implementing the MAP Pledge to Customers, establishing an alternate dispute resolution system to help resolve customer complaints within the industry, and developing a shop accreditation program to encourage policies in concert with the MAP Standards of Service and Inspection Guidelines.

MAP has united the aftermarket behind its consumer-oriented goals and has established itself both within and outside of the industry. We welcome you to join us as MAP continues its outreach. With your support, both the automotive repair industry and your customers will reap the benefits. Please contact MAP at:

808 17th Street, NW Suite 200
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MAP UNIFORM INSPECTION GENERAL GUIDELINES

OVERVIEW OF SERVICE REQUIREMENTS & SUGGESTIONS

It is MAP policy that all exhaust, brake, ABS, steering and suspension, wheel alignment, tires and wheels, driveline, engine performance and maintenance and heating, ventilation and air conditioning services be offered and performed under the guidelines and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be required or suggested. In addition, suggestions may be made to satisfy the needs expressed by the customer.

This section lists the various parts and conditions that indicate required or suggested service or part replacement. Although this list is extensive, it is not inclusive. In addition to this list, a technician may make a suggestion. This suggestion must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

* Example: An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.

* Example: A brake rotor has been worn to the point where it

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measures less than the vehicle manufacturer's specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or to address a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may only be to suggest service.

* Example: An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.

* Example: The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a customer declines to authorize a service or repair indicated in the MAP Uniform Inspection Guidelines as "required," a MAP shop may refuse service on that system, if proceeding with the work could create or continue an unsafe or unsatisfactory condition.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the Uniform Inspection Guidelines that follow.

PART REPLACEMENT CODE IDENTIFICATION

NOTE: Refer to the following tables for definitions of the codes listed in the condition/procedure tables for the specific components that may need to be replaced.

A - PART NO LONGER PERFORMS INTENDED PURPOSE

A - PART NO LONGER PERFORMS INTENDED PURPOSE		
Reasons to Require Repair or Replacement		Reasons to Suggest Repair or Replacement
A - Part no longer performs intended purpose	1	Part is close to the end of its useful life (just above discard specifications, or weak; failure likely to occur soon, etc.)

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observe safety procedures and equipment requirements established by the vehicle manufacturer to reduce the possibility of serious personal injury.

CAUTION: Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS.

NOTE: Intermittent electrical conditions are often caused by a loss of ground, poor connection, or water intrusion into the wiring harness.

Electro-magnetic interference (EMI) may be caused by incorrect installation of accessories or components. EMI can result in improper system operation.

ACCELEROMETERS (G SENSOR OR LATERAL)

Condition	Code	Procedure
Broken	A	Require replacement.
Connector loose	A	Require repair or replacement.
Loose	A	Require repair or replacement.
Missing	A	Require replacement.
Out of position	A	Require re-positioning to vehicle manufacturer's specifications.
Output signal incorrect	A	Require replacement.

ACCUMULATORS - BRAKE

Condition	Code	Procedure
Leaking	A	Require replacement.
Missing	A	Require replacement.
Pre-charge incorrect	A	Require replacement.

BACKING PLATES OR ANCHOR PINS

Condition	Code	Procedure
Anchor pin bent	A	Require repair or replacement.
Anchor pin broken	A	Require replacement.

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Anchor pin worn, affecting structural integrity	3	A	3	Require replacement.
AA				
Backing plate bent	3	A	3	Require repair or replacement.
AA				
Backing plate cracked	3	A	3	Require repair or replacement.
AA				
Backing plate broken	3	A	3	Require replacement.
AA				
Corroded, affecting structural integrity	3	A	3	Require repair or replacement.
AA				
Loose	3	A	3	Require repair or replacement.
AA				
Missing	3	A	3	Require replacement.
AA				
Shoe lands worn	3	A	3	Require repair or replacement.
AA				

BRAKE FLUID

DOT 3 and DOT 4 brake fluids are clear or light amber in color. DOT 5 brake fluid is violet in color. Correct fluid required for the brake system is stamped on the master cylinder cover.

It is suggested that the system should be flushed and refilled with correct brake fluid when performing hydraulic brake service.

BRAKE FLUID

AA				
Condition	3	Code	3	Procedure
AA				
Beyond service interval	3	C,3	3	Suggest replacement.
AA				
Brake fluid incorrect	3	A	3	Require service. See note (1) below.
AA				
Contaminated, e.g. fluid other than brake fluid present	3	A	3	Require service. See note (2) below.
AA				
Rubber master cylinder cover gasket distorted and gummy	3	A	3	Require service. See note (2) below.
AA				

- NOTE: (1) If a fluid other than specification brake fluid is present in the brake system, the required service is to flush and fill with the correct brake fluid.
- (2) If a fluid other than brake fluid is present in the brake system which DOES affect the rubber parts, the required service is to: a) remove all components having rubber parts from the system, b) flush lines with denatured alcohol or

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brake cleaner, c) repair or replace all components having rubber parts, and d) bleed and flush with correct brake fluid. (Code A)

If a fluid other than brake fluid is present in the brake system which DOES NOT affect the rubber parts, the required service is to flush and fill with the correct brake fluid. (Code A)

AA

BRAKE FRICTION MATERIAL

NOTE: Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses.

CAUTION: It is required that friction material be matched in axle sets for consistent braking characteristics.

BRAKE FRICTION MATERIAL

AA

Condition	3	Code	3	Procedure
Contaminated, e.g. fluid that leaked from caliper, wheel cylinder or axle seal	3	A	3	Require replacement.
Cracked through	3	A	3	Require replacement.
Flaking or chunking	3	A	3	Require replacement.
Glazed (shiny)	3		3	No service suggested or required.
Grooves or ridges	3	B,2	3	No service suggested or required. See note (1) below.
Permanently attached hardware bent	3	A	3	Require replacement.
Permanently attached hardware broken	3	A	3	Require replacement.
Permanently attached hardware loose	3	A	3	Require replacement.
Permanently attached hardware missing	3	A	3	Require replacement.
Permanently attached hardware seized	3	A	3	Require repair or replacement.
Rivets loose	3	A	3	Require replacement.
Separating from backing	3	A	3	Require replacement.

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Shoe table or web bent 3 A 3 Require replacement.

Shoe table or web cracked 3 A 3 Require replacement.

Shoe table or web worn 3 A 3 Require replacement.
 affecting performance 3 3

Surface cracking 3 3 No service suggested or required.
 3 3 Further inspection may be
 3 3 necessary.

Tapered wear 3 A 3 Further inspection required.
 3 3 See note (2) below.

Thickness of one pad is 3 B,2 3 Suggested minimum service is to
 greater than opposite pad 3 3 lubricate caliper anchor and
 in the same caliper 3 3 hardware. However, caliper may
 (uneven wear) 3 3 need to be rebuilt or replaced.
 3 3 See note (3) below.

Wear indicator device 3 A 3 Require replacement of
 (electronic) contacts rotor 3 3 appropriate parts. See caution
 3 3 below.

CAUTION: The pad wear indicator light may come on due to other
 electrical problems.

Wear indicator device 3 B,2 3 Further inspection required.
 (mechanical) bent 3 3 See note (4) below.

Wear indicator device 3 B,2 3 Further inspection required.
 (mechanical) broken 3 3 See note (4) below.

Wear indicator device 3 B,2 3 Further inspection required.
 (mechanical) contacts 3 3 See note (4) below.
 rotor 3 3

Worn to minimum 3 A 3 Suggest replacement.
 specification 3 3

Worn below minimum 3 A 3 Require replacement.
 specification 3 3

Worn close to, but above, 3 A 3 Suggest repair or replacement.
 minimum specification 3 3

NOTE: (1) When reconditioning or replacing drums or rotors,
 replacement of friction material may be suggested depending
 on the severity of the grooves or ridges.
 (2) This type of wear is normal on some vehicles. Refer to
 specific vehicle application. If not normal, require

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replacement of pads and correction of cause.

- (3) Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.
- (4) Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. Friction material replacement is determined based upon the conditions stated in this section. Periodic inspection suggested.

AA

BRAKE SHOE HARDWARE

BRAKE SHOE HARDWARE

AA

Condition	Code	Procedure
Broken	A	Require replacement.
Distorted	A	Require replacement.
Missing	A	Require replacement.
Surfaces are rust-pitted	A	Suggest replacement.

AA

BRAKE STOPLIGHT SWITCHES

BRAKE STOPLIGHT SWITCHES

AA

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement.
Missing	A	Require replacement.
Out of adjustment	A	Require adjustment or replacement.
Output signal incorrect	A	Require replacement.

AA

CALIPER HARDWARE

CALIPER HARDWARE

AA

Condition	Code	Procedure
Bent	A	Require repair or replacement.
Broken	A	Require repair or replacement.

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Corroded, affecting performance 3 A 3 Require repair or replacement.
Dust boots on slider pin (bolt) are missing 3 B,2 3 Suggest replacement of boots.
Dust boots on slider pin (bolt) are torn 3 B,2 3 Suggest replacement of boots.
Missing 3 A 3 Require replacement.
Shims bent 3 A 3 Require removal or replacement.
Shims (OE standard) missing 3 A 3 Require replacement.
3 3 See note (1) below.
Shims out of position 3 A 3 Require removal or replacement.
Shims worn 3 A 3 Require removal or replacement.
Slider pin (bolt) bent 3 A 3 Require repair or replacement of
3 3 slider pin or bolt & lubricants.
3 3 slider pin or bolt & lubricants.
Slider pin (bolt) rust-pitted 3 A 3 Require repair or replacement of
3 3 slider pin or bolt & lubricants.
Slider pin (bolt) worn 3 A 3 Require repair or replacement of
3 3 slider pin or bolt & lubricants.
Threads damaged 3 A 3 Require repair or replacement.
Threads stripped (threads missing) 3 A 3 Require replacement.
Worn, affecting performance 3 A 3 Require replacement.
NOTE: (1) Aftermarket shims may be suggested to reduce noise.

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CALIPERS

You are not required to replace or rebuild calipers in axle sets. However, when replacing or rebuilding a caliper due to the conditions that follow, you may suggest servicing, rebuilding, or replacement of the other caliper (on the same axle) for improved performance and preventive maintenance (for example, the part is close to the end of its useful life, replacing the caliper may extend pad life, or contribute to more balanced braking).

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CAUTION: When installing calipers (loaded or unloaded), it is required that friction material be matched in axle sets for consistent braking characteristics.

Determine the need to replace or rebuild based upon the individual caliper conditions that follow.

CALIPERS

Condition	3	Code	3	Procedure
Bleeder port damaged (if non-repairable)	3	A	3	Require replacement of caliper.
Bleeder screw plugged	3	A	3	Require repair or replacement of bleeder screw. See note (1) below.
Bleeder screw broken off in caliper (if non-repairable)	3	A	3	Require replacement of caliper. See note (1) below.
Bleeder screw seized	3	A	3	Require replacement of caliper. See note (2) below.
Casting damaged - heavy corrosion affecting structural integrity	3	A	3	Require replacement of caliper.
Casting damaged - worn by rotor or wheel, affecting structural integrity	3	A	3	Require replacement of caliper.
Dust boot around caliper is torn	3	B,2	3	Suggest rebuilding or replacement of caliper.
Leaking	3	A	3	Require rebuilding or replacement of caliper.
Mounting pin threads damaged	3	A	3	Require repair or replacement of component with damaged threads.
Mounting pin threads stripped (threads missing)	3	A	3	Require repair or replacement of component with stripped threads.
Mounting pin threads stripped in caliper bracket (threads missing)	3	A	3	Require repair or replacement of caliper bracket.
Mounting pin threads stripped in steering knuckle (threads missing)	3	A	3	Require repair or replacement of steering knuckle.

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Pad thickness is greater than opposite pad in the same caliper (uneven wear)	3	A	3	Require lubrication of caliper anchor and hardware. However, caliper and/or hardware may need to be rebuilt or replaced. See note (3) below.
AA				
Pads in one caliper are thinner than pads in the other caliper on the same axle	3	A	3	Further inspection required. See note (4) below.
AA				
Parking brake cable support, lever, or return spring bent	3	A	3	Require replacement of parts.
AA				
Parking brake cable support, lever, or return spring broken	3	A	3	Require replacement of parts.
AA				
Parking brake mechanism in caliper inoperative	3	A	3	Require repair or replacement.
AA				
Piston anodized finish worn off	3	A	3	Require replacement of piston and rebuilding or replacement of caliper.
AA				
Piston corroded (pitted or peeling chrome plating)	3	A	3	Require replacement of piston and rebuilding or replacement of caliper.
AA				
Piston face damaged (small scratches, chips acceptable)	3	A	3	Require replacement of piston and rebuilding or replacement of caliper.
AA				
Piston face scored by rotor (small scratches, chips acceptable)	3	A	3	Require replacement of piston and rebuilding or replacement of caliper.
AA				
Piston sealing surface damaged	3	A	3	Require replacement of piston and rebuilding or replacement of caliper.
AA				
Piston sticking	3	A	3	Require rebuilding or replacement of caliper.
AA				

NOTE: (1) Only required if the hydraulic system must be opened.
 (2) Seized is defined as a bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.
 (3) Some vehicles are designed with inner and outer pads of different thicknesses. Refer to specific vehicle applications.

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Missing 3 A 3 Require replacement.

AA

NOTE: (1) If moisture enters the controller, it can reduce life expectancy or impair function.

AA

FLUID LEVEL SENSOR SWITCHES BRAKE

FLUID LEVEL SENSOR SWITCHES BRAKE

AA

Condition 3 Code 3 Procedure

AA

Connector loose 3 A 3 Require repair or replacement.

AA

Float saturated 3 A 3 Require replacement.

AA

Missing 3 A 3 Require replacement.

AA

Output signal incorrect 3 A 3 Require replacement.

AA

FOUR WHEEL DRIVE SWITCHES

FOUR WHEEL DRIVE SWITCHES

AA

Condition 3 Code 3 Procedure

AA

Broken 3 A 3 Require replacement.

AA

Connector loose 3 A 3 Require repair or replacement.

AA

Leaking 3 A 3 Require repair or replacement.

AA

Loose 3 A 3 Require repair or replacement.

AA

Missing 3 A 3 Require replacement.

AA

Output signal incorrect 3 A 3 Require replacement.

AA

HOSES

HOSES

AA

Condition 3 Code 3 Procedure

AA

Blistered 3 A 3 Require replacement.

AA

Fitting threads damaged 3 A 3 Require repair or replacement.

AA

Fitting threads stripped 3 A 3 Require replacement.

(threads missing) 3 3

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Incorrectly secured	3	A	3	Require repair.
Inner fabric (webbing) cut	3	A	3	Require replacement.
Leaking	3	A	3	Require replacement.
Mounting hardware damaged	3	A	3	Require repair or replacement.
Mounting hardware missing	3	A	3	Require replacement.
Outer covering is cracked to the extent that inner fabric of hose is visible	3	A	3	Require replacement.
Restricted	3	A	3	Require replacement.
Routed incorrectly	3	A	3	Require routing correction.

HYDRAULIC MODULATORS BRAKE

Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not possible, then replace the modulator assembly.

HYDRAULIC MODULATORS BRAKE

Condition	3	Code	3	Procedure
Disabled	3	A	3	Require repair or replacement.
Electrical failure	3	A	3	Require repair or replacement.
External leak	3	A	3	Require repair or replacement.
Housing cracked	3	A	3	Require repair or replacement.
Internal leak	3	A	3	Require repair or replacement.
Missing	3	A	3	Require replacement.
Valve stuck	3	A	3	Require repair or replacement.

HYDRO-BOOSTERS

Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

HYDRO-BOOSTERS

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Condition	Code	Procedure
Does not apply assist, or inadequate assist	A	Require repair or replacement.
Leaks fluid at fitting	A	Require tightening or replacement.
Leaks fluid at unit	A	Require repair or replacement. See note (1) below.
Leaks fluid from pressure hose(s)	A	Require replacement of hose(s).
Leaks fluid into passenger compartment	A	Require repair or replacement.
Wires corroded	A	Require repair or replacement.
Wires have exposed conductors	A	Require repair or replacement.
Wires burned	A	Require repair or replacement.

NOTE: (1) Follow diagnostic procedures as outlined in service manual to determine cause of leak and if unit can be repaired.

HYDRO-ELECTRIC BOOSTERS (POWERMASTER)

Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

HYDRO-ELECTRIC BOOSTERS (POWERMASTER)

Condition	Code	Procedure
Connector bent	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector loose	A	Require repair or replacement.
Does not apply assist, or inadequate assist	A	Require repair or replacement.
Leaks fluid at fitting	A	Require tightening or replacement.
Leaks fluid at unit	A	Require repair or replacement. See note (1) below.

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Leaks fluid from pressure hose(s) 3 A 3 Require replacement of hose(s).
3 3

Leaks fluid into passenger compartment 3 A 3 Require repair or replacement.
3 3

NOTE: (1) Follow diagnostic procedures as outlined in service manual to determine cause of leak and if unit can be repaired.

IGNITION DISABLE SWITCHES

IGNITION DISABLE SWITCHES

Condition	3	Code	3	Procedure
Bent	3	A	3	Require replacement.
Broken	3	A	3	Require replacement.
Corroded	3	B,2	3	Suggest repair or replacement.
Missing	3	A	3	Require replacement.
Out of adjustment	3	A	3	Require adjustment or replacement.
Output signal incorrect	3	A	3	Require replacement.

LIGHTS - BRAKE

LIGHTS - BRAKE

Condition	3	Code	3	Procedure
Brake stoplights inoperable	3	A	3	Further inspection required to determine cause. See note (1).
Bulb burned out	3	A	3	Require replacement.
Warning light does not come on during bulb check	3		3	Further inspection required to determine cause. See note (1).
Warning light flashes	3		3	Further inspection required to determine cause. See note (1).
Warning light is intermittent	3		3	Further inspection required to determine cause. See note (1).
Warning light stays on after initial bulb check	3		3	Further inspection required to determine cause. See note (1).

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NOTE: (1) Follow appropriate procedure for determined cause.

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MASTER CYLINDERS - BRAKE

MASTER CYLINDERS - BRAKE

AA

Condition	3	Code	3	Procedure
Brake fluid leaking from rear of master cylinder bore	3	A	3	Further inspection required. See note (1) below.
Brake pedal drops intermittently	3	A	3	Further inspection required. See note (2) below.
Fluid level low	3		3	Further inspection required. See caution below.

AA

CAUTION: DO NOT TOP OFF. Look for disc pad wear or fluid leak.

Refer to OEM procedures for adjusting low fluid level.

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Internal valve failure	3	A	3	Require repair or replacement. See note (3) below.
Master cylinder has residue in reservoir	3	B,2	3	Further inspection required. See note (4) below.
Master cylinder leaking brake fluid internally	3	A	3	Require repair or replacement. See note (5) below.
Piston does not return	3	A	3	Require repair or replacement.
Ports plugged	3	A	3	Require repair or replacement.
Rubber master cylinder cover gasket distorted and gummy	3	A	3	Require replacement of the gasket. See note (6) below.

AA

- NOTE: (1) Check for possible vacuum leak at booster input seal and/or push rod misalignment as possible causes. If neither is the cause, require repair or replacement of master cylinder.
- (2) This condition may be normal on some vehicles equipped with anti-lock brakes. If all other possible causes have been eliminated, require repair or replacement of master cylinder.
- (3) Require repair or replacement of valve if possible. If not possible, require replacement of the master cylinder.
- (4) DO NOT replace master cylinder unless it exhibits conditions listed for replacement. You may suggest fluid change according to OEM service intervals.
- (5) Use hose clamp test to determine this condition. Use an

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AA
Parking brake parts are 3 A 3 Require replacement of broken
broken 3 3 parts.

AA
Parking brake parts bent 3 A 3 Require replacement of bent parts.
AA

PEDAL TRAVEL SWITCHES

PEDAL TRAVEL SWITCHES

AA
Condition 3 Code 3 Procedure
AA
Bent 3 A 3 Require replacement.
AA
Broken 3 A 3 Require replacement.
AA
Corroded 3 B,2 3 Suggest repair or replacement.
AA
Missing 3 A 3 Require replacement.
AA
Out of adjustment 3 A 3 Require adjustment or replacement.
AA
Output signal incorrect 3 A 3 Require replacement.
AA

PRESSURE DIFFERENTIAL SWITCHES

PRESSURE DIFFERENTIAL SWITCHES

AA
Condition 3 Code 3 Procedure
AA
Bent 3 A 3 Require replacement.
AA
Broken 3 A 3 Require replacement.
AA
Corroded 3 B,2 3 Suggest repair or replacement.
AA
Missing 3 A 3 Require replacement.
AA
Output signal incorrect 3 A 3 Require replacement.
AA
Leaking 3 A 3 Require repair or replacement.
AA

PRESSURE SWITCHES

PRESSURE SWITCHES

AA
Condition 3 Code 3 Procedure
AA
Connector loose 3 A 3 Require repair or replacement.

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Housing damaged	3	A	3	Require replacement.
Leaking	3	A	3	Require repair or replacement.
Loose	3	A	3	Require repair or replacement.
Missing	3	A	3	Require replacement.
Output signal incorrect	3	A	3	Require replacement.

RELAYS - BRAKE

RELAYS - BRAKE

Condition	3	Code	3	Procedure
Housing cracked	3	B,2	3	Suggest replacement. See note (1) below.
Intermittent	3	A	3	Require replacement.
Missing	3	A	3	Require replacement.
Output signal incorrect	3	A	3	Require repair or replacement.

NOTE: (1) If moisture enters the relay, it can reduce life expectancy or impair function.

ROTORS

Determine the need to recondition based upon individual rotor conditions that follow. Friction material replacement does not require rotor reconditioning unless other justifications exist. DO NOT recondition new rotors unless they are being pressed or bolted onto an existing hub. It is not necessary to replace rotors in axle sets. However, when replacing or reconditioning a rotor due to the conditions that follow, you may suggest reconditioning of the other rotor on the same axle to eliminate uneven braking behavior.

Determine the need to replace based upon the individual rotor conditions that follow. Reconditioning is defined as machining and block sanding, or block sanding only. Block sanding is defined as using 120-150 grit sandpaper with moderate to heavy force for 60 seconds per side. Always wash rotors after servicing or before installing.

ROTORS

Condition	3	Code	3	Procedure
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Corrosion affecting structural integrity	3 A 3	3	Require replacement. See (1) note below.
AA			
Cracked	3 A 3	3	Require replacement.
AA			
Hard spots	3 A 3	3	Suggest reconditioning or replacement of rotor according to OEM specs.
AA			
Lateral runout (wobble) exceeds OEM specs	3 A 3	3	Require re-indexing, reconditioning, or replacement according to specs.
AA			
Measured thickness is less than OEM discard specifications	3 A 3	3	Require replacement.
AA			
Rotor thickness will be less than OEM "machine to" specifications after required reconditioning	3 A 3	3	Require replacement. See note (2) below.
AA			
Surface is rust-pitted	3 A 3	3	Require reconditioning or replacement of rotor according to OEM specs.
AA			
Surface is scored	3 A 3	3	Require reconditioning or replacement of rotor according to OEM specs. See note (3) below.
AA			
Thickness variation (parallelism) exceeds OEM specifications	3 A 3	3	Require reconditioning or replacement of rotor according to OEM specs.
AA			
NOTE: (1) Examples of severe corrosion are: composite plate separated from friction surfaces and cooling fins cracked or missing.			
(2) If OEM does not supply "machine to" specifications, you may machine to discard specifications.			
(3) Scoring is defined as grooves or ridges in the friction contact surface. Some vehicle manufacturers require machining when scoring exceeds their allowable specifications.			
AA			

SELF-ADJUSTING SYSTEMS

SELF-ADJUSTING SYSTEMS			
AA			
Condition	3	Code 3	Procedure
AA			
Inoperative	3	A 3	Require repair or replacement of inoperative parts.
AA			
Missing	3	A 3	Require replacement.

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Star wheel does not turn freely 3 A 3 Require repair or replacement.

STEEL BRAKE LINES

CAUTION: When replacing steel brake lines, replacement product must meet or exceed OEM design specifications.

STEEL BRAKE LINES

Condition	3	Code	3	Procedure
Fitting incorrect (e.g. compression fitting)	3	A	3	Require replacement.
Flare type incorrect	3	A	3	Require replacement.
Leaking	3	A	3	Require tightening or replacement.
Line material incorrect (copper, etc.)	3	A	3	Require replacement.
Mounting hardware damaged	3	A	3	Require repair or replacement.
Mounting hardware missing	3	A	3	Require replacement.
Restricted	3	A	3	Require replacement.
Routed incorrectly	3	A	3	Require routing correction.
Rust-pitted	3	A	3	Suggest replacement.

TIRES & WHEELS

Incorrect tire size, diameter, or pressure may affect the operation of ABS, traction control, and braking systems.

Consult the vehicle owner's manual or vehicle placard for correct size, speed ratings, and inflation pressure of the original tires.

TOOTHED RINGS (TONE WHEEL)

If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.

TOOTHED RINGS (TONE WHEEL)

Condition	3	Code	3	Procedure
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Alignment incorrect	3	A	3	Require repair or replacement.
Bent	3	A	3	Require replacement.
Contaminated	3	B,2	3	Suggest cleaning; identify and correct cause.
Cracked	3	A	3	Require replacement.
Incorrect number of teeth	3	A	3	Require replacement.
Loose	3	A	3	Require replacement of worn parts.
Missing	3	A	3	Require replacement.
Teeth broken	3	A	3	Require replacement.
Teeth distorted	3	A	3	Further inspection required. 3 See note (1) below.
Teeth missing	3	A	3	Require replacement.

NOTE: (1) No action required unless ABS system performance is affected. If performance is affected, require replacement.

VACUUM BOOSTERS

VACUUM BOOSTERS	3	Code	3	Procedure
Auxiliary vacuum pump inoperative	3	A	3	Require repair or replacement.
Vacuum booster applies too much assist (oversensitive)	3	A	3	Require replacement.
Vacuum booster check valve grommet deteriorated	3	A	3	Suggest replacement of grommet.
Vacuum booster check valve leaking	3	A	3	Require replacement of check valve.
Vacuum booster check valve missing	3	A	3	Require replacement of check valve.
Vacuum booster check valve stuck closed	3		3	valve.
Vacuum booster check valve stuck open	3	A	3	Require replacement of check valve.

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Vacuum booster does not apply enough assist	3	A	3	Require replacement.
AAAAAA				
Vacuum booster does not release	3	A	3	Require replacement.
AAAAAA				
Vacuum booster fails to store or maintain vacuum	3	A	3	Require replacement.
AAAAAA				
Vacuum hose filter restricted	3	A	3	Require replacement of filter.
AAAAAA				
Vacuum hose filter leaking	3	A	3	Require replacement of filter.
AAAAAA				
Vacuum hoses collapsed	3	A	3	Require repair or replacement of hose.
AAAAAA				
Vacuum hoses leaking	3	A	3	Require repair or replacement of hose.
AAAAAA				
Vacuum hoses missing	3	A	3	Require replacement of hose.
AAAAAA				
Vacuum hoses restricted	3	A	3	Require repair or replacement of hose.
AAAAAA				

VALVES - BRAKE

VALVES - BRAKE				
AAAAAA				
Condition	3	Code	3	Procedure
AAAAAA				
Leaking	3	A	3	Require repair or replacement.
AAAAAA				
Linkage bent (rear load valves)	3	A	3	Require repair or replacement.
AAAAAA				
Linkage broken (rear load valves)	3	A	3	Require repair or replacement.
AAAAAA				
Linkage disconnected (rear load valves)	3	A	3	Require repair or replacement.
AAAAAA				
Pressure incorrect	3	A	3	Require adjustment. If not possible, require replacement.
AAAAAA				
Seized	3	A	3	Require replacement.
AAAAAA				
Sticking	3	A	3	Require replacement.
AAAAAA				

WHEEL ATTACHING HARDWARE

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For conditions noted below, also check conditions of wheel stud holes.

CAUTION: Proper lug nut torque is essential. Follow manufacturer's torque specifications and tightening sequence.
DO NOT lubricate threads unless specified by the vehicle manufacturer.

WHEEL ATTACHING HARDWARE

Condition	Code	Procedure
Bent	A	Require replacement.
Broken	A	Require replacement. See note (1) below.
Loose	A	Require repair or replacement of affected component.
Lug nut installed backward	A	Require repair.
Lug nut mating type incorrect	A	Require replacement of nut.
Lug nut mating surface dished	A	Require replacement of nut.
Lug nut flats rounded	A	Require replacement of nut. See note (2)
Lug nut seized	A	Require replacement of nut and/or stud. See note (2) below.
Stud incorrect	A	Require replacement of stud.
Threads damaged	A	Require repair or replacement of component with damaged threads.
Threads stripped (threads missing)	A	Require replacement of component with stripped threads.

NOTE: (1) Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.

(2) Only required if removing wheel.

WHEEL BEARINGS, RACES, & SEALS

NOTE: When repacking or replacing wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based

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upon the individual component conditions that follow.

WHEEL BEARINGS, RACES, AND SEALS

Condition	3	Code	3	Procedure
Rear axle seal on rear-wheel drive leaking	3	A	3	Require replacement of seal and inspection of axle, bearing, housing, and vent tube.
Seal leaking	3	A	3	Require replacement of seal and inspection of bearings.
Spindle worn	3	A	3	Require replacement of spindle and bearings.
Wheel bearing assembly feels rough when rotated	3	A	3	Require replacement of bearing assembly.
Wheel bearing balls are pitted	3	A	3	Require replacement of bearing assembly.
Wheel bearing balls are worn	3	A	3	Require replacement of bearing assembly.
Wheel bearing end-play exceeds manufacturer's specifications	3	A	3	Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require repair or replacement of worn component.
Wheel bearing race is loose in the hub bore	3	A	3	Require replacement of hub assembly and wheel bearings.
Wheel bearing races are pitted	3	A	3	Require replacement of bearing assembly.
Wheel bearing races are worn	3	A	3	Require replacement of bearing assembly.
Wheel bearing rollers are pitted	3	A	3	Require replacement of bearing assembly.
Wheel bearing rollers are worn	3	A	3	Require replacement of bearing assembly.

WHEEL CYLINDERS

You are not required to replace or rebuild wheel cylinders in axle sets. However, when rebuilding or replacing a wheel cylinder due to the conditions that follow, you may suggest rebuilding or replacement of the other wheel cylinder (on the same axle) for

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preventive maintenance, for example, the part is close to the end of its useful life.

Determine the need to rebuild or replace based upon the individual wheel cylinder conditions that follow.

WHEEL CYLINDERS

Condition	Code	Procedure
Attaching hardware bent	A	Require replacement of bent parts.
Attaching hardware broken	A	Require replacement of broken parts.
Attaching hardware corroded affecting structural integrity	A	Require replacement of corroded parts.
Attaching hardware loose	A	Require repair or replacement.
Attaching hardware missing	A	Require replacement of missing parts.
Bleeder port damaged (if non-repairable)	A	Require replacement.
Bleeder screw plugged	A	Require repair or replacement of bleeder screw. See note (1) below.
Bleeder screw broken off in wheel cylinder (if non-repairable)	A	Require replacement. See note (1) below.
Bleeder screw seized	A	Require replacement. See note (2) below.
Bore corroded (pitted)	A	Require replacement.
Bore grooved	A	Require replacement.
Bore oversized	A	Require replacement.
Casting mounting threads damaged	A	Require repair or replacement.
Casting mounting threads stripped (threads missing)	A	Require replacement.
Dust boot damaged	A	Require replacement of dust boot. See note (3) below.
Dust boot missing	A	Require replacement of dust boot.

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	3		3	See note (3) below.
Leaking	3	A	3	Require rebuilding or replacement.
	3		3	See note (4) below.
Piston anodized finish worn off	3	A	3	Require replacement of piston and rebuilding or replacement of wheel cylinder.
Piston corroded (pitted)	3	A	3	Require replacement of piston and rebuilding or replacement of wheel cylinder.
Piston stuck in bore	3	A	3	Require replacement of wheel cylinder.
Wheel cylinder loose	3	A	3	Require repair. See note (5) below

- NOTE: (1) Only required if the hydraulic system must be opened.
 (2) Seized is defined as bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.
 (3) Inspect for related conditions to wheel cylinder.
 (4) Leaking is defined as a drop or almost a drop. Dampness is normal.
 (5) Further inspection is required to determine whether the attaching hardware may be reused or replaced. This may include screws, clips, rings, or backing plate, depending upon the design.

WHEEL SPEED & VEHICLE SPEED SENSORS

WHEEL SPEED & VEHICLE SPEED SENSORS	3	Code	3	Procedure
Air gap incorrect	3	A	3	Require adjustment to vehicle manufacturer's specifications.
	3		3	See note (1) below.
Broken	3	A	3	Require replacement.
Housing cracked	3	A	3	Require replacement.
Internal resistance does not meet specifications	3	A	3	Require replacement. See note (2) below.
Lead routing incorrect	3	A	3	Require re-routing according to vehicle manufacturer's specs.
Loose	3	A	3	Require adjustment to vehicle

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Connector burned	3	A	3	Require repair or replacement.
Connector loose	3	A	3	Require repair or replacement.
Connector melted	3	A	3	Require repair or replacement.
Conductors exposed	3	A	3	Require repair or replacement.
Diode open	3	A	3	Require replacement.
Diode shorted	3	A	3	Require replacement.
Excessive resistance	3	A	3	Require repair or replacement.
Fuse blown	3	A	3	Require replacement.
Fusible link blown	3	A	3	Require replacement.
Mis-routed	3	A	3	Require re-routing to vehicle manufacturer's specifications.
Open	3	A	3	Require repair or replacement.
Poor ground	3	A	3	Require repair or replacement.
Shorted	3	A	3	Require repair or replacement.
Socket bent	3	A	3	Require repair or replacement.
Socket broken	3	A	3	Require repair or replacement.
Socket burned	3	A	3	Require repair or replacement.
Socket corroded	3	A	3	Require repair or replacement.
Socket loose	3	A	3	Require repair or replacement.
Socket melted	3	A	3	Require repair or replacement.
Terminal bent	3	A	3	Require repair or replacement.
Terminal broken	3	A	3	Require repair or replacement.
Terminal corroded	3	A	3	Require repair or replacement.
Terminal loose	3	A	3	Require repair or replacement.

END OF ARTICLE