DISC AND DRUM BRAKE TROUBLE SHOOTING

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1. EXCESSIVE PEDAL TRAVEL
2. GRABBING OR UNEVEN BRAKING ACTION
3. FRONT DISC BRAKES VERY SENSITIVE TO LIGHT BRAKE APPLICATION
4. EXCESSIVE PEDAL EFFORT
5. RATTLES OR BRAKE SQUEAL
6. BRAKE CHATTER, ROUGHNESS OR PULSATION
7. PREMATURE REAR WHEEL LOCK-UP UNDER HARD BRAKE APPLICATIONS
8. SCRAPING
9. DRAGGING BRAKES
10. EXCESSIVELY HOT BRAKES AND FAILURE TO RELEASE
11. BRAKE PEDAL CAN BE DEPRESSED WITHOUT BRAKING EFFECT
12. BRAKE SYSTEM WARNING LIGHT DOES NOT TURN ON
13. BRAKE SYSTEM WARNING LIGHT DOES NOT TURN OFF

1. EXCESSIVE PEDAL TRAVEL

POSSIBLE PROBLEM	CORRECTION
Partial hydraulic system failure with dual hydraulic system.	Check front and rear system for failure and repair. Fill and bleed system.
Low fluid level in reservoir.	Check for leak, repair, fill reservoir. Bleed system if necessary.
Incorrect master cylinder push rod adjustment.	Adjust push rod.
Air in hydraulic system.	Bleed system and refill master cylinder.
Rear brake not adjusting properly.	Repair self-adjusting system and adjust brakes.
Bent lining pad.	Recondition caliper.[*]*
Loose caliper mounting.	Replace hardware on single piston caliper. Torque mounting bolts to specifications.
Loose wheel bearing.	Adjust to specifications.
Excessive lateral run-out of rotor.	Check run-out with dial indicator. Resurface or replace rotor.
Weak or expanding brake hoses.	Replace brake hose. Bleed system.

2. GRABBING OR UNEVEN BRAKING ACTION

POSSIBLE PROBLEM	CORRECTION
Front end out of alignment.	Check alignment. Replace worn parts. Realign front end.
Incorrect tire pressure.	Inflate tires to recommended pressures.
Unmatched tires.	Tires with approximately the same amount of tread should be used on the same axle. Tires should be of the same type of construction.
Restriction in hydraulic system.	Check hoses and lines for damage. Replace as necessary.
Loose caliper mounting.	Replace hardware on single piston caliper. Torque mounting bolts to specification.
Wrong or damaged lining pad.	Recondition caliper.*
Malfunctioning metering or proportioning valve.	Replace metering or proportioning valve.
Power brake unit defective.	Repair or replace power brake unit.
Malfunctioning caliper assembly.	Recondition caliper.* Flush hydraulic system with brake fluid if seals are swollen.
Malfunctioning rear brakes.	Check self-adjusting system and brake springs. Repair as necessary.

3. FRONT DISC BRAKES VERY SENSITIVE TO LIGHT BRAKE APPLICATION

POSSIBLE PROBLEM	CORRECTION
Metering valve malfunctioning.	Replace metering valve and bleed system.

[*] RECONDITIONED CALIPERS: REPLACE ALL LINING PADS, HYDRAULIC PARTS. CLEAN CALIPER BORE AND PISTONS ON BOTH CALIPERS.

4. EXCESSIVE PEDAL EFFORT

POSSIBLE PROBLEM	CORRECTION
Power brake malfunction.	Check power brake and repair if necessary.
Partial hydraulic system failure with dual hydraulic system.	Check front and rear system for failure and repair.
Lining worn beyond specification.	Recondition calipers.* [*]
Sticking or frozen pistons in caliper.	Recondition calipers.*
Lining contaminated with grease, oil or brake fluid.	Recondition calipers.*
Brake fade due to poor quality or incorrect lining.	Replace lining pads on both calipers.

NOTE: Due to the nature of the disc brake a squeal may be considered normal if and when it occurs occasionally. A constant squeal indicates a possible problem in the brake.

5. RATTLES OR BRAKE SQUEAL

POSSIBLE PROBLEM	CORRECTION
Loose caliper mounting.	Replace hardware on single piston caliper. Torque mounting bolts to specifications.
Brake shoe anti-rattle spring weak or missing.	Replace anti-rattle springs.
Excessive shoe to caliper or shoe to piston clearance.	Recondition calipers.*
Poor quality lining.	Replace pads- use insulator type.
Rust.	Clean caliper- lube with high temp. grease.
Worn hardware.	Recondition calipers.*

6. BRAKE CHATTER, ROUGHNESS OR PULSATION

POSSIBLE PROBLEM	CORRECTION
Loose wheel bearings.	Adjust wheel bearings to specifications.
Front end out of alignment.	Check alignment. Replace worn parts. Realign front end.
Rear drums out of round.	Resurface or replace rear drums.
Lining contaminated with grease, oil or brake fluid.	Recondition calipers.*
Excessive lateral run-out of rotor.	Check run-out with dial indicator. Resurface or replace rotor.
Rotor excessively out of parallel.	Check rotor and resurface or replace.

7. PREMATURE REAR WHEEL LOCK-UP UNDER HARD BRAKE APPLICATIONS

POSSIBLE PROBLEM	CORRECTION
Proportioning valve malfunctioning.	Replace proportioning valve and bleed system.

8. SCRAPING

[*] RECONDITIONED CALIPERS: REPLACE ALL LINING PADS, HYDRAULIC PARTS. CLEAN CALIPER BORE AND PISTONS ON BOTH CALIPERS.

POSSIBLE PROBLEM	CORRECTION
Loose wheel bearings.	Adjust to specifications.
Rotor rubbing caliper housing or splash shield.	Check for rust or mud build-up on caliper or splash shield next to rotor. Check for bent splash shield.
Loose caliper mounting.	Replace hardware on single piston caliper. Torque mounting bolts to specifications.
Broken return springs on drum brakes.	Replace return springs in axle set.

9. DRAGGING BRAKES

POSSIBLE PROBLEM	CORRECTION
Master cylinder pistons not returning correctly.	With reservoir cover off, check for fluid spurt at bypass hole, as pedal is depressed. Adjust push rod if necessary or recondition master cylinder.
Check valve installed in outlet to front disc brakes.	Check outlet hole and remove check valve if line is connected to disc brake caliper.
Metering valve incorrectly installed.	Port marked "inlet" goes to master cylinder. Port marked "outlet" goes to disc calipers.
Incorrect parking brake adjustment or binding parking brake cable.	Correct binding cable if necessary and adjust to specifications.
Restriction in hydraulic system.	Check hoses and lines for damage. Replace as necessary.

10. EXCESSIVELY HOT BRAKES AND FAILURE TO RELEASE

POSSIBLE PROBLEM	CORRECTION
Broken brake return springs on drum brakes.	Replace return springs in axle sets.
Frozen or sticking caliper pistons.	Recondition calipers.*[*]
Driver's foot riding brake pedal.	Instruct driver not to rest foot on pedal.
Master cylinder or power brake malfunction.	Repair or replace master cylinder or power brake unit.
Sticking or binding pedal linkage.	Free up and lubricate linkage.

11. BRAKE PEDAL CAN BE DEPRESSED WITHOUT BRAKING EFFECT

POSSIBLE PROBLEM	CORRECTION
No fluid in master cylinder reservoir.	Check for leak and correct. Fill master cylinder and bleed system.
Air in hydraulic system.	Bleed system and fill master cylinder.
Rear brakes out of alignment.	Check and repair self-adjusting system. Adjust rear brakes.
Leaking wheel cylinders.	Recondition or replace wheel cylinder.
Internal leak in master cylinder.	Recondition or replace master cylinder.
Leaking caliper seals.	Recondition calipers[*].*

12. BRAKE SYSTEM WARNING LIGHT DOES NOT TURN ON

[*] RECONDITIONED CALIPERS: REPLACE ALL LINING PADS, HYDRAULIC PARTS. CLEAN CALIPER BORE AND PISTONS ON BOTH CALIPERS.
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POSSIBLE PROBLEM	CORRECTION
Bulb burned out.	Replace bulb.
Warning switch has open circuit.	Check circuit and repair.
Damaged warning light switch.	Replace switch.

13. BRAKE SYSTEM WARNING LIGHT DOES NOT TURN OFF

POSSIBLE PROBLEM	CORRECTION
One section dual brake system inoperative.	Check for leaks and repair.
Differential pressure valve not centered.	Center valve.
Grounded wire to warning light switch.	Correct grounded wire.
Damaged warning light switch.	Replace switch.

STOP AND THINK!
IS IT NECESSARY TO REPLACE HARDWARE AND HYDRAULIC PARTS?

CONSIDER THESE FACTS!

NEW HYDRAULICS GIVE NEW PERFOMANCE

The dust boot and hydraulic seal are vital to brake performance. The piston and inboard shoe must move freely. The piston seal not only prevents fluid leakage but also acts as a self-adjusting mechanism. The seal grips the piston. When sufficient lining to rotor clearance exists the seal allows the piston to slip out. As the seal grips the piston it is stretched out when hydraulic pressure is applied, and returns to normal when pressure is released pulling the piston back with it. This action give running clearance.

If gummy residue collects on the piston and cylinder bore, piston movement will be restricted and insufficient lining clearance will develop, leading to rapid wear.

Always replace the dust boot, seal and clean the piston and bore with every reline.

OLD HARDWARE WEARS OUT-
NEW HARDWARE EXTENDS LINING LIFE

Caliper pins and sleeves rust and cannot be cleaned and reused. The caliper pins and sleeves ride in rubber bushings. The rubber bushings deteriorate with age, heat and stress. Running clearance wear of the pads depend upon the proper relaxation of the rubber bushings and sleeves. Drum brake return springs and hold-down parts wear out and lose their tension due to heat, constant stretching, and compression when the brakes are applied and released. Adjusting parts are also affected by stress and heat. Adjusting cables stretch, and worn adjusting screws prevent the brake assembly from adjusting. If these parts are not replaced, the results will be high lining wear and poor brake performance. Other hardware that must be replaced includes anti-noise clips and springs for quiet brake operations.

DO THE JOB RIGHT!
USE NEW HARDWARE AND HYDRAULIC PARTS-
FOR DISC AND DRUM BRAKE JOBS YOU CAN RELY ON!

When To Use Chemical Compounds During Disc Pad Installation

The Federal-Mogul TEC Center recommends different uses of chemical compounds when installing disc brake pads depending on the pad design. The type of design will determine what chemicals a technician should and should not use on the back of the disc brake pad plates to provide optimal function and service life with Wagner disc pad products.

Disc Pads with Integrally Molded Insulators

Wagner ThermoQuiet®, with its patented IMI Sound Insulator design, requires that **NO** chemical compounds (EMP, Silicone Lubricants, Moly Lube, etc.) be placed on the insulator area of the disc brake pads. ThermoQuiet® with the IMI Insulator is designed to be installed right out of the box and onto the vehicle. Use of chemicals on the insulator may reduce the insulator's effectiveness.

Disc Pads with Shims Attached

When installing disc pads with constrained layer shims already attached to the disc pad plate, the Technician should put a slight coat of Wagner's Silicone Lubricant on the back of the shim. This will aid as an additional noise suppressant.

Technicians should **NOT** put any other chemical compound on the back of the shim. Compounds that are tacky might cause the shim to be pulled from the back of the disc pad plate. Chemical compounds such as Moly Lube or other products that have a petroleum base should not be utilized. Petroleum base products can have an adverse effect on rubber in a brake system.

Disc Pads without Shims Attached

When installing disc pads that do not have shims attached (as per OE) the technician should utilize the EMP compound that is included in the box with the pads. EMP compound should be put on the back of the disc pad plate where there is contact with the outer caliper fingers or caliper piston when installed. EMP compound should be applied in a thin coat approximately 1.5 – 2.0 mm thick on the back of the disc pad plate 10 to 15 minutes prior to the installation of the disc pads. This will allow the EMP compound proper cure time. If time for curing is not allowed the EMP compound will be ineffective as a noise suppressant.

General

On all disc brake designs, the caliper rails or abutments (where there is metal-to-metal contact with the disc pad plate) should be cleaned and lubricated with Moly Lube. Guide Pins should be lubricated with Wagner's Silicone Lubricant. Moly Lube or petroleum based products should not be utilized with caliper guide pins as it will adversely affect the rubber guide pin boots..

Brake Noise – Is it the Fault of the Disc Pads or the Rotors?

Many service technicians are experiencing comebacks on disc brake pads sooner than they expect due to noise. In most cases, the brake rotor is the culprit. Proper rotor surface and cleaning are critical to overall braking performance. The Federal-Mogul Technical Training Center and the St. Louis rotor & drum manufacturing facility have teamed up to provide the following information.

Rotor Surface's Impact on Brake Noise

The smoother the rotor, the better. When dragging a fingernail over the rotor surface, it should feel glass smooth. The proper rotor surface is critical in reducing or eliminating brake noise comebacks. **New Wagner brand rotors are machined to a mirror-like finish, requiring no additional machining or preparation prior to installation.** However, when refinishing brake rotors, most shop lathes will require a non-directional finish to obtain the proper rotor surface or RA. A non-directional finish is necessary to break off the "mountain peaks" that are produced when the rotor is turned using a shop lathe. Otherwise, these fragments break off during initial brake application and end up trapped in the "valleys". Eventually the fragments end up embedded in the pad, causing noise.

A non-directional finish will also reduce the phonograph record type grooves, which can cause noise. The grooves prevent the proper rotor surface area from contacting the disc pad. As a result, the rotor's contact points will overheat, hardening the contact points. The contact points will eventually break off and end up embedded in the pad, eventually causing noise when they contact the rotor.

Installing "softer" disc pads to compensate for a rough rotor surface will result in increased dusting and accelerated pad wear. Therefore, optimal braking performance requires a smooth rotor surface.

A Note Regarding Brake Lathes

Many technicians have reported very good results using the newer, more expensive round bits. Older lathes may have significant wear in the bearings, which will prevent the rotor being held true during machining. Speed in a shop certainly means money, but it should not take precedence over required maintenance of equipment and proper machining processes.

Cleaning the Rotor and Its Impact on Brake Noise

Proper cleaning of resurfaced rotors must be done. This is one of the most overlooked areas. The proper way to clean a resurfaced rotor prior to installation is to use plain old soap and hot water and a scrub brush. This will clean the particles out of the "valleys". Brake cleaner spray may not clean fragments from the “valleys”. Subsequently, the fragments become embedded in the pads, eventually causing noise. Try the two methods (brake cleaner spray vs. soap and water). Using the "white paper towel test", you’ll discover the soap and water method is the most effective.

Rotor Refinishing Procedure

- Check lateral runout and parallelism prior to cutting
- Ensure tool bits are sharp and brake lathe is in good operating condition

	Rough Cut	**Finish Cut**
Spindle Speed	150 RPM	150 RPM
Depth of Cut (per side)	.005”	.002”
Tool Cross Speed/Revolution	.006-.010”	.002” maximum
Silencer Band	Yes	Yes
Sand Rotors – Final Finish	No	Yes *

* Perform secondary finish operation using 120 grit sandpaper with mild pressure for 60 seconds

- Clean off the rotor surface with soap and hot water and a scrub brush

The following steps are also important to reduce the vibration that causes brake noise

- Inspect and replace worn brake hardware and guide pins
- Be certain to use the proper lubricants. Properly clean and lubricate caliper mountings.

Finally, check for proper wheel bearing adjustment and wheel nut torque.

Remember, the smoother and cleaner the rotor, the better the vehicle’s braking performance.

<u>Disc Pad and Brake Shoe Burnish Procedure</u>

An effective burnish cycle to seat the friction materials into the opposing rotor and drum surfaces requires approximately 200 stops. The 200 stops is consistent with the burnish procedure in the FMVSS 105. As a practical matter for installers, 200 stops probably will not happen since few installers have all day to make that number of stops. Therefore, we recommend the following burnish procedure:

- **Make approximately 20 <u>complete</u> stops from 30-mph or 20 "slow downs" from 50-mph to 20-mph with light to moderate pedal pressure**
- **NO PANIC STOPS**
- **Allow at least 30 seconds between brake applications for the brake pads or shoes to cool down**
- **No high speed stops and/or braking under heavy loads that could result in glazed or otherwise damaged linings**

Using these guidelines, the friction materials will have conformed to the surface of the rotors and drums for improved stopping performance. In addition, the thermal conditioning of the friction materials during this process will increase the stability of braking effectiveness over a greater range of temperatures compared to when they were first installed.

Overview: Brake Glide

The name for this condition is called "glide". Glide symptoms after brake service are 95% of the time related to rotor finish. Now that most technicians are installing good pads and "cheap" rotors, the greater the propensity to hear more glide complaints. This is due to the unacceptable final finish many of the in-shop machined surfaces or offshore-unbranded rotors are shipped with. To this day, I have NOT had a single glide issue with any branded premium rotor supplier. CQ has a blended program, so we cannot use that offering as a model. I have had many glide complaints from their customers. The installers in our distribution markets need to understand that their in-shop machining practices, as well as the use of offshore private label rotors can heavily contribute to this issue.

Micro-finish/Ra

The offshore product is just not prepared properly (micro-finish, Ra or roughness average. etc.). Many times, a non-premium rotor is machined in shops to "rid" it of lateral runout. All offshore product that I have worked with has a non-directional pattern (straight pattern as opposed to a preferred "swirl" pattern) that is NOT part of a new branded rotor. This is due to the fact that the machining equipment in the offshore factories is very much like the machines in our installer bays. If you hear the term "turn" a rotor, then most likely they are using that type of older, less preferred 1960's technology. If an offshore rotor was used, they usually have a cosmoline or oiled in plastic bag anti-rust type coating applied in effort to prevent rust on the boat during ocean shipping (saltwater) and shelf storage. This coating gets into the rotor vents and is very difficult to remove. During break-in that coating will smoke heavily when the brake heat up. Then park the car in an attached garage. The smell travels through the customer's whole house.

Preventing Glide

Any rotor that is machined locally needs to have a non-directional finish applied with a large radius 120 grit disc polisher/sander. This rotating disc should be applied for at least 45-90 seconds per side while the rotor is rotating on a brake lathe. Then the final step is to wash the rotor with soap and water prior to installing. Otherwise the metal particles that should be washed off will embed themselves into the new friction material. If a semi-metallic pad already has 50% or so of ferrous metal in it, and the tech fails to wash the machining particles off, he could end up with a pad that has 75% metal in it right after brake service. That situation could contribute to glide and noise. I prefer the "rub" washing method with a clean cloth rag for training purposes. It shows how a rotor can get shiny and if done properly one can see shadows in the finish. That finish if measured on a profilometer, (a device to measure Ra) should show a Ra of less than 75. A surface with low Ra number is a good thing to obtain, helping prevent a glide condition.

The short answer to this complicated issue is to ask the question, **"Does this ever happen with new, <u>branded</u> rotors"?** The answer will usually be a quiet "No". Worn brakes have created the smooth finish needed to get the proper "brake torque" designed into the vehicle, just as a branded piece has the correct finish that give that "good" stopping effect. Now let's talk about disc pads;

Vehicle Specific Issues - Thermal Abuse and Glide

Problems with semi-metallic pads, i.e., MX591, MX857 etc. Both are for Dodge Caravans, Town and Country's and the Ply Voyagers. These mini-vans are equipped with some of the most under designed braking systems out there. The MX591 is the front pad used on a disc front/drum rear system. These vehicles come from the factory with a height sensing proportioning valve on the rear axle. This valve is designed to lower rear brake pressure when the vehicle is unloaded, preventing rear lock-up and loss of control. Over time, this valve tends to diminish rear pressure, causing excessive wear on the front disc brakes. Therefore the vehicle gradually "looses" rear brake contribution. A visual inspection of the rear brake shoes shows plenty of lining material remaining, thus no rear brake service. The front pads/rotors are usually blue and have signs of "thermal abuse". The installer then procures good pads and cheap rotors for this vehicle, usually a high-mileage car by this time. The "after brake service" test drive then can result in the scenario that the vehicle requires abnormally high peddle pressure in order to stop and glazes the pads. The MX857 is the front pad for the rear disc version of the newer Caravans and Town &

Country's,, which have an equal or worse stopping reputation. Now you have a mini-van with all four wheels getting rotors that may not have the correct finish to generate acceptable stopping effect after brake service, or maybe the shop "turned" the rotors and look-out, that car will just not stop!

Semi-Metallic vs. Non-Ferrous Ceramic

The next question to ask is **"Does a glide symptom ever occur with non-metallic (PD) pads?"** The answer will usually be another quiet "No". Why? Because non-metallic pads are prescribed for cars that usually have a much lower "Thermal Average" of working brake temperature. Non-metallic pads are usually used on lighter, lower hyd pressure vehicles with larger diameter rotors (16,17,18 inch rims) that allow repositioning of the caliper away from the center of the axle, gaining a leverage advantage, thus ultimately lowering the working temps of the overall brake system. These are the platforms that benefit from Ceramic type friction material. Semi-metallic pads are usually for vehicles that, during OE platform testing, can result in the thermal averages being higher than that of non-metallic systems (therefore out of ceramic formulation ranges), testing up into the semi-metallic temperature ranges. This is one of the main reasons to only use ceramic where it is used OE, and stay with semi-metallic where OE. Tell that to the other guys who offer ceramic in FMSI 369, 370, 591, 632, 702, 857, 942, 1083 etc. If a ceramic formulation is exposed to working temps with systems designed only for semi-metallic mixes, then it will result in rapid wear, heavy dust (all though it will be lighter in color), and pulsation. This pulsation can be from excessive material transfer, or "tattooing" of the rotor when the vehicle comes to a stop with high, metallic type temperatures present. Now the vehicle has a pulsation, however that pulsation may NOT be warpage related. It is friction transfer related, having unequal portions of the rotor's friction service impregnated with unwanted heavy transfer from ceramic pads used in a semi metallic application. Metallic pads do NOT usually do this during high heat, normal semi-metallic temperature conditions.

Semi-Metallic Ra and Glide

Why are semi-metallic pads usually associated with glide? The reasons are many, however one of the most important is the fact that the semi-met vehicle is very much reliant on rotor surface Ra, so much so that the Dr/rotor spec guides now have a column in them specifying the OE Micro-finish required. The engineers understand that if a rotor surface is outside of that range (higher Ra is undesirable) then the odds of having a glide issue develop are good. This is an unwanted condition that will most often result in a glide complaint. If during the test drive the heat is allowed to increase higher than desirable test drive temperatures, the pads will gas out, the resins in the pad will glaze over, and the pad will have been thermally abused before the break-in process is even completed. Now the vehicle has poor stopping symptoms (originally due to a poor rotor surface finish that results in more pedal pressure for longer duration's during the test drive, resulting in excessive test drive temperatures). The pads are now compromised, or glazed. It is fashionable then for unknowledgeable technicians to blame the pads, when the root cause was the incorrect rotor finish. Changing the pads to any brand at this time will always result in a normal stopping effect, since the new abused pads smoothed the rotor, essentially preparing the rotor for the next set of new pads. However, since the technician "thinks" it's the TQ semi-metallic product caused this issue, he installs another brand with good results. His results would also be the same (good) if he installed a 'new' set of Mix's to replace the abused, glazed pads that were compromised (glazed) from the poor rotor finish.

Premium Semi-Metallic Vs Non-Premium Semi-Metallic

It has been my experience that all premium semi-metallic friction suppliers experience this unwanted phenomenon. My experience has also shown that non-premium semi-metallic offerings may or may NOT demonstrate this glide condition with poor rotor Ra as often as a premium formulation could. It may be related to the fact that most premium metallic formulations are also designed to prevent high-wear situations, attempting to provide a long-life feature of their semi-metallic offering.