W A Technology

Stingray Wheel Chatter on Sharp, Slow Turns

The C7 Stingray, when making very slow, sharp turns, has a significant tire chatter or vibration when cold! Worse than the C6.

Page 1-20 in the 2014 Owner's Manual states: *Tire Chatter/Hop*:

"When driving at slow speeds and in very tight turns, the vehicle may have tire chatter/hop. This condition is normal and the vehicle does not require service."

What Causes This Issue?

The Stingrays high performance, racecar handling makes tradeoffs necessary. This is particularly an issue with the higher performance Z51 package. The Z51's racecar type tire compound and lower aspect ratio of the 19 versus 18 inch diameter front tires in the base car, makes the slow speed "chatter" even worse. Especially severe when the tires are below about 45 F. GM states, that the near racetrack tire compound heats sufficiently to achieve optimum performance in one lap on a racetrack. I find it heats up quickly in road conditions.

Factors Causing This Unusual "Chatter:"

Some folks are sufficiently surprised and concerned about the "chatter" and request the dealer, "*do something*." As GM dealers will tell them, *"The condition is normal."* However that statement is not very comforting when that "chatter or vibration" is felt, especially when the tires are cold. This picture review covers some key causes.

Partial Solution; A Better Caution Label:

There is a partial solution that reduces the "chatter" problem. *"Just don't turn as sharply when the tires are cold!"* There is a good reason for this being a reasonable compromise and one that makes the turning radius closer to the pervious C6. Excess "chatter" is usually only encountered in cold weather, when pulling out of a garage or a parking place after the car has been parked for some time. That is when the tires are turned sharply either in forward or reverse. It is not encountered in any normal driving on the road.

Before GM considers making the C7 less racecar oriented with increased Ackerman steering or decreased turning radius similar to a C6, a proper Caution, such as: *"When the Stingray's High Performance Tires are Cold, Use Less Than a Full Turning Radius, Make "K" Turns! This Will Reduce the Observed Slow Speed Chatter When Performing Tight Turning Maneuvers."*

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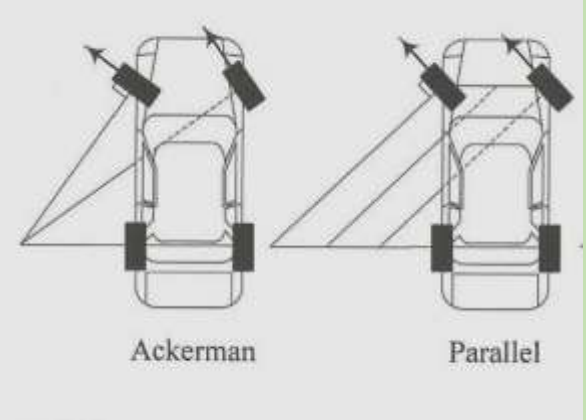
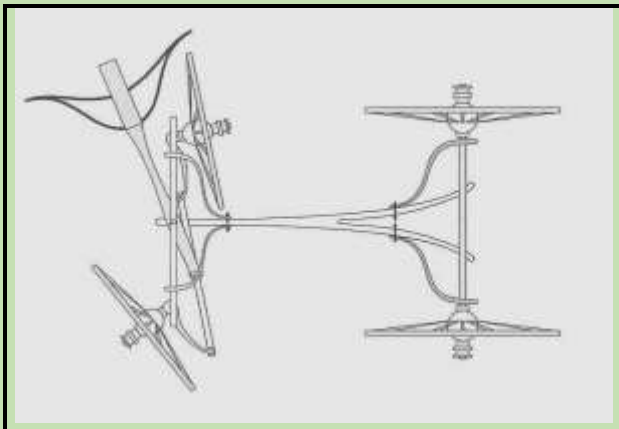
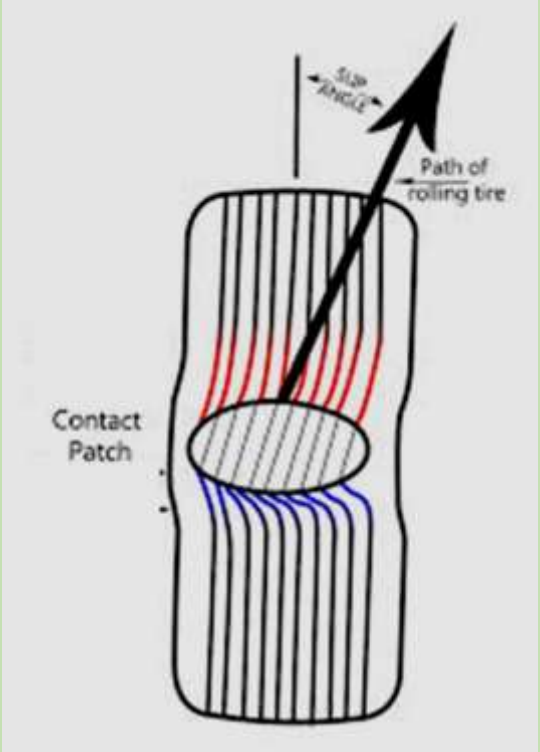
Photo Sequence

"Chatter," experienced when the C7 is turned sharply at low speeds is caused by less than "full" Ackerman steering employed. You can see in the left figure that when turning sharply the two tires turn at different radius causing, if parallel, one tire to scrub or "chatter" as it is dragged across the pavement. The solution is to have the tires turn at different radiuses. The sharper the turn desired the more the steering angle difference is needed! Note the C7 has a 2 foot sharper turning radius then the C6, making the "chatter" more pronounced.

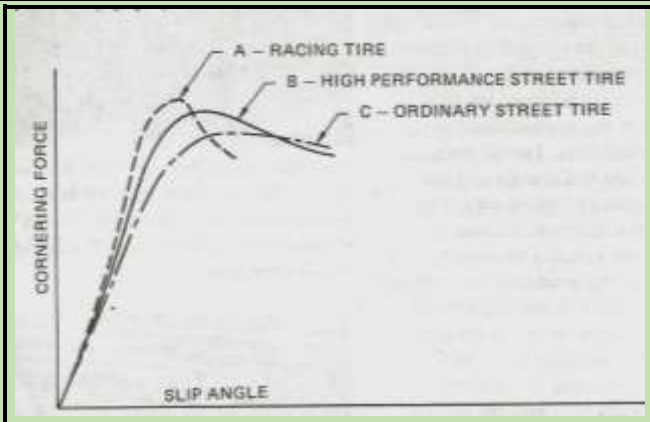


This Ackerman steering principle was developed around 1816 to improve the turning problem encountered in horse drawn carriages! As shown, a sharp turn requires a significantly different turning radius for each wheel if one is not to be dragged as the other moves smoothly. The stiff, iron faced wood rims were subjected to significant forces. Ackerman steering is used in most passenger cars to provide the needed different turning radiuses.



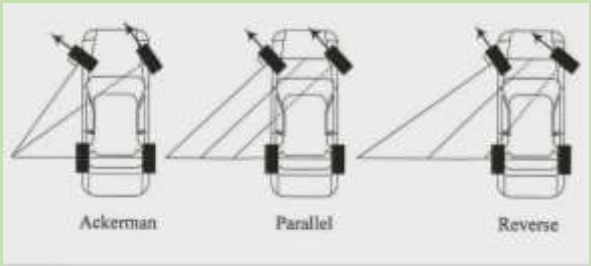


If on dirt the chatter caused by scrubbing would be less than when on ridged concrete. With rubber car tires, a reduced amount of "theoretical" Ackerman steering is needed because the rubber flexes, which reduces the scrubbing forces when on a hard surface. The amount it deviates from a straight line is called slip angle. Therefore to reduce the scrubbing-causing "chatter" will not require the full amount of Ackerman difference in turning radius between the front tires. Typically, for passenger cars, only enough Ackerman steering is built-in to provide acceptable "chatter" reduction when matched with the tire slip angle. *Low slip angel tires would require more Ackerman geometry to avoid "chatter."*



However, slip angle has a significant effect on the maximum cornering force. Maximum cornering force is achieved with tires having a low slip angle. The Michelin tires used in the C7, especially the Z51, are closer to racing tires than even high performance street tires. Therefore the reduced slip angles mean the Ackerman steering angle would have to be increased to completely avoid slow speed "chatter" in sharp turns. Why not do that is next!

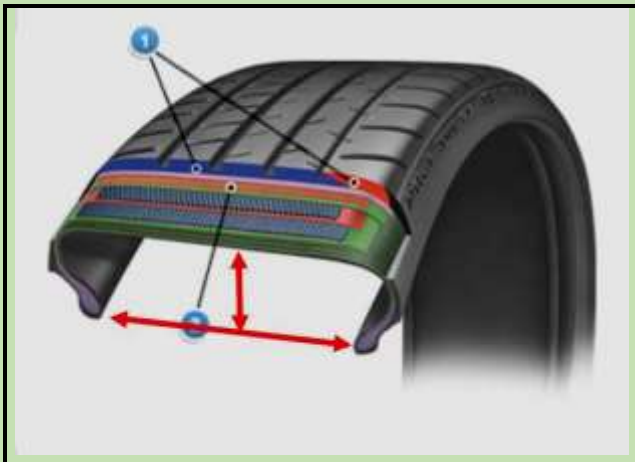
Although Ackerman steering is a correct condition at slow speeds, at high speeds there is significant lateral acceleration and the wheels operate at high slip angles. Furthermore, the loads on the inner wheels will be much lower than the outer wheels. When increasing the load, less slip angle is required to reach the peak of the lateral force. Under these conditions the inner front wheel of an Ackerman steering vehicle would be at a higher slip angle than required for maximum lateral force. Therefore less Ackerman is desired..



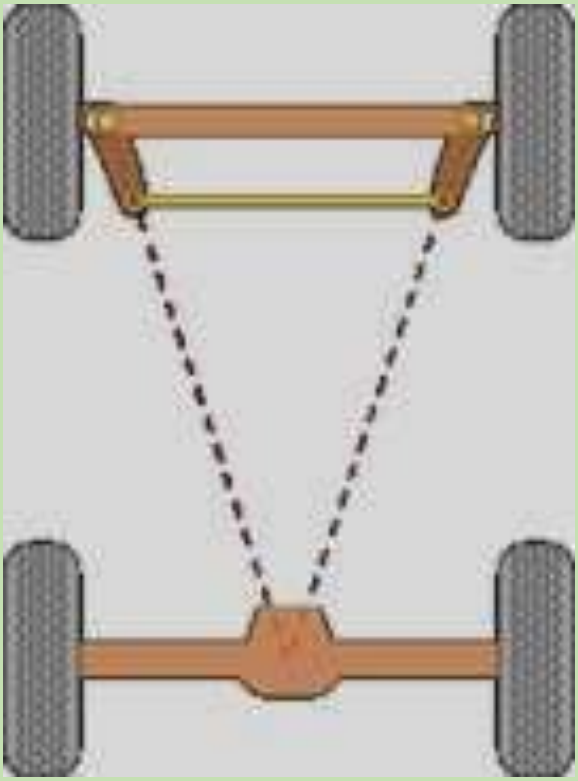
For optimum lateral g force performance, unfortunately less Ackerman steering is desirable so low speed sharp turn performance is sacrificed!

The Z51 Michelin, very low profile, stiff, run flat, high performance tires have low slip angles. Quoting info from Michelin, the C7 Pilot Super Sport ZP tire features the next-generation of racetrack-born tread compounds found in the record-setting Pilot Sport Cup ZP of the C6 ZR1 and Z06. The Michelin tire fitted to the Z51 tire features a custom dual-tread compound and pattern that achieves near-racing-slick grip and handling levels. When cold, the tires are even stiffer and the compound reacts even worse to chatter. GM also states the "chatter" is worse when it is wet. On wet pavement the forces increasing slip angle are reduced so the tire will "drag" more.

A number of forum posters have said the "chatter problem" goes away with all-season tires that have higher slip angles!



Cold tire performance differences are also a factor for normal driving. There is significantly less traction until the tires are warm. With cold tires, when pulling onto a 4 lane highway near my home, the traction control will engage at less than ¼ throttle. When the tires are warm even ½ throttle can be used without it engaging!



Possible Ackerman Linkage

For The Curious:

One way to achieve Ackerman steering geometry can be generated by moving the steering pivot points inward. The steering pivot points can be part of a rack and pinion system. (*Leave the angle difference calculation to a geometry class!)* With perfect Ackerman, at any angle of steering, the center point of all of the circles traced by all wheels will lie at a common point. However pure Ackerman steering is not used for cars, partly because it ignores important dynamic, slip angle and different tire loading effects in a turn. The principle is really only sound for low-speed maneuvers. As noted, some race cars even used reverse geometry to compensate for the large difference in tire loads and slip angle between the inner and outer tires while cornering at high speed. Such geometry can help reduce high-speed cornering tire temperatures during but compromises low-speed performance.

Some suggested GM fix the issue, labeling it a poor design! It is not a poor design. If you like to see the high "g" numbers and brag about the C7 beating XYZ on a track, please GM don't compromise! A better Caution Label advising not to turn as sharply when the tires are cold, as noted In the introduction, would be useful.
Those living where the winter is frequently near freezing during the day may want to consider changing to all-season tires and sacrificing some performance or alternating with winter tires.

Note to GM: Other than an improved Caution Label, if you feel you must do something for the few who are "troubled" by the "Chatter" then don't mess up the performance, at least on the Z51. If the Caution doesn't get folks to use less turning radius when the tires are cold, use what was on my mid '70's CJ5. When I installed the first All-Terrain wide radial tires when first available, the steering angle stops were adjusted to prevent the tires from hitting the fenders! Dealers can adjust the stops so those "concerned folks" can avoid encountering "Chatter." Perhaps with all the hi tech features in the C7 there should be an "automatic steering stop." Just need to slip a spacer in the appropriate spot when it is cold! *Perhaps a good place to use a memory metal wire since there would be no loads involved!*

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Other 2017 Grand Sport & 2014 Stingray PDF's Available:

Some 40 items discuss improvements or information about a 2017 Grand Sport and 2014 Stingray function and/or esthetics. Some are minor and others, like the installing ceramic brake pads, include detailed install information.

Below are the PDF's available. Click on picture (may need Ctrl pressed.) Or just copy and paste the PDF info (Blue type) into your browser. Or email me at GUttrachi@aol.com **and state the title desired, shown in Yellow:**

Note: **GS indicates the info was updated from that available for the C7 Z51 PDFs.**

Rusty GS/C7 Muffler ***Why the C7 muffler is rusted and a simply way to make rust turn matte black.*** ***Bottom pic rusted, top pic treated*** **http://netwelding.com/Muffler_Rust.pdf**	
Change GS/C7 Oil ***WHY change your own oil and HOW to do it*** ***Revised, includes C7 Lifting Methods*** **http://netwelding.com/Changing_Oil.pdf**	
C7 Carbon Fiber Side Skirts ***How to install side skirts with jacking information for DIY's without lifts*** **http://netwelding.com/Side_Skirts.pdf**	
C7 Carbon Fiber Splitter w/End Plates ***How to install Splitter & Nylon bra fit*** **http://netwelding.com/CF_Splitter.pdf**	
C7 Removing GM Plastic Film ***How To Remove The Rocker Panel Film*** **http://netwelding.com/Rocker_Panel_Film.pdf**	

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GS/C7 Mirror Proximity Alarm ***Limit switch alarm warns when passenger mirror is too close to door frame*** **http://netwelding.com/Mirror_Proximity_Alarm.pdf**	
Jacking Pads for GS/C7 ***Jacking Pads must 2 1/2 inch max OD. Made four. Bought 2 1/2 inch OD x 2 inch high pads after installing side skirts; Bought pads right for the GS.*** **http://netwelding.com/Jacking_pads.pdf**	
GS/C7 Radar Power ***For C7 tapped rear fuse panel. For GS tapped mirrow*** **http://netwelding.com/Radar_Detector_Power.pdf**	
GS/C7 Belt Rattle ***Passenger seat belt rattles against the seat back. The solution, add a shoulder belt pad.*** **http://netwelding.com/Eliminate_Rattle.pdf**	
Aluminum C7 Chassis and Weld Repair ***The C7 has an all aluminum chassis, made from 117 welded pieces*** **http://netwelding.com/Aluminum_Chassis.pdf**	
GS/C7Ceramic Brake Pads ***The Z51 has very dusty brakes. These pads help!*** **http://netwelding.com/Ceramic_Pads.pdf**	
GS/C7 License Plate Frame; **Must Meet South Carolina Law** **http://netwelding.com/License_Plate_Frame.pdf**	
Manage GS/C7 Spilled Gas ***Protect the side of the Vette when filling up with gas*** **http://netwelding.com/Manage_Spilled_Gas.pdf**	
GS/C7 License Plate & Cargo Lights ***LED license plate light & cargo area bulbs are brighter and whiter*** **http://netwelding.com/License_Plate_Light.pdf**	
GS/C7 Rear Cargo Area ***Rear cargo area needs storage device and rear protector*** **http://netwelding.com/Rear_Cargo_Area.pdf**	

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GS/C7 Door Panel Protector ***Black plastic protector added to prevent scuffing of door when exiting*** **http://netwelding.com/Door_Panel_Protector.pdf**	
GS/C7 Improved Cup Holder ***A solution to the cup holder spilling under hard braking or shape turns.*** **http://netwelding.com/Improved_cup_Holder.pdf**	
GS/C7 Wheel Chatter/Hop ***Why sharp, low speed turns with cold tires causes the front tires to chatter/hop.*** ***http://netwelding.com/Wheel_Chatter.pdf***	
C7 Carbon Fiber Grille Bar ***Install genuine carbon fiber grille bar overlay*** ***http://netwelding.com/CF_Grille_Bar.pdf***	
Jacking a GS/C7 Vette ***Safely jacking either front only or back & front*** ***http://netwelding.com/Jacking_A_C7.pdf***	
Deer Whistle Installed on GS/C7 ***Do they work? Plus Install Info*** ***http://netwelding.com/Deer_Whistle.pdf***	
Replacing C7 Battery ***After using a GM type charger and showing fully charged a voltage low, replaced battery with AGM!*** **http://netwelding.com/Battery_Issues.pdf**	
GS/C7 Window Valet ***Lower Windows with FOB*** ***Window Valet Helps 2014/2015 Latch Hatch*** **http://netwelding.com/Hatch_Latch.pdf**	
GS/C7 Splash Guards ***GM offers splash guards for the C7 Corvette. An easy DIY installation. ACS Best Front Guards for GS.*** ***http://netwelding.com/Splash_Guard.pdf***	

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GS/C7 Blind Spot Mirror

Smaller rear and side windows cause C7 blind spots. Small "blind spot mirrors" help

http://netwelding.com/Blind_Spot.pdf

GS/C7 Skid Pad Protector

After the air dam, the aluminum "skid pad" hits driveway ramps etc. Plastic protector helps.

http://netwelding.com/Skid_Pad_Protector.pdf

GS/C7 Wheel Locks

Wheel locks, torqued to required 100 ft-lbs, help protect your expensive wheels from theft.

http://netwelding.com/Wheel_Locks.pdf

GS/C7 OnStar Lights

The OnStar LED's in the rear view mirror, at a quick glance, look like a police car flashing light! This is a fix.

http://netwelding.com/OnStar_Lights.pdf

GS/C7 Skip Shift Eliminator

Skip Shift Eliminator install with suggestions on jacking a C7.

http://netwelding.com/Skip_shift_Eliminator.pdf

C7 Catch Can & Clean Oil Separator

Direct inject engines like the LT1, are particularly subject to "coking." What is Coking and how to reduce the potential?

http://netwelding.com/Catch_Can.pdf

GS/C7 Round Shift Knob

A round shift knob shortens throw.

http://netwelding.com/Shift_Knob.pdf

GS/C7 Stingray Sill Plate

Stingray sill plate replaces original.

http://netwelding.com/Sill_Plate.pdf

GS/C7 Nylon Bra

Nylon Bra Stops Bugs on Front and Grill. Fits with Stage 3 Winglets

http://netwelding.com/Nylon_Bra.pdf

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GS/C7 Clutch Fluid Change ***Clutch fluid after 3000 miles gets dirty*** **http://netwelding.com/Clutch_Fluid.pdf**	
C7 Carbon Fiber Hood Vent ***Replaces Plastic Hood Vent*** **http://netwelding.com/Hood_Vent.pdf**	
GS/C7 Cold Air Intake ***Low Restriction Air Filter & Duct*** **http://netwelding.com/Cold_Air_Intake.pdf**	
Garmin GPS for GS Cubby ***Garmin Mounts in GS Cubby*** **http://netwelding.com/GPS_In_Cubby.pdf**	
GS Splitter Stage 3 Winglet ***Stage 3 Winglets Integrate with Spats*** **http://netwelding.com/Stage_3_Winglets.pdf**	
GS 2LT to 2.5 LT ***Red Upper Dash Pad Like 3LT*** **http://netwelding.com/Red_Dash_Pad.pdf**	
Jake Emblem/Decals for GS ***Jake Symbols Support GS Racing Image*** **http://netwelding.com/Jake_Emblems.pdf**	
GS Splitter Protector ***Rugged Plastic Protection for Splitter*** **http://netwelding.com/Splitter_Protectors.pdf**	
GS: Vitesse Throttle Controller ***Adjustable Throttle-by-Wire Control*** **http://netwelding.com/Throttle_Control.pdf**	
May Be Of Interest: **Engineering a ProStreet Rod** ***How Our '34 ProStreet Rod Was Designed and Built*** ***8.2 Liter Engine, 4 Wheel Disk Brakes & Coilovers*** **http://netwelding.com/Engineering%20Street%20Rod%203-08.pdf**	

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